

Nuvu Developments Ltd
Former Jackson's Brickworks
Remediation Options Appraisal and
Remediation Strategy

Rev C

September 2024

Contaminated Land, Brownfield & Environmental Contracting



REPORT TITLE: Remediation Options Appraisal and Remediation Strategy

REPORT NUMBER: Rev C

CLIENT NAME: Nuvu Developments Ltd

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List of Acronyms

AOD	Above ordnance datum
BGS	British Geological Survey
CDM	Construction Design Management
CEMP	Construction Environmental Management Plan
CSM	Conceptual Site Model
EA	Environment Agency
EHO	Environmental Health Officer
EQS	Environmental Quality Standard
FPCD	Factory Production Control Document
GAC	Granular Activated Carbon
HGV	Heavy Goods Vehicle
HRM	High Risk Materials
IMS	Integrated Management System
LCRM	Land Contamination Risk Management
LDPE	Low Density Polyethylene
LGV	Light Goods Vehicle
LRM	Low Risk Materials
LRM C&D	Low Risk Materials Construction & Demolition
MCC	Manchester City Council
NPS	National Permitting Service
PFAS	Per- and Polyfluorinated Substances
PFOS	Perfluoro octane sulfonate
PPE	Personal Protective Equipment
RD&IP	Remediation Design & Implementation Plan
SAC	Special Area of Conservation
SHW	Specification for Highway Works
SI	Site Investigation
SoBRA	Society of Brownfield Risk Assessment
SSSI	Site of Special Scientific Interest
TBT	Toolbox Talk
TOP	Total Oxidisable Precursors
TPH	Total Petroleum Hydrocarbons
UU	United Utilities
WA	Wardell Armstrong

WFD	Waste Framework Directive
WTS	Water Treatment System

1.0 Preamble

1.1 Appointments

- 1.1.1 Vertase FLI Ltd (VertaseFLI) was employed by Nuvu Developments Ltd ('the Client') to undertake pre-contract services to address the requirements of outstanding pre-commencement planning conditions associated with proposed land remediation works at the former Jackson's Brickworks, off Ten Acres Lane, Newton Heath, Manchester ('the Site'). Wardell Armstrong LLP (WA) has been retained by the Client as independent environmental consultant.

1.2 Legal Context

- 1.2.1 Permission to undertake the proposed land remediation works was granted by Manchester City Council (MCC) (MCC application number 129197/FO/2021) subject to conditions. Pre-commencement planning conditions relevant to land contamination comprise condition 5 (site investigation), condition 6 (detailed assessment of risks), condition 7 (options appraisal and remediation strategy), and condition 9 (verification report).
- 1.2.2 The purpose of these conditions is to ensure compliance with relevant policies associated with water quality and land contamination set out in the Manchester Local Development Framework Core Strategy Development Plan published by MCC (dated 2012). These policies are understood to reflect the requirements of the National Planning Policy Framework (NPPF).
- 1.2.3 The planning permission for the proposed land remediation works is intended to enable redevelopment of the site for a mixed residential and commercial end use, which has also been granted permission by MCC (MCC application number 133700/FO/2022).

1.3 Document Purpose/Planning Conditions

- 1.3.1 The purpose of this document is to report the process and outcome of the remediation options appraisal and subsequent remediation strategy, which together are required for the discharge of Condition 7 of Planning Permission 129197/FO/2021 granted by MCC as provided in Appendix D. It is also intended to be a record of how VertaseFLI will

meet and carry out the remediation objectives. Preparation of the remediation options appraisal and remediation strategy has been undertaken in accordance with guidance published in Land Contamination Risk Management (LCRM).

1.3.2 This document also serves to address the following additional pre-commencement planning conditions, for which VertaseFLI are responsible:

- *Condition 10: Existing and Proposed Site levels*
- *Condition 14: Temporary Surface Water Drainage Strategy*
- *Condition 17: Ecology and*
- *Condition 18: Protection of the Canal Corridor.*

1.3.3 A separate report is produced by VertaseFLI to comply with Condition 08. This report will provide details on the geotechnical aspects and materials specifications of the remediation works including Ground stabilisation, earthworks and enabling works.

1.3.4 Submission of documents to MCC to satisfy relevant planning conditions MCC is undertaken on behalf of the Client, by Deloitte.

1.4 Description of Proposed Development

1.4.1 The proposed development, for which this report seeks to discharge several planning conditions, is for site remediation works in preparation for onward development.

1.4.2 The onward development which has also been granted permission by MCC (planning ref: 133700/FO/2022) comprises the following:

- Residential dwellings (houses and apartments).
- Community building with ground floor commercial floor space.
- Secondary school with associated playing fields.
- Associated car parking, highways, landscaping, community park and
- Pocket park.

1.5 Competence

1.5.1 LCRM states that planning related assessments must be undertaken by a 'Competent Person'. The contributors to the preparation of this

document meet the National planning Policy Framework (NPPF) definition of 'competent person' given in Annex 2 of the NPPF, have a proven track record of dealing with land contamination and hold qualifications recognised by LCRM (Table 1-1).

Table 1-1. Evidence of competence of the report contributors

Evidence of Competence (Membership & Qualification)	Applicability to the Contributors to this Document
Membership of professional organisation relating to land contamination	Duncan Scott is a Chartered member of the Geological Society of London (CGeol and CSci) Mike Kelly is a Chartered member of the Geological Society of London (CGeol)
Specialist in Land Contamination (SiLC)	Duncan Scott is a SiLC
Suitably Qualified Person (SQP) under the National Quality Mark Scheme (NQMS)	Duncan Scott is a SQP
Others	Duncan Scott is on the UK Register of Ground Engineering Professionals (RoGEP)

1.6 Liaison with Manchester City Council

1.6.1 VertaseFLI have liaised with the Contaminated Land Officer at Manchester City Council, Laura Miller, with regard to the remediation of the site primarily through her attendance at meetings.

1.6.2 VertaseFLI will continue this liaison throughout the project.

1.7 Liaison with Environment Agency

1.7.1 VertaseFLI have engaged with the Environment Agency (EA) extensively throughout the pre-planning and planning phases of this project principally via the pre-application advice charging scheme (ref: ENVPAC/1/GMC/00310).

1.7.2 Discussions/correspondence have primarily been with the Technical Specialist in the area Groundwater and Contaminated Land Team, Lee

Beveridge, and the Project Manager in the Green Growth Team & Sustainable Places Team, Andy Davies.

- 1.7.3 Due to the complexity of the ground conditions at the Site, the challenges associated with the removal of all uncertainties from the conceptual site model (CSM) via site investigation undertaken prior to the commencement of remediation were acknowledged during the pre-application discussions. In view of these challenges, a verbal agreement was made in Spring 2023 to move away from a traditionally “fixed” remediation strategy underpinned by a CSM based solely on pre-remediation site investigation towards a more “dynamic” approach to remediation of the Site. Dynamic elements of the approach were broadly agreed to relate to data collection during the remediation works (to further refine the CSM) and to the excavation depth. Further detail about the dynamic approach is provided in Section 08.
- 1.7.4 Following this verbal agreement, the EA reinforced this agreement within their pre-application advice letter (EA letter ref: SO/2020/120757/06-L01 dated 26th May 2023), which stated that pre-remediation site investigation to attempt to address the residual uncertainties “may still not offer the ability to draw definitive conclusions about the risks posed by contamination given the heterogeneity of the site materials”. In view of this, it was agreed that, where viable, these residual uncertainties shall be addressed by additional data collection during implementation of the remediation works (as opposed to prior to commencement of the works) whereby outstanding information gaps are addressed when access to materials at greater depths within the Made Ground is more practical and better-quality information about their chemical and physical composition can be obtained.
- 1.7.5 Further discussions between VertaseFLI and the EA Technical Specialist in the area Groundwater and Contaminated Land Team, Lee Beveridge, and the EA Project Manager in the Green Growth Team & Sustainable Places Team, Andy Davies were undertaken at a meeting on 11th September 2024. This document (Rev C) has been updated to reflect the outcomes of the meeting, with particular reference to the deeper excavation protocol.

- 1.7.6 Outside of the scope of planning VertaseFLI have also requested pre-application advice from the EA National Permitting Service (NPS) regarding a permitting route for the re-use of materials. At the time of writing (November 2023), VertaseFLI are still awaiting definitive advice from the EA NPS with respect to all the materials intended to be re-used.

1.8 Site Background Information

- 1.8.1 The Ten Acres Lane site is a brownfield site, which is a former landfill in part. The site lies currently derelict but has the benefit of planning permissions for Remediation and Redevelopment as outlined above (Section 1.2).
- 1.8.2 VertaseFLI will be responsible for delivering the remediation works in accordance with this document and other documents submitted and approved by planning permission 129197/FO/2021.
- 1.8.3 The site has been extensively investigated over a number of years extending back to the initial Celtic Technologies reports from 2007, on behalf of an historical site owner, and more recently by Wardell Armstrong on behalf of Nuvu Developments Ltd. The site investigations undertaken are comprehensive covering all areas of the site and now enable assessment of environmental risks and preparation of the necessary options appraisals and this strategy and implementation plan.
- 1.8.4 However, it is noted that some further additional investigation data will need to be collected during the remediation to finalise the verification of the site, to confirm the CSM and associated risk assessment models and to inform a "dynamic remediation strategy" that will ensure that all risks are fully defined and appropriately mitigated. This approach has been agreed as a principle with the EA and the EHO during pre-application discussions and is set out in more detail in the following sections.
- 1.8.5 Wardell Armstrong and other members of the design team have produced several documents to support the planning application for the proposed remediation including an initial Options Appraisal and

Preliminary Remediation Strategy. These documents are listed in Table 1-2.

Table 1-2. Reports to support the planning application.

Date	Document Title and Status
December 2020	WA Outline Remediation Strategy This document was submitted in support of the Planning Application for the land remediation works (129197/FO/2021)
June 2020	WA Gap Analysis and Indicative Scope of Further Works This document was submitted in support of the Planning Application for the land remediation works (129197/FO/2021)
August 2022	WA Ten Acres Vapour Assessment
October 2022	WA Updated Combined Phase I and Phase II Ground Investigation Report. This document has previously been submitted to the Environment Agency for review under a Pre-Application Advice Service agreement for comment in the context of Condition 5 of 129197/FO/2021
October 2022	WA Preliminary Options Appraisal Prepared in draft only
October 2022	WA Preliminary Remediation Strategy Prepared in draft only
March 2023	Technical Note – Hydrogeological Conceptual Site Model Clarifications This document has previously been submitted to the Environment Agency for review under a Pre-Application Advice Service agreement for comment in the context of Condition 5 of 129197/FO/2021
April 2023	Technical Note – Deeper Ground Conditions and Laboratory Testing Clarifications This document has previously been submitted to the Environment Agency for review under a Pre-Application Advice Service agreement for comment in the context of Condition 5 of 129197/FO/2021

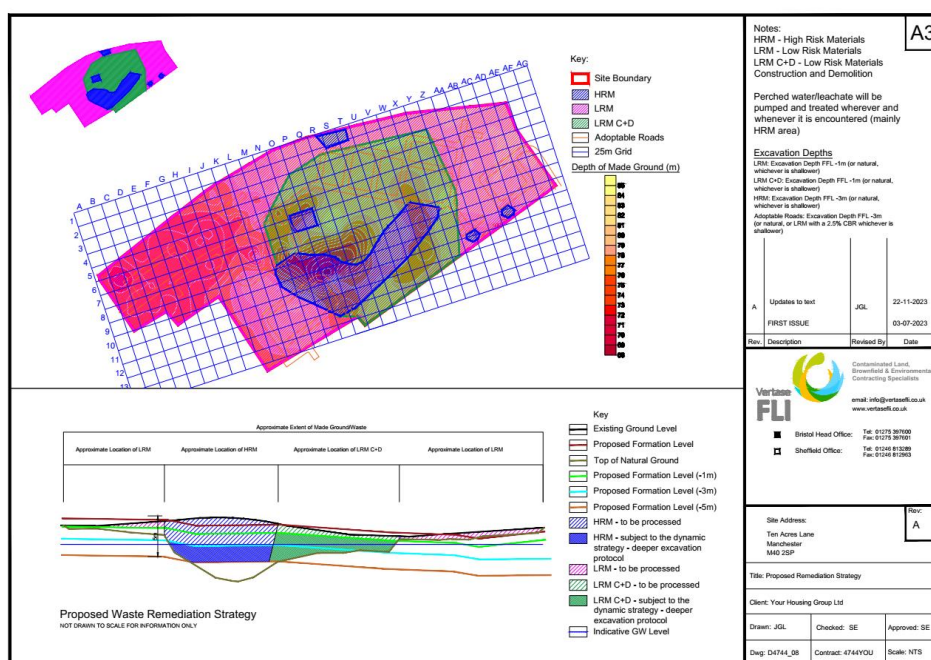
1.8.6 The documents listed in Table have been used by VertaseFLI as a basis for preparation of updated documentation to address the relevant pre-commencement planning conditions (i.e., detailed remediation strategy, options appraisal and remediation strategy). Building on the reports by WA has involved supplementary assessment of the site investigations information, review and detailed consideration of the comments on the WA reports given by the Environment Agency (EA) and Local Authority, preparation of a detailed ground model (Appendix B) and ultimately final design of the remediation and enabling works required.

1.8.7 It is intended that this will be built upon during the works as described throughout this document. The validation at the site will take an

innovative approach to soils and chemical testing management whereby we will collect and present all the relevant information and data in a 3d validation model that will be live throughout the works to allow the delivery team and the regulator to track progress and assess information.

1.9 Brief Overview of Remediation Works

1.9.1 The Remediation Strategy Design and Implementation is covered in detail in Section 08 and Section 09 of this document; however, an indicative remediation plan is shown below and in Appendix E as *Drawing D4744_08 Proposed Remediation Strategy*:



Drawing D4744_08 Proposed Remediation Strategy

1.9.2 The three main objectives of the proposed works are as follows:

- 1: To remediate a contaminated brownfield site, to protect future uses of the Site and existing receptors adjacent to the Site from soil contamination and ground gas risks and to ensure risks to controlled waters are managed.
- 2: To provide suitable development platforms for the residential development and associated infrastructure and

- 3: To provide suitable development platforms for the school and playing fields.

1.9.3 VertaseFLI have designed a suitable remediation strategy (Section 8.0 of this document) based on the outcomes of the options appraisal (Section 7.0 of this document).

1.9.4 Briefly the remediation works comprises:

- Source reduction via partial excavation of Made Ground for on-site treatment and re-use where appropriate.
- Source reduction via partial excavation for Construction and Demolition and other wastes deposited at the site for re-use where appropriate.
- Source reduction through pumping and on-site treatment of leachate/perched water.
- Pathway interruption through provision of engineered fill.
- Post remediation measures to be incorporated during the construction phase.

2.0 Overview of Previous Work

2.1 Desk Study

- 2.1.1 A summary of the historic desk studies is provided in *VertaseFLI (2023). Detailed Quantitative Assessment of Risk, Issue 1, Rev A, dated 20/10/23.*

2.2 Ground Investigations

- 2.2.1 A summary of previous ground investigations is provided in *VertaseFLI (2023). Detailed Quantitative Assessment of Risk, Issue 1, Rev A, dated 20/10/23.*

2.3 Summary of Preliminary Remediation Strategy

- 2.3.1 With reference to *Wardell Armstrong (2022). Preliminary Remediation Strategy. Issue 1.0. Oct 2022*, the following is a brief summary of the preliminary remediation strategy for the site.
- 2.3.1.1 The WA Preliminary Remediation Strategy assessed all the contamination links and produced a number of remedial solutions for consideration.
- 2.3.1.2 Relevant screening criteria to be used during the remedial works, were not included. Re-use criteria for excavated made ground has been developed by VertaseFLI as per Section 8.6.
- 2.3.1.3 Assessment of carbon footprint, environmental or social impacts from the proposed remedial techniques, was not included. Relevant assessment has been made in the VertaseFLI Options Appraisal (Section 4.0).
- 2.3.1.4 Furthermore, the WA strategy did not take account of the geotechnical parameters for the Site. Geotechnical suitability and engineering requirements of the proposed remediation techniques have been assessed by VertaseFLI and are presented under separate cover in the VertaseFLI Ground Stabilisation Works Plan to address planning condition 08.
- 2.3.1.5 The general approach for the Site as set out by WA was to broadly ensure:

- a) *Soils containing elevated contaminant concentrations and asbestos that represent a risk to Human Health are dealt with appropriately.*
- b) *Ground gas is managed.*
- c) *Japanese Knotweed is managed.*

2.4 Review of the Current PFAS Data

- 2.4.1 There have been several previous investigations conducted on the Ten Acres site all with the broad aim of better understanding the site, building the site conceptual site model, delineating contamination and waste types, and assessing the risks associated with the contamination and waste.
- 2.4.2 Most of these site investigations pre-dated PFAS as a contaminant of concern in the UK. As such, only the Wardell Armstrong, October 2022, Combined Phase 1 and Phase 2 Investigation Report included any sampling and analysis for PFAS.
- 2.4.3 The results presented in the Wardell Armstrong 2022 report have been re-interpreted by VertaseFLI in Section 3 to present the current understanding of PFAS contamination within the site.

2.5 Updated Ground Model

- 2.5.1 VertaseFLI has developed an updated ground model (Appendix B) which defines the site, pre-remediation. This has aided in the understanding of the site and its risks to the future development and environment and also allowed development of a comprehensive strategy to address those risks. This has also been developed to consider Planning Condition 10 as below.

Condition 10) Prior to the commencement of development, plans of the existing site and proposed site levels in the form of cross sections, shall be submitted to and approved in writing by the City Council as local planning authority. The development shall be carried out in accordance with the approved details.

- 2.5.2 The concept of a ground model will be further developed during the remediation with all relevant collected data from investigations and validation during the remediation added to the model to include all chemical and geotechnical testing as well as a photo record. The

updated Ground Model will be built during the works in a bespoke software tool allowing access to the regulators and will be presented on completion as part of the Verification and Risk Assessment process.

2.6 Quantitative Risk Assessment

2.6.1 VertaseFLI has developed a Detailed Quantitative Assessment of Risk, Issue 1, Rev A, dated 20/10/23. The purpose of this document is to provide sufficient information to satisfy Condition 6 of planning Permission 129197/FO/2021 granted by MCC as below:

Condition 6) Prior to the commencement of on-site remediation works, the applicant shall submit, for written approval, to the Local Planning Authority, a detailed assessment of risks to human and environmental receptors (including those off-site). The development shall be implemented in full accordance with the details so approved.

2.6.2 The VertaseFLI Detailed Quantitative Assessment of Risk document was submitted to MCC on 25th October 2023.

2.6.3 Relevant contaminant linkages identified within the VertaseFLI risk detailed assessment (VertaseFLI 2023) are:

- Exposure of future site users to contaminants in shallow Made Ground (via direct contact, ingestion and inhalation of soil-derived dusts) in residential gardens and public open spaces.
- Exposure of future site users to contaminants in Made Ground (via inhalation of vapours) within buildings.
- Exposure of future site users to asphyxiating ground gases (via inhalation) within buildings.
- Accumulation of explosive concentrations of ground gases within buildings.
- Direct contact of building materials with aggressive contaminants in Made Ground.
- Pollution of uncontaminated groundwater within the Secondary A aquifer by metals/inorganics that do not undergo significant mass reduction due to biological or abiotic degradation processes during transport within groundwater. It is worthy of note that this relevant pollutant linkage had a high degree of uncertainty

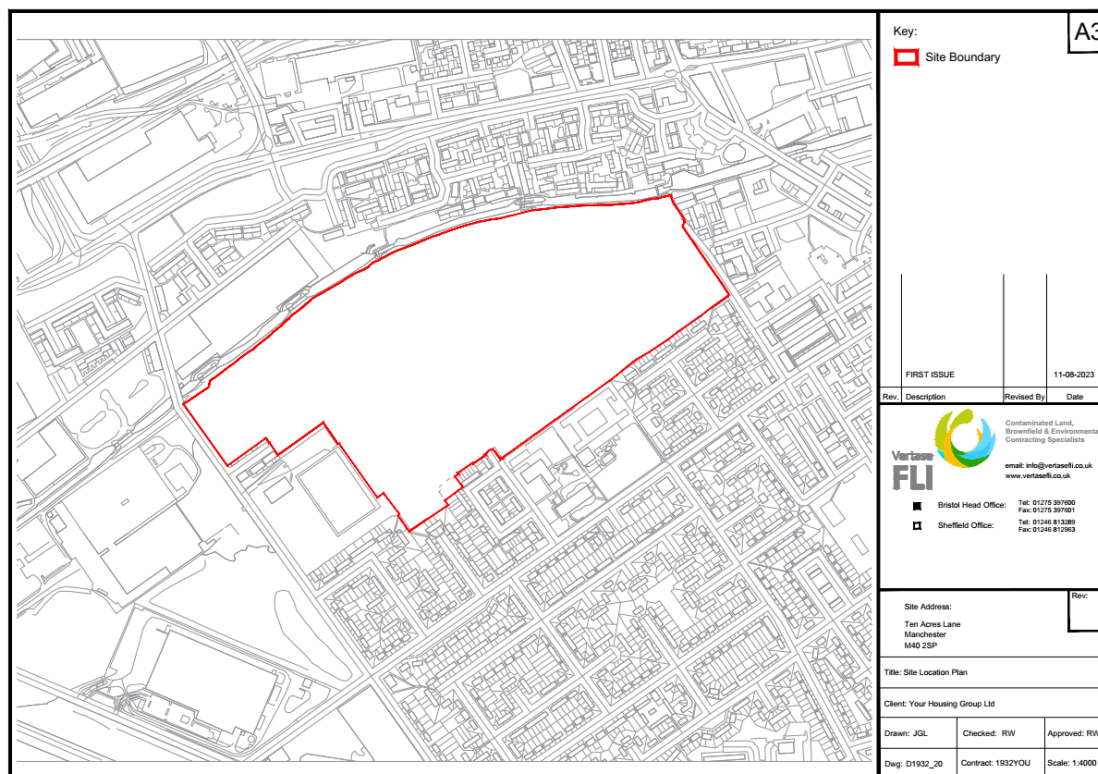
underpinning it due to an absence of off-site monitoring wells located within the contaminant flow path between the Site and receptor.

- 2.6.4 These relevant contaminant linkages shall form the focus of the remediation options appraisal documented herein.

3.0 Current Understanding of the Site

3.1 Site Location and Site Use

- 3.1.1 The Site is roughly rectangular in shape and comprises approximately 19 Ha of derelict land which falls gently from the northeast (approximately 85m Above Ordnance Datum - AOD) to the southwest (approximately 75m AOD). It is located approximately 4km to the northeast of Manchester city centre at National Grid Reference 387599, 400309.
- 3.1.2 Formerly, the eastern two thirds of the Site were densely vegetated / overgrown with mature trees and shrubs. In comparison the western section of the site comprised rough grassland with thickets of semi-mature trees. Vegetation clearance has recently been undertaken at the site to clear the majority of dense vegetation across the site and enabled further ground investigation although at the time of writing, tree stumps and large stands of Japanese knotweed remain.
- 3.1.3 No buildings are present on-site.
- 3.1.4 Fly tipping and surface debris are widespread across the site.
- 3.1.5 Vehicular access to the site is via a locked / gated and fenced compound off Ten Acres Lane. Concrete blocks are placed either side of the compound gates.
- 3.1.6 The remainder of the site is secured by 2.5m high metal mesh security fencing along its boundaries. However, there are areas where fencing panels have been removed / cut allowing trespassers to enter the site.
- 3.1.7 An area of concrete hardstanding is situated within the eastern section of the site adjacent to the site's eastern boundary.
- 3.1.8 The site location is presented below and in Appendix E as *Drawing D1932_20 Site Location Plan*



Drawing D1932_20 Site Location Plan

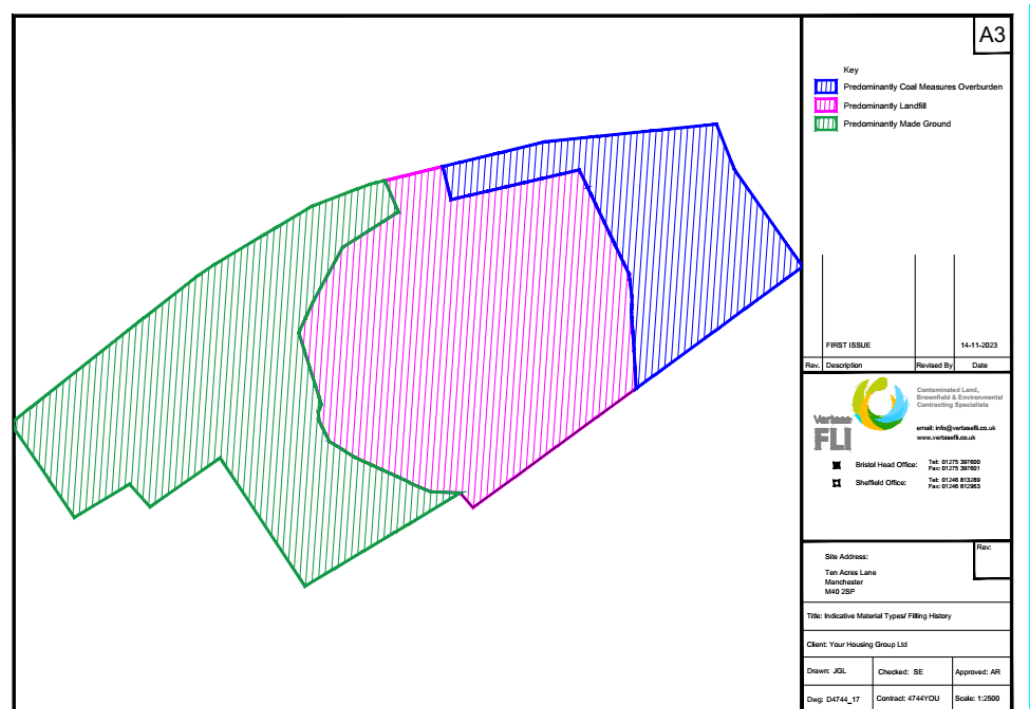
3.2 Site Overview

3.2.1 The site is commonly referred to as a former landfill. This is not technically accurate as whilst some landfilling has occurred on the site in historic brick pits this is relatively restricted to certain areas of the site where extensive clay extraction had historically taken place. In broad terms the site can be split into three sections as described below, which is based on a physical characterisation exercise that was undertaken to aid understanding of material heterogeneity;

- 1) Landfilled Section to the middle of the site which contains the former deeper brick pits and hence the majority of the historically placed HRM (High Risk Materials) and LRM C&D (Low Risk Materials Construction and Demolition Waste).
- 2) The made ground section to the Ten Acres Lane end which has been upfilled (much like many off the sites in major cities with a variety of made ground soils). This is the LRM (Low Risk materials)

- 3) The Coal Measures Overburden area. To the East of the site the site has been raised by the placement of predominantly reused natural materials from the coal measure strata. This is also termed LRM (Low Risk Materials)

3.2.2 The sections of the site as outlined above are shown below and in Appendix E as *Drawing D4744_17 Indicative material types/filling history*.



Drawing D4744_17 Indicative material types/filling history.

3.2.3 Greater detail on the make-up of the ground deposits at the site can be found in the Ground Model, Appendix B which links the site history and site investigation data to provide a comprehensive 3-dimensional model of the site.

3.3 Proven Ground Conditions

3.3.1 A significant number of investigations have been undertaken at the Site dating back to 2001. However, the findings of these investigations have

been summarised in more recent reports prepared for the Site by WA as outlined in Section 2.0.

3.3.2 Ground conditions beneath the Site are variable and comprise significant thicknesses of Made Ground to depths of between 0.3m up to 14.8mbgl, underlain by Glacial Till ranging in thickness from 35m to 45m, which in turn is underlain by solid geology comprising weathered sandstone of the Collyhurst Sandstone Formation and Chester Formation.

3.3.3 A summary of proven ground conditions beneath the Site is provided in Table 3-1.

Table 3-1 Summary of proven ground conditions

Strata	Description (taken from WA reports)
Made Ground	Comprises various types of Made Ground which include general granular soils, general cohesive soils, suspected combustion waste, suspected colliery spoil, construction and demolition waste and household waste
Glacial Till	Firm to stiff, fissured, brown, slightly sandy to sandy, gravelly clay with occasional lenses of predominantly medium dense, brown/grey gravelly clayey sand. The Glacial Till is identified to be a Secondary (Undifferentiated) Aquifer based on the BGS Aquifer Designation Map (Superficial Drift).
Weathered Sandstone of the Collyhurst Sandstone Formation	Extremely weak to weak, laminated, reddish brown, fine to coarse grained sandstone with well-rounded "millet seed" grains. The sandstone is identified to be a Principal Aquifer based on the BGS Aquifer Designation Map (Bedrock).
Weathered Sandstone of the Chester Formation	Reddish brown, fine to medium sand with black, red, white and green grains and rare angular, fine black gravel. The sandstone is identified to be a Principal Aquifer based on the BGS Aquifer Designation Map (Bedrock)

3.3.4 In addition to the proven ground conditions beneath the Site, to the south of the Site the superficial deposits are designated as a Secondary A aquifer based on BGS geological maps. The Secondary A aquifer corresponds in part with the route of the river Medlock (located circa 690m south of the Site) and comprises alluvium and late glacial flood gravels.

- 3.3.5 However, there is conflicting information presented within the available geological mapping with regard to the proximity to which these deposits extend towards the southwestern edge of the Site. Specifically, the BGS 1:63,360 scale drift geological map dated 1970 records sand and gravel deposits extending to within a close proximity of the southwest corner of the Site, whereas the most recent BGS geological map does not show the deposits to extend so closely to the Site. The absence of sand and gravel deposits from extending in close proximity to the south of the Site is also supported by BGS records for nearby off-site boreholes and on-site investigation data obtained by WA.
- 3.3.6 The absence of evidence led WA to conclude that the encroachment of the Secondary A aquifer up to the southwestern edge of the Site was an unsubstantiated classification that was subsequently corrected by remapping of the material as Glacial Till in the most recent version of the BGS geological map.
- 3.3.7 Notwithstanding the uncertainty with regard to the exact distance between the Site and the Secondary A aquifer located to the south of the Site, it can be concluded with certainty that an off-Site Secondary A aquifer is present, which likely provides an important source of baseflow to the river Medlock.

3.4 Contaminant Sources

- 3.4.1 Potential sources of contamination as identified by previous site investigation are:
- Made ground associated with the historical use of the Site as a brickworks.
 - Made ground associated with the historical infilling of the former brickwork's clay pits during operation of the Site as a landfill.
 - Made ground used to infill a former reservoir.
 - Fly tipped materials.
- 3.4.2 The various types of Made Ground provide a primary source of leachable contaminants with the potential to cause water pollution, degradable organic carbon with the potential to generate ground gas,

and contaminants (volatile and non-volatile) with the potential to cause harm to human health and damage to buildings and building materials.

3.5 Contamination Concentrations in Made Ground

- 3.5.1 Maximum contaminant concentrations (organic and inorganic) as measured by WA are provided in *VertaseFLI (2023). Detailed Quantitative Assessment of Risk, Issue 1, Rev A, dated 20/10/23.*

3.6 PFAS Overview

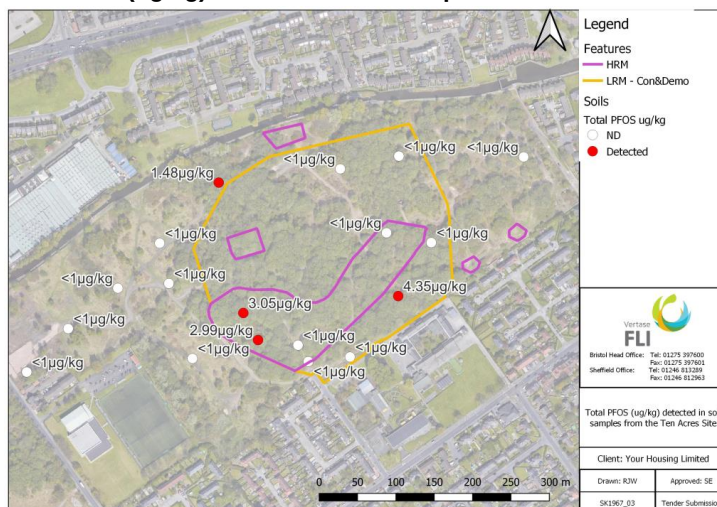
- 3.6.1 Detailed discussion on PFAS was not included in the detailed quantitative risk assessment. Therefore, to fulfil the requirements of LCRM, a review of existing chemical conditions of the site in relation to PFAS is provided.
- 3.6.2 PFAS (Perfluoroalkyl- and Polyfluoroalkyl substances) are a large group of man-made chemicals that have been used in a wide range of consumer and industrial applications due to their combination of useful properties (water-repellent, heat-resistant, oil-resistant and low chemical reactivity).
- 3.6.3 There have been several previous investigations conducted on the Ten Acres site all with the broad aim of better understanding the site, building the site conceptual site model, delineating contamination and waste types, and assessing the risks associated with the contamination and waste.
- 3.6.4 Most of these site investigations pre-dated PFAS as a focussed contaminant of concern in the UK. As such, only the most recent Wardell Armstrong, October 2022, Combined Phase 1 and Phase 2 Investigation Report included any sampling and analysis for PFAS.
- 3.6.5 The results presented in the Wardell Armstrong 2022 report have been re-interpreted by VertaseFLI to assess the current understanding of PFAS contamination within the site.
- 3.6.6 A total of 19no. soil samples and 9no. groundwater samples were collected and analysed for PFAS. The soil samples were obtained at depths ranging from 0.4m bgl to 4.9m bgl.
- 3.6.7 The groundwater samples were collected from wells with response zones at various levels within the site.

- 3.6.8 Of these samples, four soils and eleven groundwater samples were also analysed for Total Oxidisable Precursors (TOP Assay). This method subjects a sample to an oxidation process that converts a wider variety of longer chain PFAS molecules which are undetectable by current analysis methods, into the shorter chain detectable molecules. While this does not represent the entire list of known PFAS molecules, it does allow a somewhat clearer picture of the total PFAS content within the soils and groundwaters.

3.7 PFAS in Soils

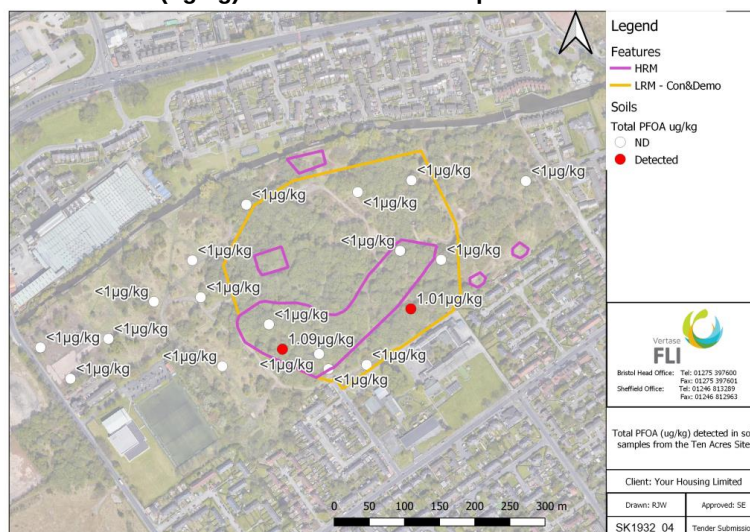
- 3.7.1 Of the 19no. soil samples tested, PFAS was detected above detection limits in only four samples. These samples are confined to the upper two metres of the site and within the made ground on site.
- 3.7.2 No PFAS was detected in the glacial till samples collected.
- 3.7.3 Within these soil samples, the PFAS detected were PFOA and PFOS in both standard testing and TOP Assay testing. The highest detected concentrations within the soils are 4.35 µg/kg for PFOS and 2.44 µg/kg for PFOA, with only a minor increase in both species following oxidation.
- 3.7.4 This suggests that PFAS impacted soils are within the made ground only. The spatial distribution of PFOS and PFOA are shown below and in Appendix E as *Drawing SK1967_03 Total PFOS detected in soil samples from the Ten Acres Site* and *Drawing SK1967_04 Total PFOA detected in soil samples from the Ten Acres Site*.

Drawing SK1967_03: Total PFOS (ug/kg) detected in soil samples from across the site.



*A non-detect is represented by a '<' followed by the reported detection limit for that sample.

Drawing SK1967_04: Total PFOA (ug/kg) detected in soil samples from across the site.



*A non-detect is represented by a '<' followed by the reported detection limit for that sample.

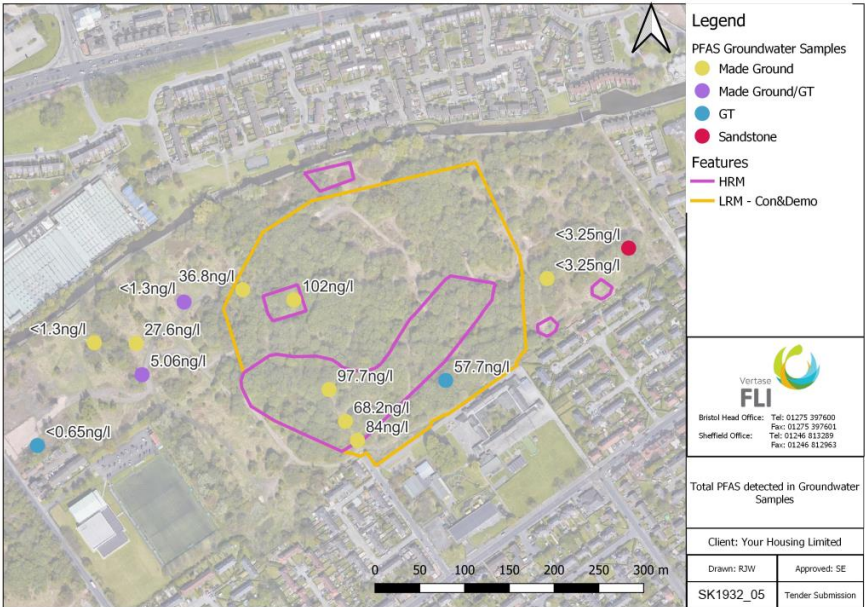
3.8 PFAS in Perched Groundwater in the Made Ground (Waste)

3.8.1 Samples CP109, CP201, CP203, WS306, WS310 and WS315 are considered to be representative of the perched shallow groundwater within the waste.

3.8.2 These results show the highest PFAS concentrations on site, with the highest results corresponding to the high-risk materials (CP109 97.7 ng/L and WS315 102ng/L).

- 3.8.3 The total PFAS detected in each of the groundwater samples is shown below and in Appendix E as *Drawing SK1932_05 Total PFAS in groundwater samples from across the site.*

Drawing SK1932_05: Total PFAS in groundwater samples from across the site.



*A non-detect is represented by a '<' followed by the reported detection limit for that sample.

3.9 PFAS in the Deeper Aquifer within the Bedrock

- 3.9.1 To date a single sample of groundwater has been collected at a depth representative of the deeper groundwater body in the sandstone bedrock aquifer, from borehole RH201.
- 3.9.2 The results for this sample are below detection limits for all detectable PFAS, both before and after TOP Assay oxidation. This suggests that the deeper aquifer is free of PFAS in this location.
- 3.9.3 However, it is noted that this borehole is situated upstream of most of the site, including the historic pit and higher risk materials, and the leachate in the historic pit.
- 3.9.4 No other deeper aquifer groundwater samples have been analysed for PFAS to date. Therefore, at this time it remains an uncertain assumption in the CSM that the deeper aquifer remains unimpacted by the PFAS from the shallow groundwater/leachate.

3.10 Results of TOP Assay

- 3.10.1 The TOP Assay analysis results for ground water have been summarised as a series of bar graphs in Figure 1. Where the results for a particular PFAS species are non-detect for all sample locations, they have been omitted from the graphs.
- 3.10.2 The results show that for the majority of groundwater samples, there is only a minor change in concentrations following oxidation. This suggests that there are no pre-cursor PFAS species within the sample.
- 3.10.3 The exception to this is within the sample from CP109, where there is a significant increase in several PFAS species following oxidation.
- 3.10.4 CP109 is considered to represent the deeper perched water/leachate in the landfill, and as such, suggests there are one or more pre-cursor species present.
- 3.10.5 The PFAS species that were shown to increase (PFOA, PFBA, PFHxA, PFHpA, PFPA and PFNA) are all part of the Perfluoroalkyl Carboxylic Acids (PFCA) subgroup of PFAS. There are a wide range of known potential precursors to this subgroup including many Polyfluoroalkyl Substances, Fluoropolymers, Perfluoroalkanoyl Fluorides,

Perfluoroalkyl Iodides and Perfluoroalkyl Aldehydes, many of which are undetectable by current technology. As such, it is difficult to identify what the increase in concentrations represent, other than a volume of unknown PFAS molecules within the leachate.

- 3.10.6 However, analysis using an extended PFAS suite, which includes some of the above PFCA precursors, may be able to identify some.

Figure 1: The results of TOP Assay analysis showing a comparison of detected PFAS concentrations pre-and post -oxidation.



3.11 PFAS in Surface Water (Canal)

- 3.11.1 The results of the three surface water samples show that the concentrations of detected PFAS remain consistent from upstream to downstream of the site, suggesting no additional contribution of PFAS from the site.
- 3.11.2 While many of the results are 'below detection limit', for both upstream and downstream samples, the detection limits have been raised, most likely due to a need for dilution of the sample in the laboratory.
- 3.11.3 However, where detected in all three samples, for example PFOS, concentrations are consistent i.e., there is no increase in PFOS from upstream to downstream.

3.12 Potential PFAS Sources in the Site

- 3.12.1 Landfills are a known source of PFAS. A recent CL:AIRE technical bulletin (TB22 March 2023) highlighted that PFAS have been detected in leachate from landfills that receive municipal, construction and industrial wastes, all of which are present within the Ten Acres Lane site.
- 3.12.2 The widespread use of PFAS in many consumer and industrial products, which end up in landfills, means that there are potential point sources within the waste, however, none of these are likely to be of high concentration.
- 3.12.3 The WA trial pit logs, borehole logs and photos have all identified different types of wastes within the landfill site. Many of these are likely to contain PFAS in some form. It is most likely that these also correspond with the areas of HRM (High Risk Materials) that have been classified.
- 3.12.4 The CL:AIRE technical bulletin (TB22 March 2023) highlighted the prevalence of 5:3 Fluorotelomer Carboxylic Acid (5:3 FTCA) in landfill leachate in the USA. This particular PFAS was not included in the testing suite in the Wardell Armstrong report, however it is available as a detectable analyte in commercial laboratories. This is included in the proposed PFAS testing suite as per Section 9.16.

3.13 PFAS Chain Length and Mobility

- 3.13.1 In both soils and groundwater, the PFAS that have been detected are primarily short chain PFAS which are known to be highly mobile and more likely to move into the liquid phase. The exception to this is the longer chain PFOS and PFOA which as seen in the data can sorb to soils or exist in the water phase.

3.14 PFAS Data Gaps

- 3.14.1 The soil sampling undertaken to date only covers the top five metres of the site. More data will need to be collected as part of the Site Investigation Works during the remediation to confirm the absence of significant risk.
- 3.14.2 There is insufficient data for PFAS concentrations in the groundwater downstream and cross-stream of the waste body. Additionally, further upstream concentrations are also required, to establish a site-wide background concentration for future risk assessments.
- 3.14.3 Further analysis of the PFAS within the leachate for a wider PFAS suite may also help identify other PFAS species for risk assessment purposes.
- 3.14.4 Further groundwater sampling in the shallow aquifer outside the construction and demolition waste is also advised to ascertain if and how PFAS is mobile locally within other parts of the site.
- 3.14.5 The proposed PFAS sampling strategy to address the above is presented in Section 09.

4.0 Sustainability Considerations

4.1 Sustainable Remediation

4.1.1 LCRM states that a competent person should consider sustainability when selecting remediation options to ensure that: (a) the benefit of doing the remediation is greater than its impact; and (b) impacts of climate change and extreme weather events are considered when selecting the final options. These elements of sustainability are addressed in Section 4.2 (benefits versus impact) and Section 4.3 (climate change).

4.2 Benefits versus Impacts of the Remediation

4.2.1 *Benefits of the Remediation*

4.2.1.1 The health benefits of implementing remediation to manage risks posed by the relevant pollutant linkages associated with future site users are well understood.

4.2.1.2 The environmental benefits of implementing remediation to manage risks posed by the relevant pollutant linkage associated with pollution of the Secondary A aquifer by metals/inorganics are less clear. This reflects the following:

- Evidence to support the existence of the relevant pollutant linkage for metals/inorganics is currently based solely on simplistic contaminant fate and transport modelling (VertaseFLI 2023), which has not been verified due to an absence of off-site monitoring wells along the assumed contaminant flow path. This introduces uncertainty into the existence of the relevant pollutant linkage.
- The contaminant fate and transport modelling is conservative as it does not account for dilution in receiving water bodies (VertaseFLI 2023). Any dilution would further reduce contaminant concentrations.
- The background groundwater quality in the Secondary A aquifer may already contain elevated concentrations of some metals / inorganics at levels above target concentrations (e.g., freshwater EQS). Whilst evidence to support this is not widespread, sampling

undertaken by Hurley et al., (2017) found that riverbed sediments in the catchment of the river Irwell and its tributaries, including the River Medlock, were enriched with heavy metal concentrations associated with both anthropogenic and natural geological sources.

- Groundwater within the Secondary A aquifer is unlikely to be used as a potable resource in the future. This is because potable groundwater is likely to be abstracted from the underlying Principal Sandstone aquifer capable of supporting larger abstractions. Instead, the groundwater within the Secondary A aquifer is only ever likely to provide baseflow to the river Medlock within the development lifetime.
- The river Medlock is an urban water course that is impacted by numerous sources of pollution including urban diffuse pollution (runoff from roads, buildings and the built environment), storm outflows and other water industry emissions (e.g., where combined sewers emit to water courses during intense rainfall), debris (from littering/fly tipping and vegetation) and land contamination. Historically, the Failsworth Sewage Works has been a main contributor to pollution in the river, however significant investment has been made in recent years to upgrade this facility to aid compliance with the Water Framework Directive (WFD) quality standards. Notwithstanding this, in 2019 the water quality in the river Medlock was classified as “fail” with regard to priority hazardous substances, which include some heavy metals and PFOS (Defra & Environment Agency 2023).

4.2.2 Impacts of the Remediation

- 4.2.2.1 Due to the quantity (circa 677,000m³) and thickness (up to 14m) of the deposits of Made Ground at the Site, complete removal of the contamination source would have disproportionately negative impacts (both societal and environmental impacts) relative to the likely benefits of the source removal. These negative impacts would be a direct result of the following:

- Greenhouse gas emissions (from the use of diesel driven plant and machinery to excavate, haul, process, dispose and replace the Made Ground).
- Dust, odour and noise emissions.
- Vehicle movements on local roads to transport waste materials to landfill or waste recycling facilities and import replacement materials (contributing to increased traffic and associated pollution).
- Stress for local residents (contributing to increased opposition to the scheme).

4.2.2.2 Furthermore, complete removal of the contamination source would be economically unviable due to costs associated with haulage, disposal and import (i.e., complete removal and replacement with import would cost in the region of £100m). The costs are outlined in Section 4.3 for clarity. Therefore, remediation options enabling a combination of source reduction, pathway interruption and potentially receptor modification shall provide a more sustainable remediation strategy for the Site.

4.2.2.3 Fundamental to the sustainability of the combination of remediation options are (i) maximising the extent to which the Made Ground can remain undisturbed without excavation; and (ii) minimising the extent to which Made Ground that is excavated requires off-site disposal as waste (in other words, maximising the quantity of excavated Made Ground that can be retained on-site for re-use as a General Fill to construct a geotechnically suitable development platform for follow-on construction works).

4.2.2.4 Due to the requirement to adjust site levels to accommodate the proposed development levels, earthworks (and thus disturbance to the Made Ground) shall be required laterally across the entire development footprint. However, the depth to which the Made Ground is disturbed during the remediation can be minimised depending on the elevation of the proposed development levels, the elevation of the underlying natural ground and an assessment of the benefit (relative to the associated impacts) of excavating Made Ground beyond a certain depth.

4.2.2.5 In general, at this Site, the benefits of excavating Made Ground are likely to become disproportionate in relation to the associated negative impacts when extending beyond FFL-3m, or significantly below a perched groundwater table. This is due to the following:

- A minimum 1m excavation depth relative to final ground level is all that is required to implement pathway interruption remediation options (e.g., a low permeability engineered platform and a clean cover system to manage health risks to future site users).
- The fuel consumption (and hence carbon dioxide emissions) of earthworks plant to transport excavated materials up haul roads with steep gradients to access/exit deeper excavations vastly exceeds that associated with transporting the same mass on flatter gradients.
- The excavation and handling of saturated Made Ground excavated from beneath a perched groundwater table is generally slower due to the requirement to allow the material to drain before haulage outside of the excavation.
- The mechanical action of excavating Made Ground from beneath a perched groundwater table can temporarily liberate / release more contaminants into the localised surrounding groundwater via agitation, particle breakage and void space creation due to particle loosening. While this can be managed during the works via forward dewatering to lower groundwater levels, future rebound of perched groundwater levels shall fill the new voids potentially promoting further contaminant dissolution.
- The exposure of perched groundwater and buried Made Ground during excavation can release volatile organics into the atmosphere.
- The environmental benefits to groundwater quality resulting from excavation of Made Ground beyond a maximum depth of FFL-3m are unlikely to increase significantly (relative to not excavating beyond FFL-3m) within the timescale associated with the development lifetime (e.g., 60 years or similar). This is because metals/inorganics are generally expected to be ubiquitous, albeit at low levels, throughout the entire deposit of Made Ground.

- 4.2.2 Minimising the quantity of excavated Made Ground requiring off-site disposal as waste significantly reduces the negative impacts of the remediation by reducing vehicle movements (associated traffic, noise, dust and greenhouse gas emissions) and minimising the amount of waste sent to landfill which is in-keeping with UK Government Policy (Defra 2021).

4.3 Costs of Complete Source Removal

- 4.3.1 The costs of complete source removal (i.e. excavation and disposal of the entire 677,000m³ of Made Ground) are illustrated in Table 4-1. For every 1m of source removal within the infilled former clay pit below a depth of 5m, the cost of excavation, disposal, import and reinstatement is a minimum of £1m.

Table 4-1. Estimated costs of complete source removal in 2024

Item	Cost
Preliminaries	£3,000,000
Excavation and Basic Separation	£3,385,000
Abnormal Excavation Costs	£5,000,000
Water Control	£1,000,000
Haulage/Transport (150,000 wagon movements)	£20,000,000
Disposal	£47,000,000
Import	£7,000,000
Backfilling with Import	£2,000,000
Testing (Verification)	£500,000
Management	£13,000,000
TOTAL	£101,885,000

4.4 Impacts of Climate Change

- 4.4.1 Guidance published by the Society of Brownfield Risk Assessment (SoBRA) on the assessment of risks to Controlled Waters from UK land contamination under conditions of future climate change (SoBRA 2022) encourages practitioners to consider the effects of climatic projections over the lifetime of the development (e.g., 60 years), including anticipated changes in precipitation, which may influence infiltration and groundwater levels.

4.4.2 The annual average rainfall in the Greater Manchester area is typically cited to be in the region of 870mm between 1981 and 2015 (data from the MET Office). By the 2080's, current climatic projections for the area suggest that winter rainfall could increase by up to 30% (see Appendix A). If not managed as part of the remediation strategy, this increased rainfall could lead to increased infiltration and mobilisation of contaminants.

4.4.3 Due to the importance of minimising disturbance to the deeper Made Ground and maximising material retention on Site, it is also important that the final remediation strategy is capable of minimising infiltration into the Made Ground, but without increasing the risk of surface water flooding due to increased runoff to remain resilient to projected changes in climate.

4.5 Sustainability Criteria for Remediation Option Identification

4.5.1 In view of the above, it is important that the following sustainability criteria are carried forward for remediation option identification and selection:

- Minimise disturbance to the Made Ground that extends greater than a maximum depth of FFL-3m.
- Maximise retention of excavated materials for re-use on site.
- Minimise infiltration of precipitation into unexcavated Made Ground (but without increasing the risk of surface water flooding due to increased runoff with no on-site storage capacity for storm water).

5.0 Identification of Feasible Remediation Options

5.1 Available Information

- 5.1.1 Sufficient information is available to undertake a remediation options appraisal. While it is acknowledged within the detailed risk assessment (VertaseFLI 2023) that there remain some uncertainties within the assumptions of the CSM that underpin the risk assessment, these uncertainties do not substantially affect the options appraisal objectives or the identification and evaluation of feasible remediation options.
- 5.1.2 Furthermore, it is proposed that the uncertainties identified in the detailed risk assessment with respect to the CSM are addressed via further ground investigation gathered during the remediation works. This is because the uncertainties primarily relate to the contaminant concentrations within the deeper Made Ground, which is more practically accessible for investigation during the remediation works when a significant thickness of the overlying shallower Made Ground has been removed.
- 5.1.3 Notwithstanding the uncertainties in the CSM, VertaseFLI has used the existing ground investigation information collected by Wardell Armstrong to construct a detailed digital ground model representing the lateral and vertical distribution of Made Ground across the Site (Appendix B). This ground model has been used to inform the remediation options appraisal via the quantification of likely volumes of Made Ground that could require excavation, treatment, disposal, and re-use.

5.2 Options Appraisal Objectives

- 5.2.1 LCRM requires that a clear set of options appraisal objectives are in place to enable the identification of feasible remediation options to manage relevant contaminant linkages. These site-specific objectives, which include management, technical and remediation objectives, are listed in Table 5-1.

Table 5-1. Options appraisal objectives

Type	Objective
Remediation	Manage unacceptable health risks to future site users
	Manage unacceptable risks of damage to buildings and building materials
	Further reduce risks of pollution to Controlled Waters
	Meet remediation sustainability criteria identified in Section 4.5 ; namely (1) minimise disturbance of the deeper Made Ground; (2) maximise retention of materials for re-use on site; (3) minimise infiltration of precipitation into unexcavated Made Ground
	Ensure the land is not capable of being designated as Contaminated Land under Part 2A of the Environmental Protection Act 1990 following redevelopment of the Site for its proposed use
	Re-use all site-won materials that are suitable for re-use within the context of a framework that negates the likelihood of the deposited materials from being classified as inappropriately deposited 'waste' under governing waste legislation
Technical	Re-grade the Made Ground at the Site to a suitable formation level that can accommodate proposed final development levels including construction makeup thicknesses and any cover systems
	Re-engineer the shallow Made Ground to provide a low permeability development platform with a long-term settlement potential that is compliant with tolerances specified for settlement-sensitive infrastructure
	Protect the integrity of the adjacent Rochdale canal throughout the works
	Prevent pollution of the adjacent Rochdale canal throughout the works (and other Controlled Waters)
	Appropriately decommission all monitoring wells within excavation areas to ensure vertical contaminant migration pathways are broken
	Enable practical access for undertaking additional investigation of deeper Made Ground to address residual uncertainties in the CSM
Management	Complete the remediation works within a timescale suitable for the use of grant funding for the follow-on construction phase (e.g., for the proposed School site)
	Complete the remediation works within budget
	Implement remediation options in accordance with appropriate Regulatory controls (e.g., environmental permit) to manage environmental risks
	Ensure that Regulatory controls (e.g., environmental permits) associated with remediation options can be obtained within the available pre-commencement timescale (prior to March 2024)
	Minimise disruption to neighbouring residential properties

5.3 Regulatory Controls

- 5.3.1 Obtaining and/or reaching agreements on Regulatory controls associated with land remediation activities can provide a significant pre-commencement time-constraint to some remediation projects. In recent years, this constraint has become particularly magnified on land remediation projects where the Made Ground is already considered to be classified as “waste” under the Waste Framework Directive (WFD) by the Environment Agency.
- 5.3.2 The challenges of navigating through the Regulatory regime with respect to the re-use of materials that could be regarded as having been previously discarded (and thus already classified as waste), to reach a solution that is compatible with the proposed development (residential land use where future property sales may require financial institutions to provide finance secured against the properties themselves), have already been considered through productive pre-application discussions with the Environment Agency (pre-application reference EA/EPR/LB3001TT/A001).
- 5.3.3 In conducting the options appraisal described herein, a number of assumptions have been made about the applicability of Regulatory controls to the various activities typically associated with land remediation. These assumptions are summarised against each activity in Table 5-2.

Table 5-2. Assumptions about the applicability of Regulatory Controls to various activities typically associated with land remediation at the Site.

Activity Associated with Land Remediation	Assumptions Regarding Regulatory Controls
Excavation of materials	No Regulatory Control
Removal of leachate from excavations	No Regulatory Control
Removal of perched water from excavations	Exempt from Regulatory Control if removed at a rate less than 20m ³ /day, or less than 100m ³ /day for a period of 3 months on construction sites
Storage and treatment of excavated materials	Controlled by an Environmental Permit for treatment (either fixed facility or mobile facility)
Storage and treatment of water	Controlled by an Environmental Permit for treatment (either fixed facility or mobile facility)
Re-use of excavated materials that are suitable for use (either immediately or following treatment)	The material shall have reached "End of Waste" by virtue of following a WRAP Protocol to produce aggregate and/or demonstrating suitability for use
Disposal of unsuitable materials	The material shall be deemed waste and transported off-site to a suitable facility under the waste duty of care code of practice
Disposal of treated water	Controlled by a Trade Effluent Discharge Consent

5.4 Shortlist of Feasible Remediation Options

- 5.4.1 A shortlist of feasible remediation options is provided in Table 5-3. The shortlist is based on the relevant contaminant linkages (2.6.3), options appraisal objectives (Section 5.2) and the assumptions about the applicability of Regulatory Controls to remediation options (Section 5.3).
- 5.4.2 Remediation options that have been eliminated from the shortlist are those that will not meet options appraisal objectives, are not practical, durable or effective, and will not meet budget and time constraints. Due to the vast number of remediation options available for soil and groundwater (Nathanail et al., 2007), those that have been eliminated are not listed herein and only those that are considered feasible are listed in Table 5-3.

Table 5-3. Shortlist of feasible remediation options

Type	Option Description
Source Reduction / Immobilisation	Partial excavation of Made Ground for off-site disposal coupled with replacement of imported clean materials
	Partial excavation of Made Ground for on-site ex-situ physical treatment (via screening, crushing, sorting) to remove contaminant source materials (wood, textiles, plastics, metal) coupled with re-use of materials that are physically and chemically suitable as fill
	Pumping and ex-situ treatment of leachate and perched groundwater coupled with discharge of treated water to foul sewer
	Stabilisation and solidification of metals/inorganics in Made Ground using lime, cement or other binders
Pathway Interruption	Engineered capping layer to reduce infiltration into deeper Made Ground
	Simple clean cover system comprising a minimum of 600mm clean soils in soft areas (gardens, landscaping and open space)
	Engineered clean cover system in soft areas (gardens, landscaping and open space)
	Placement of hardstanding associated with the proposed development (including drainage for surface water runoff)
	Containment of contaminant source by constructing an impermeable vertical barrier around some or all of the Site (e.g., sheet piling, trench wall)
	Interruption of contaminant pathway by constructing a permeable reactive barrier downgradient of the source (e.g., comprising granular activated carbon)
	Contaminant resistant vapour membrane in buildings
	Passive ground gas protection measures in buildings
Receptor Modification	Contaminant resistant drinking water pipes
	Use of an appropriate concrete mix to resist attack from aggressive ground conditions

6.0 Evaluation of Options

6.1 Evaluation Criteria

6.1.1 Options appraisal evaluation criteria against which the feasible remediation options have been scored are as follows:

- Likely acceptability to relevant stakeholders (Regulators, Client, local residents) (1 = low acceptability; 5 = high acceptability)
- Sustainability (1 = low sustainability; 5 = high sustainability)
- Cost to implement (1 = low affordability; 5 = affordable)
- Timescale to implement (1 = too long; 5 = within available timescale)
- Practicability (1 = impractical; 5 = practicable)
- Effectiveness (1 = low effectiveness; 5 = high effectiveness)
- Durability over the lifetime of the development (1 = poor durability; 5 = high durability)
- Track record (1 = weak evidence; 5 = strong evidence)
- Availability (1 = poor availability; 5 = wide availability)
- Health and safety requirements (1 = high level of health and safety requirements; 5 = low level of health and safety requirements).

6.2 Evaluation Outcomes

6.2.1 Scoring of the remediation options against the evaluation criteria set out in Section 6.1 is provided in Appendix C. The relative total scores for each remediation option are summarised in Table 6-1 (higher scores meaning that the option is more favourable with respect to the criteria).

Table 6-1. Summary of scores for each remediation option against the evaluation criteria (summarised from information provided in Appendix C)

Remediation Option	Score
<u>Source Reduction/Immobilisation</u>	
Partial excavation of Made Ground for off-site disposal coupled with replacement of imported clean materials	33
Partial excavation of Made Ground for on-site ex-situ physical treatment (via screening, crushing, sorting) to remove contaminant source materials (wood, textiles, plastics, metal) coupled with re-use of materials that are physically and chemically suitable as fill	41
Pumping and ex-situ treatment of leachate and perched groundwater coupled with discharge of treated water to foul sewer	44
Stabilisation and solidification of metals/inorganics in Made Ground using lime, cement or other binders	27
<u>Pathway Interruption</u>	
Shallow engineered fill to reduce infiltration into deeper Made Ground	47
Simple clean cover system comprising a minimum of 600mm clean soils in soft areas (gardens, landscaping and open space)	47
Engineered clean cover system in soft areas (gardens, landscaping and open space)	46
Placement of hardstanding associated with the proposed development (including drainage for surface water runoff)	48
Containment of contaminant source by constructing an impermeable vertical barrier around some or all of the Site (e.g., sheet piling, trench wall)	27
Interruption of contaminant pathway by constructing a permeable reactive barrier downgradient of the source (e.g., comprising granular activated carbon)	27
Contaminant resistant vapour membrane in buildings	47
Passive ground gas protection measures in buildings	47
Contaminant resistant drinking water pipes	46
<u>Receptor Modification</u>	
Use of an appropriate concrete mix to resist attack from aggressive ground conditions	48

7.0 Final Remediation Strategy

7.1 Most Appropriate Options

- 7.1.1 The combination of most appropriate remediation options forming the final remediation strategy comprises a combination of source reduction, pathway interruption and receptor modification options (Table 7-1). The combination of options forming the final strategy is based on those which scored the highest against the evaluation criteria (Section 6.2).

Table 7-1. Summary of final remediation strategy

Final Remediation Strategy	Implementer
<u>Source Reduction</u>	
Partial excavation of Made Ground for on-site ex-situ physical treatment (via screening, crushing, sorting) to remove contaminant source materials (wood, textiles, plastics, metal) coupled with re-use of materials that are physically and chemically suitable as fill	VertaseFLI
Pumping and ex-situ treatment of leachate and perched groundwater coupled with discharge of treated water to foul sewer	VertaseFLI
<u>Pathway Interruption</u>	
Engineered capping layer to reduce infiltration into deeper Made Ground	VertaseFLI
Simple clean cover system comprising a minimum of 600mm clean soils in soft areas (gardens, landscaping and open space)	Others
Placement of hardstanding associated with the proposed development (including drainage for surface water runoff)	Others
Contaminant resistant vapour membrane in buildings	Others*
Passive ground gas protection measures in buildings	Others*
Contaminant resistant drinking water pipes	Others*
<u>Receptor Modification</u>	
Use of an appropriate concrete mix to resist attack from aggressive ground conditions	Others*

Notes:

*Subject to confirmation following post-remediation risk assessment based on data collected during and after remediation

7.2 Key Assumptions

7.2.1 Key assumptions associated with the final remediation strategy are as follows:

- 'Partial' excavation of Made Ground refers to an excavation depth not exceeding a maximum of FFL-3m or top of natural ground. However, localised excavation of Made Ground to depths not exceeding 5m below final ground level shall be undertaken where the additional excavation shall result in significant betterment such as (i) removal of materials that are grossly impacted by chemical contamination or (ii) provision of a stable sub-formation for the placement and compaction of overlying fill (see Appendix F). Details associated with the proposed excavation depths and volumes, are provided within the Remediation Design & Implementation Plan (RS&IP), which is covered in Section 8.0 through to Section 12.
- Additional data collection to address the residual uncertainties in the CSM (including confirmation of the characteristics of the deeper Made Ground to remain in-situ following remediation and the hydraulic conductivity of the Glacial Till) shall be conducted during the remediation works. The scope of the additional ground investigation is provided within the RS&IP, with particular reference to Section 9.13.
- All Made Ground demonstrated to be physically and chemically suitable for re-use as fill within the development platform area shall be placed and compacted in accordance with an earthworks specification. Details associated with the earthworks specification, including acceptability testing requirements, shall be provided within the RS&IP.

7.3 Remediation Strategy Design and Implementation

7.3.1 Sections 8 – 12 of this report provide greater detail about the design and implementation of the remediation strategy for the Ten Acres Site. This is termed the Remediation Design & Implementation Plan (RD&IP) and is presented as the following sections:

Section 08: Remediation Strategy Design

Section 09: Remediation Strategy Implementation which also includes strategies to fulfil the requirements of the following planning conditions:

- Condition 14 Temporary surface water drainage strategy
- Condition 17 Ecology
- Condition 18 Measures to protect the canal corridor.

Section 10: Health, Safety & Environmental Management.

Section 11: Remediation Verification Plan.

Section 12: Remediation Measures to be incorporated during the construction phase.

Remediation Design & Implementation Plan (RD&IP)

8.0 Remediation Strategy Design

8.1 Introduction

8.1.1 The strategy for remediation has been derived as a result of thorough review of all historical data, logs, photo records and assessment/interpretation. This section sets out how the remediation will address identified sources, pathways or receptors in order to manage identified risks.

8.1.2 The overall enabling and remediation scheme has 4 main phases which will be programmed concurrently:

- 1) Pre-Remediation Phase: Pre remediation works to secure the site, manage the existing landscaping, recover topsoil, manage invasive species and reprofiling of the site area adjacent to Ten Acres Lane to facilitate site access and compound establishment. We will also establish a compound and construct the treatment compound.
- 2) Main Remediation Phase: Excavation, processing, treatment and off-site disposal, where appropriate, of deleterious materials including any other facilitation works.
- 3) Leachate Remediation Phase: Pumping and treatment of leachate within the filled pits.
- 4) Reinstatement Phase: Reinstatement of suitable materials at the site and validation of the same to provide engineered development platforms.

8.1.3 This remediation design and implementation plan builds on the preliminary remediation strategy initially developed by Wardell Armstrong which sets out:

- The initial CSM
- An initial Options Appraisal
- The main drivers and objectives for remediation
- The outline remediation recommendations and
- Broadly how the remediation of the site is to be undertaken.

- 8.1.4 The remediation design is required to ensure that, upon completion of the residential development, the ground, groundwater and ground gas conditions at the site are appropriate for its intended use and do not pose an unacceptable risk to human health and the surrounding environment, which could trigger determination of the land as Statutory Contaminated Land under Part 2a of the Environmental Protection Act (EPA) 1990. Proposed remediation measures will be implemented so there will be no unacceptable contamination risks to identified receptors.
- 8.1.5 The VertaseFLI Options Appraisal assessed remedial options with the conclusion being that an earthworks-based remediation approach comprising excavation, processing and re-use was the preferred remediation option. This document builds on that recommendation following consultation with the EA as part of a Pre-Application Discussion as further described in Section 1.7.
- 8.1.6 In summary, this has been developed into a detailed design to address risks from both contamination to future site users and Controlled Waters alongside geotechnical issues and risk from hazardous ground gas associated with the putrescible elements of the fill. It is also important to note that the removal and processing/treatment of historically placed fill will provide betterment of the groundwater quality beneath the site by removing elements of the contamination source and reducing infiltration in addition to the proposed targeted groundwater remediation/leachate treatment. Full details are provided in subsequent sections of this document.
- 8.1.7 Following completion of the remediation works described in this document, additional remedial measures will require implementation during the construction phase, which include the provision of clean cover across all soft landscaping within the developed site and the provision of ground gas protection measures to all proposed buildings. These additional measures are to be undertaken by subsequent developers of the site and are therefore, outside the scope of this Remediation Strategy. However, some commentary is provided in Section 12. Proposed verification of clean cover is provided in Section 11.

8.2 Pre-Remediation Material Classification

8.2.1 Underpinned by an extensive review of the site investigation data (borehole and trial pit logs, material descriptions and photographic records), VertaseFLI have identified three distinct classifications of Made Ground at the Site based on their visual content of physically 'undesirable' materials. These distinct classifications are summarised in Table 8-1.

Table 8-1. Distinct classifications of Made Ground across the site based on the visual content of physically 'undesirable' materials

Classification	Description
High Risk Materials	Comprises a high proportion of physically undesirable material within an aggregate/soil matrix. Physically undesirable materials include putrescible waste i.e., waste that can de-compose quickly, solid/liquid contamination (e.g. NAPL), drums, tanks, chemical containers, clinical waste, large quantities of asbestos containing materials, tires, waste electrical items, wood, plastic, carpets and other textiles, metal including household items such as pans, rubber / PVC.
Low Risk Materials C+D	Comprises a moderate proportion of physically undesirable material within an aggregate/soil matrix. Physically undesirable materials may include wood, plastic, textiles, asbestos containing materials, metal
Low Risk Materials	Comprises a low proportion of physically undesirable material within an aggregate/soil matrix. Physically undesirable materials may include wood, plastic, textiles, asbestos containing materials, metal at low/incidental quantities

8.2.1 Further explanation and visualisations of these material types can be found at Appendix B.

8.2.2 Each of the classifications of materials are to be excavated, processed and treated sufficiently to enable either their re-use on site and or disposal off site as explained in more detail in Section 9.0.

8.3 Areas and Depths

8.3.1 The spatial distribution of the physical material classifications described in Section 8.2 are illustrated in the Ground Model (Appendix B). An understanding of the spatial distribution is important as it indicates the likely areas where deeper excavation is likely to be required to maximise the feasible removal of undesirable materials from the Made Ground.

- 8.3.2 All Made Ground across the Site shall be excavated to natural ground or final floor level minus 1m (FFL-1m), whichever is encountered first.
- 8.3.3 Excavation beyond this depth may continue within areas of the site where the Made Ground extends deeper than FFL-1m (which occurs primarily within the infilled former clay pits). Excavation below FFL-1m shall be undertaken in accordance with a protocol for the deeper excavation of Made Ground, which is provided in Appendix F of this document.
- 8.3.4 Further details in relation to the excavation areas and depths are provided in Section 9.0 of this report.

8.4 Volumes

- 8.4.1 Initial minimum anticipated excavation volumes are presented in the Ground Model (Appendix B), however they are also summarised below in Table 8-1:

Table 8-2. Minimum anticipated excavation volumes

Material Classification	Volume (m3)
Topsoil	18,728
High Risk Materials	83,778
Low Risk Materials C+D	96,110
Low Risk Materials	73,631
Total Materials	272,247

8.5 Iterative Verification of the CSM

- 8.5.1 It is recognised by the project team, the EA and the EHO that at sites with complex ground conditions such as this, it is very difficult to address all uncertainties within the CSM prior to commencement of the remediation works.
- 8.5.2 Therefore, a traditional “fixed” remediation strategy underpinned by a CSM that is based solely on pre-remediation site investigation information, is impractical. Instead, some key assumptions made in the CSM shall be verified during the remediation works (see Section XX).

8.6 Dynamic Approach to Excavation Depth

- 8.6.1 Due to the limitations of the pre-remediation site investigation techniques (trial pits and boreholes), the characteristics (physical and chemical) of the Made Ground within the infilled clay pit below a depth of 3m has some residual uncertainty. The information available suggests that the deeper Made Ground primarily comprises inert materials (construction and demolition waste) with infrequently intermingled materials with descriptions that would imply having more 'hazardous' characteristics.
- 8.6.2 In view of this uncertainty, and coupled with the practicalities of excavating Made Ground significantly deeper than 3m, the EA have agreed that a dynamic approach to excavation can be adopted when excavating to depths >FFL-1m. This approach can be implemented when the deeper Made Ground is accessible and visible, which will only occur during the works. As such, the dynamic approach to excavation provides a framework for decision making on site during the excavation works to inform whether excavation should continue or cease.
- 8.6.3 To help inform the dynamic excavation strategy, a detailed 3D ground model that was prepared (Appendix B), which enabled the definition of areas of differing material types and the maximum likely excavation depth for these material types. This ground model used the terms "low risk material", "low risk materials comprising construction and demolition waste" and "high risk materials" to help classify the materials based on the quantity of undesirable materials present within them (see Section 8.2).
- 8.6.4 However, based on further discussion with the EA (on 11th September 2024), a revised protocol has been developed (Appendix F – titled *Dynamic Strategy -Deeper Excavation Protocol Rev B*), which is applicable in all areas of the site where artificial ground extends greater than FFL-1m (this applies primarily to the infilled former brick pits).

8.7 Compliance Points

- 8.7.1 Compliance points to derive risk-based re-use criteria for excavated Made Ground that are protective of pollution risks to Controlled Waters (Section 8.8) have been set based on guidance published by the

Environment Agency (Guidance on Land Contamination Groundwater Compliance Points: Qualitative Risk Assessments dated March 2017) and discussion with the Environment Agency.

- 8.7.2 The guidance states that where pollutants have already entered groundwater (as is the case at this Site due to the age and depth of the Made Ground) the priority is to take all necessary and reasonable measures to:
- Minimise further entry of contaminants where there is a defined source.
 - Limit the pollution of groundwater or any effect on the status of the groundwater body from the future expansion of the plume, if necessary, by actively reducing its extent.
- 8.7.3 "Reasonable" is defined by the guidance as feasible without involving disproportionate costs.
- 8.7.4 Compliance points adopted here to enable the derivation of risk-based re-use criteria for excavated Made Ground are summarised in Table 8-3. The primary purpose of the compliance points is groundwater resource protection (i.e., protection of groundwater present in the Secondary A Aquifer).
- 8.7.5 The default compliance point distance for resource protection from the contaminant source is 50m for (i) all hazardous substances in all aquifers for contaminants already in the groundwater or from inputs from soils and the unsaturated zone which can't be prevented; or (ii) non-hazardous pollutants in groundwater with strategic resource potential.

Table 8-3. Summary of compliance points to used to derive risk-based re-use criteria that are protective of groundwater resources

Compliance Point	Contaminants
Unsaturated zone soils above the groundwater table (Level 1 assessment in the context of the Remedial Target Methodology)	Hazardous substances that are present in the Made Ground but have not entered groundwater at concentrations above limits of detect (i.e., polychlorinated biphenyls – PCBs)
Groundwater in the saturated zone at a maximum distance downgradient of the source area of 50m (Level 3 assessment in the context of the Remedial Target Methodology)	Hazardous and non-hazardous substances that have already entered groundwater (TPH, PAHs, VOCs/SVOCs, metals)
Notes: At the request of the Environment Agency, a sensitivity analysis has been applied to the Level 3 assessment compliance point to consider shorter distances of 10m and 25m, in addition to 50m	

8.8 Re-Use Criteria for Excavated Made Ground

8.8.1 The establishment of re-use criteria (physical and chemical criteria) for excavated Made Ground is an essential element of remediation design because, in the context of this strategy, the criteria directly influence the following:

- What material is technically suitable for re-use on Site in the context of Planning, Permitting and Waste Legislation.
- The assessment of whether treatment is required at the point of excavation to make the material suitable for re-use.
- The design of the treatment process required to modify initially unsuitable material to ensure it becomes suitable for re-use.
- The treatment endpoint (i.e., the point at which treatment can cease)
- The status of the material in the context of waste classification (i.e., demonstrating that a material is suitable for re-use and will not lead to overall adverse environmental or human health impacts is a primary element of demonstrating that it has ceased to be a waste).

- 8.8.2 Re-use criteria for excavated Made Ground are summarised in Table 8-4.

Table 8-4. Re-use criteria (physical and chemical) for excavated Made Ground

Re-Use Criteria
Particle Size Distribution (PSD) that is in-keeping with a classification of acceptable earthworks material in the Specification for Highway Works (SHW) Series 600 – the purpose of this is to ensure that the material is capable of undergoing compaction using commercially available compaction plant to minimise air void content and minimise future settlement potential
A composition that is in-keeping with the permitted constituents for acceptable earthworks materials (including recycled materials) in SHW Series 600 and/or does not disproportionately increase the settlement, pollution or gas generation potential
Degradable organic carbon content that is in-keeping with a ground gas regime for which the risks to receptors (buildings and human health) can be managed via the inclusion of passive ground gas protection measures in buildings (i.e., up to and including Characteristic Situation 3). This shall be taken to be $\leq 4\%$ by mass of degradable organic carbon in materials placed below buildings and infrastructure based on CL: AIRE Research Bulletin 17 (RB17)
Concentrations of soluble contaminants of concern (i.e., risk driving contaminants identified to be present through previous site investigation) that do not exceed risk-based criteria derived using the EA Remedial Targets Methodology to ensure target concentrations are not exceeded at relevant compliance points (see Section 8.7 for discussion on compliance points). The concentrations in the materials intended for re-use shall be measured via a combination of solid and leachate testing.
The list of contaminants of concern and their risk-based criteria is provided in Table 8-5, Table 8-6, Table 8-7

- 8.8.3 The detailed quantitative risk assessment produced by VertaseFLI (2023) demonstrated that concentrations of organic contaminants present in the perched groundwater (assumed to be in equilibrium with their concentrations sorbed to Made Ground) do not pose unacceptable risks to Controlled Waters. The risk assessment also indicated that metals and inorganics may pose a risk of pollution to groundwater within the Secondary A aquifer, however the options appraisal (Section 4.0) demonstrates that conducting remediation works to address this risk is unsustainable (as the cost and impact outweighs environmental benefit).
- 8.8.4 Therefore, the re-use of excavated Made Ground (after treatment to remove unacceptable materials) shall not increase pollution risks to

Controlled Waters or lead to further deterioration in the quality of groundwater relative to target concentrations (e.g., Environmental Quality Standards for surface freshwater). Nevertheless, risk-based criteria for key contaminants of concern have been derived to confirm that treated materials remain suitable for re-use after treatment (Table 8-5, Table 8-6 and Table 8-7).

- 8.8.5 The contaminants of concern represent a comprehensive list of hazardous and non-hazardous substances that are known to be present within the Made Ground based on the previous site investigation works.
- 8.8.6 For hazardous substances that have not been detected in groundwater, the criteria have been derived assuming a compliance point at the base of the unsaturated zone (Level 1).
- 8.8.7 For hazardous and non-hazardous substances that are known to have already entered groundwater, the criteria have been derived assuming a compliance point within groundwater downgradient of the source area (Level 3). A distance to compliance point of 50m has been assumed (see Section 8.7), albeit shorter distances of 10m and 25m have been used to inform a sensitivity analysis (see worksheets in Appendix H).
- 8.8.8 The sensitivity analysis (with respect to the distance to compliance point) confirms the known sensitivity of the re-use criteria to the distance.

Table 8-5. Risk-based re-use criteria for contaminants of concern present in materials that have not already entered groundwater

Contaminant	Criteria for Solid (mg/kg)	Criteria for Pore-Water (mg/L)
PCBs	23.2	0.001

Notes:

Calculated using Level 1 of remedial targets methodology. Worksheets are provided in Appendix H

Table 8-6. Risk-based re-use criteria for organic contaminants of concern present in materials that have already entered groundwater (assuming a 50m compliance point)

Contaminant	Criteria for Solid (mg/kg)	Criteria for Pore-Water (mg/L)
Aliphatic C5-6	824	70.2
Aliphatic C6-C8	3,760	70.2
Aliphatic C8-C10	594	1.4
Aliphatic C10-C12	2,320	0.69
Aliphatic C12-C16	51,900	0.69
Aliphatic C16-C35	5,560,000	0.69
Aromatics EC5-EC7	0.284	0.234
Aromatics EC7-EC8	1.08	0.346
Aromatics EC8-EC10	31.5	1.4
Aromatics EC10-EC12	7.33	0.207
Aromatics EC12-EC16	14.6	0.207
Aromatics EC16-EC21	41	0.207
Aromatics EC21-EC35	365	0.207
Anthracene	0.0182	0.00023
Benzo(a)pyrene	1.12	0.000621
Benzo(b)fluoranthene	0.0573	0.0000391
Benzo(ghi)perylene	0.11	0.0000189
Benzo(k)fluoranthene	0.081	0.0000391
Fluoranthene	0.0704	0.000276
Indeno(123-cd)perylene	0.28	0.00023
Naphthalene	2.78	0.299
Phenol	0.0554	0.0836
Chloroform	0.0664	0.069
Bis(2-ethylhexyl) phthalate	31.3	0.0141
PFOS	0.556	0.039

Notes:

Calculated using Level 3 of remedial targets methodology. Worksheets are provided in Appendix H for distances of 50m, 25m and 10m.

Table 8-7. Risk-based criteria for inorganic contaminants of concern present in materials that have already entered groundwater (assuming a 50m compliance point)

Contaminant	Criteria for Solid (mg/kg)	Criteria for Pore-Water (mg/L)
Arsenic	5.11	0.0102
Boron	21	2.04
Cadmium	0.0256	0.000256
Chromium	23.1	0.00481
Chromium VI	0.0635	0.00348
Copper	2.2	0.0219
Lead	14.3	0.0143
Manganese	126	0.126
Mercury	0.0358	0.0000716
Nickel	17.4	0.0348
Vanadium	0.263	0.0204
Zinc	1.18	0.0309
Iron	1,640	1.02
Total Cyanide	68,600	13,000

Notes:

Calculated using Level 3 of remedial targets methodology. Worksheets are provided in Appendix H for distances of 50m, 25m and 10m.

9.0 Remediation Strategy Implementation

9.1 Roles and Responsibilities

9.1.1 VertaseFLI is a specialist remediation contractor that has been appointed by the Client to deliver the Remediation Contract for the scheme.

9.1.2 VertaseFLI will also be responsible for a programme of site enabling works implemented as part of the Site wide remediation to create a suitable platform for the proposed development.

9.1.3 The relevant stakeholders for the Site remedial works are outlined below.

Contractual parties:

CDM Client:	NUVU Developments Limited
CDM Principal Contractor	VertaseFLI Limited
CDM Principal Designer	TBC
Cost consultant to NUVU	CPC
JCT Supervisor and technical advisor to NUVU	Wardell Armstrong

9.1.4 Other relevant parties:

CDM Contractor – Remediation	VertaseFLI Limited
Remediation Verification Designer	VertaseFLI Limited
Ground gas technical advisor	EPG

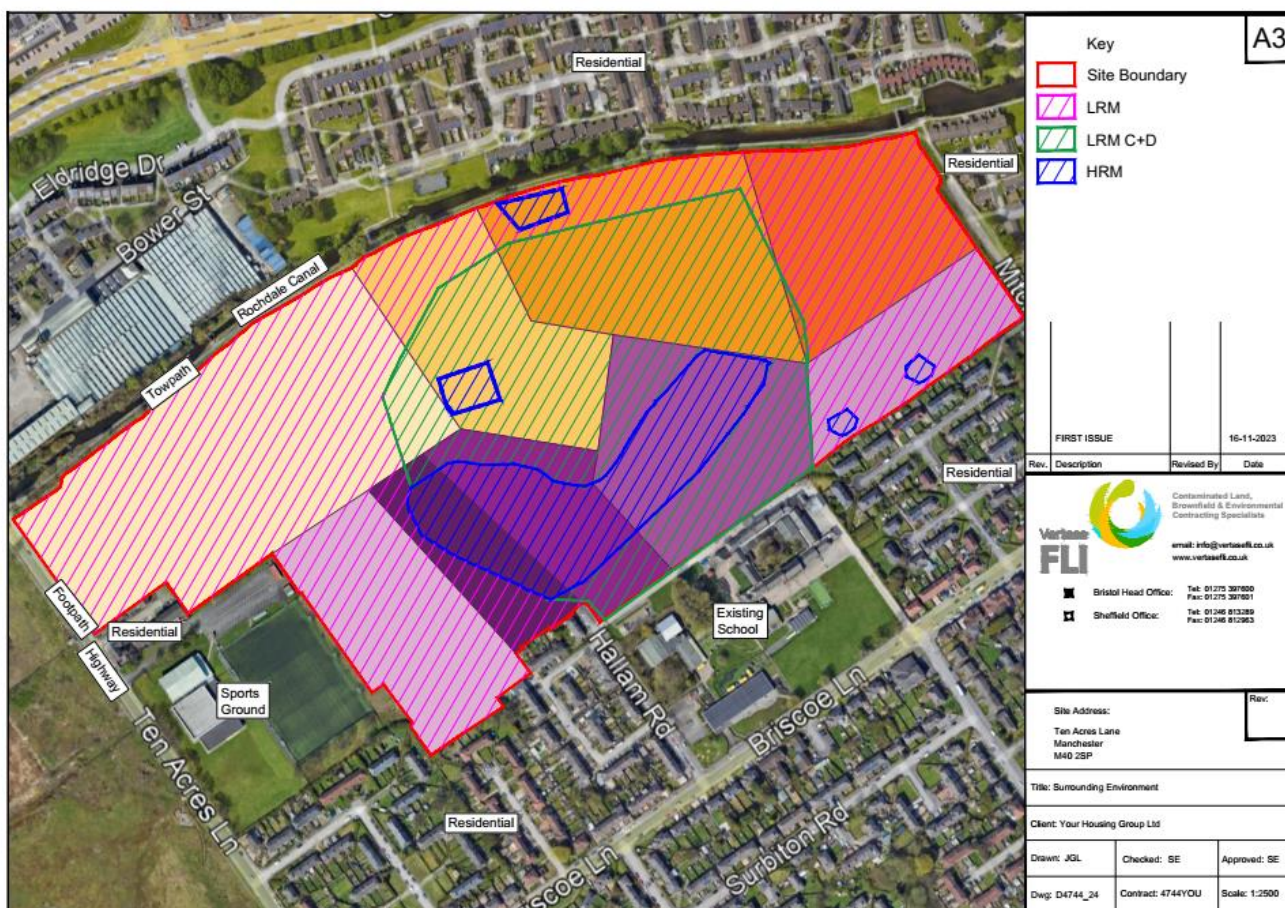
9.2 Programme and Durations

9.2.1 In order to meet deadlines associated with the drawdown and use of grant funding secured for the development, it is the Client's intention for the Main Remediation Phase works to commence on Site in March 2024.

- 9.2.2 As described in Section 1.1, to support this programme, VertaseFLI has been employed under a pre-contract services agreement to address the requirements of the outstanding pre-commencement planning conditions associated with the proposed land remediation works.
- 9.2.3 The proposed remediation works shall aim to maximise the onsite re-use of materials, to minimise off-site disposal and maximise the sustainability of the overall scheme. Re-use of materials, in the context of the Waste Framework Directive and its implementation into UK legislation and regulation shall also be considered and are further detailed in Section 5.3.
- 9.2.4 It is currently envisaged that the site remediation will be completed in a single phase of works over a period of 24 months, planning ref: 129197/FO/2021. A programme of works is included in Appendix G.
- 9.2.5 The onward development, covered by planning ref: 133700/FO/2022, shall be constructed in two phases. Phase 1 of the development is located in the western half of the Site. Phase 2, which includes the secondary school, is located in the eastern half of the Site.

9.3 Surrounding Environment

- 9.3.1 In the context of the remediation works proposed, we have assessed the surrounding environment, the aim of which is to understand and incorporate impact reduction into the remediation strategy and implementation.
- 9.3.2 These environs are shown below and in Appendix E as *Drawing D4744_24 Surrounding Environment*.



- 9.3.3 The Site is bound by the Rochdale Canal and a series of locks to the north. The canal flow west. A footpath is adjacent to the Canal and is well used by members of the public. Residential properties are situated on the adjacent side of the canal.
- 9.3.4 Mitchell Street and residential properties are adjacent to the to the eastern boundary.
- 9.3.5 The southern boundary is adjacent to the back gardens of residential properties of Briscoe Lane, as well as Briscoe Lane Academy School.
- 9.3.6 Ten Acres Lane and Ten Acres Lane Sports complex lie to the west of the site. On a recent site walkover, ochreous discharge was identified at the Ten Acres Lane end of the site (thought to be emanating from site) as shown below on photographs 01 to 03. Whilst this is visible under high rainfall entering the canal it does not appear to be making a visual impact currently within the waterbody.



Photograph 01



Photograph 02



Photograph 03

- 9.3.7 This will be further investigated, and remedial works incorporated into the remediation strategy to address this.
- 9.3.8 No sensitive sites (SSSIs, RAMSARs, SACs etc) lie within 500m of the Site. However, it should also be noted that the Rochdale Canal Special Area of Conservation (SAC)/ Site of Special Scientific Interest (SSSI) is approximately 1.5 km from the Site. A non-designated stretch of this canal borders the Site to the north.
- 9.3.9 Further consideration of surrounding environs is provided in the Ground Model, Appendix B.

9.4 Access/Egress and Traffic Movements.

- 9.4.1 Details of the proposed traffic management at the site during the remediation works, is presented as Section 08 in the VertaseFLI Construction Environmental Management Plan (CEMP) document which has been submitted to Manchester City Council Pursuant to the release of conditions 3&4 as briefly summarised below. For full planning condition wording, refer to Appendix D.

Condition 3) Prior to the commencement of development, a detailed construction management plan outlining working practices during development shall be submitted to and approved in writing by the local planning authority.

Conditon 4) Prior to the commencement of development, a detailed construction environmental management plan outlining working practices during development shall be submitted to and approved in writing by the local planning authority.

- 9.4.2 As summary of the proposed Traffic Management at the Site, including details on Access/Egress is provided below:
- 9.4.3 During each phase of the works traffic assessments will be undertaken throughout the works to minimise the impacts of traffic movement, on the surrounding road network, and impact to the general public.
- 9.4.4 It is proposed that all construction traffic will access the site at the gated entrance on Ten Acres Lane. The location of the access is shown in Appendix E as *Drawing D1932_24 Traffic Route*.
- 9.4.5 This main entrance was more recently constructed wide enough and sufficiently set back from the main carriage way to allow articulated waggons and low loaders access to the site unhindered. This access proved sufficient during the tree removal phase undertaken in the winter of 2022, when low loaders brought large plant to site, and articulated waggons removed from site large quantities of felled trees and green waste.
- 9.4.6 All HGV traffic will approach the site from the North and turn left into the site. All HGV traffic will leave the site and turn right towards the north and the A62. This methodology is designed to avoid the low bridges on Ten Acres Lane and Briscoe Lane to the South where these roads cross under the railway, and to limit the passage of HGV traffic through residential areas as far as possible. Cars and LGV will approach and leave the site in either direction.
- 9.4.7 During the site preparation, earthworks and remediation phases of the proposed development, an increase in HGV traffic may be experienced

on the local road network. However, it is anticipated that the increase in the number of HGV movements to and from the Site would not be significant. The proposed routing of HGVs will direct vehicles to the A62 and the M60 at Junction 22 where necessary.

- 9.4.8 Where possible, the times of arrival and departure of vehicles from the site will be planned (at site level) to limit additional traffic during identified peak times, thus minimising disruption to the local road network.
- 9.4.9 All persons engaged in the site preparation, enabling and remediation phases entering the Site in an HGV will be provided in advance with a copy of the Construction Traffic Management Plan drawing to ensure that it is followed. This is issued to suppliers and subcontractors by the Principal Contractors procurement team at the time of instruction.
- 9.4.10 Appropriate signage will be erected to direct traffic at the site entrance and a banksman / gateman will be provided where necessary.
- 9.4.11 The movement of construction vehicles along sensitive roads, wherever possible, will be prevented/minimised through consultation and ongoing engagement with Manchester City Council and other partners.
- 9.4.12 Movement of HGVs will be restricted at peak times when possible, to lighten the vehicular traffic upon the route onto Ten Acres Lane and the junction with the A62.

9.5 Ecology

- 9.5.1 There is potential risk from contamination in perched/shallow groundwater and silt laden run-off entering the non-designated section of the Rochdale Canal that is adjacent to the Site. These risks will be mitigated/controlled by the surface water management measures described in Section 9.4 of this document.
- 9.5.2 During the remediation phases, VertaseFLI will be responsible for avoiding, reducing or compensating for any adverse biological effects. Mitigation measures may include but not be limited to the following:
- 9.5.3 Removal of vegetation with the potential to support nesting birds should, wherever possible be undertaken outside the bird nesting period. If any active clearance work has to be undertaken during the

main nesting season, this would only be undertaken under the supervision of a qualified ecologist. At the time of writing, all tree clearance works have been undertaken on Site. Only stumps, roots and low-lying vegetation remains to be cleared.

- 9.5.4 The mitigations measures to be employed on Site are in accordance with Condition 17 of the Planning ref 129197/FO/2021 as detailed below:

Condition 17) No removal of or works to any tree and shrubs shall take place between 1st March and 31st August inclusive unless a competent ecologist has undertaken a careful, detailed check of vegetation for active birds' nests immediately before the vegetation is cleared and provided written confirmation that no birds will be harmed and/or that there are appropriate measures in place to protect nesting birds interests on-sit. Any such written confirmation should be submitted to the local planning authority.

9.6 Temporary Surface Water Drainage Strategy

- 9.6.1 This section of the document has been developed to address Planning Condition 14 as detailed below:

Condition 14) No development shall take place until a document highlighting a temporary surface water drainage strategy, designed in accordance with Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards, has been submitted to and approved in writing by the Local Planning Authority. The development shall be implemented in accordance with the approved temporary surface water drainage system.

- 9.6.2 Adequate prevention measures will be employed to ensure water management throughout the remediation phase. The control of contaminated and wastewater is crucial throughout the project for the protection of controlled waters and surrounding environment.
- 9.6.3 Surface water runoff on site has historically collected / ponded on the southern boundary of the site, the current landowner installed a collection trench system along this boundary and a means of water

treatment in December 2022. This system has function well since its installation and has prevented surface water running off the site.

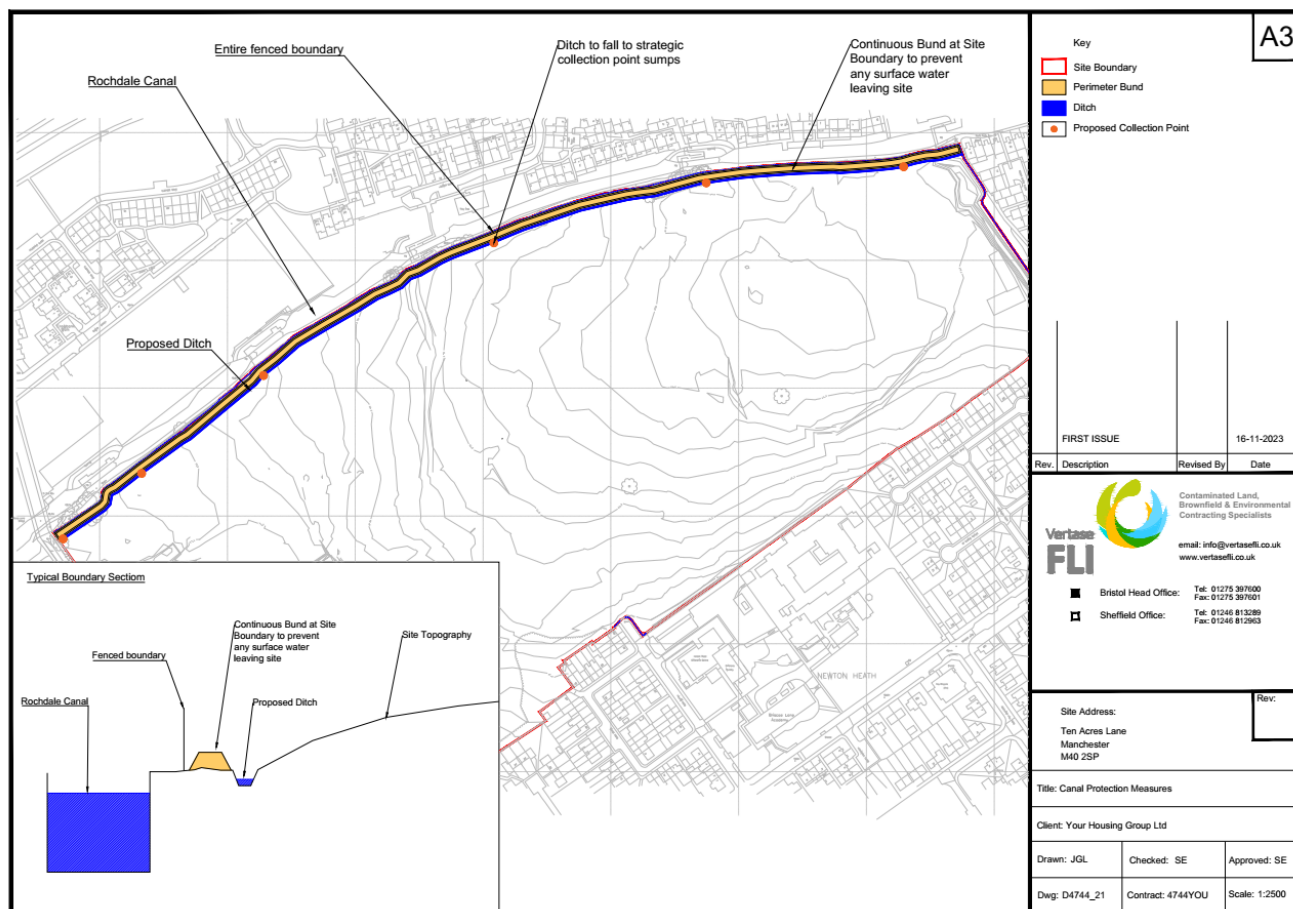
- 9.6.4 The existing collection trench is shown in Appendix E as *Drawing D1932_25*.
- 9.6.5 It is our intention to utilise and maintain this collection trench system for as long as feasibly possible to aid in the collection and control of surface water. The trench will be extended where required should other low points on the southern boundary be identified.
- 9.6.6 Where the site has generally higher ground i.e., to the north and east shallow earth bunds will be created to prevent localised surface water from running off the site. Localised surface water will be collected in temporary sumps and pumped to the collection trench.
- 9.6.7 Water encountered within excavations and low points on site will be pumped via the existing collection trench and on-site water treatment plant to reduce contaminant concentrations to acceptable levels prior to consented discharge.
- 9.6.8 The water treatment plant will be located on an impermeable bunded pad. The pad and bund will be subject to repair as required, to ensure that there is no further risk to subsurface/controlled waters in the event of system failure. Any build-up of rainwater or spillage water will be held within the bund and passed through the treatment plant for consented discharge.
- 9.6.9 Wherever safe and practical to do so, open-top vessels will be covered.
- 9.6.10 Treated wastewater from site operations will be discharged in accordance with the conditions set by United Utilities.

9.7 Protection of the Canal Infrastructure

- 9.7.1 There is a possibility, although the likelihood is low, that lateral migration of groundwater beneath the site toward the Rochdale Canal located to the North of the Site, could occur. There is some evidence of seepage of water from the edge of the site to the canal footway.
- 9.7.2 The Rochdale Canal was constructed in the late 1790's and early 1800's. Canals at this time were generally excavated to between 4ft and 6ft (1.22m and 1.83m) and the current maximum boat draught for

passage on the Rochdale Canal is 3ft 9in (1.14m). Site investigation locations along the northern boundary of the site, from WA and Celtic investigations, have recorded clay Glacial Till to depths in excess of 3m bgl. Therefore, it is considered likely that, in the absence of information with regard to an engineered liner, the canal is, at the very least, naturally clay lined. This assumption, that the canal is isolated with respect to groundwater from the site, is supported by the difference in of water levels in the canal with respect to the perched groundwater levels within boreholes screened within the Made Ground on site.

- 9.7.3 The Wardell Armstrong SI data indicates that contaminants recorded within surface water are, generally, not consistent with those recorded in groundwater samples from boreholes screened within the perched groundwater within Made Ground.
- 9.7.4 There is, currently, the possibility that contaminants may enter the canal through surface run-off due to the topography of the site in respect to the canal and it is noted that some seepages currently occur along the length of the site. However, this will be addressed through the remediation and development of the site. in the short term this will be managed with some localised improvement with some temporary drainage/management during remediation works.
- 9.7.5 Throughout the remediation works, management of surface water will be undertaken as per Section 9.6, however, to fully comply with Condition 18 of Planning Ref: 129197/FO/2021 as summarised below, additional mitigation measures will be employed as described hereafter.
- Condition 18) Prior to the commencement of onsite remediation works, finalised details of measures intended to protect the canal corridor from pollution and contamination.*
- 9.7.6 Along the sites frontage with the Canal tow path in the North of the Site, surface water runoff will be intercepted by placement of a physical earth bund barrier and collection trench. This barrier will be regularly monitored, and any defects immediately rectified. As required, surface water will be pumped from the collection trench) to a suitable storage area on site and away from the site boundary. This canal protection measure is shown below and in Appendix E as Drawing D4744_21 *Canal Protection Measures*.



- 9.7.7 During site monitoring, water levels on site will be recorded and managed to prevent water discharge into the canal during the works. Water encountered within excavations and low points on site will be pumped via the existing collection trench and on-site water treatment plant to reduce contaminant concentrations to acceptable levels prior to consented discharge.
- 9.7.8 The water treatment plant will be located on an impermeable bunded pad. The pad and bund will be subject to repair as required, to ensure that there is no further risk to subsurface/controlled waters in the event of system failure. Any build-up of rainwater or spillage water will be held within the bund and passed through the treatment plant for consented discharge.
- 9.7.9 Existing redundant drains and other connections and pathways to the canal will be traced and blocked off during the remediation works.
- 9.7.10 Measures are also necessary to reduce dust and windblown debris from the site entering the canal.

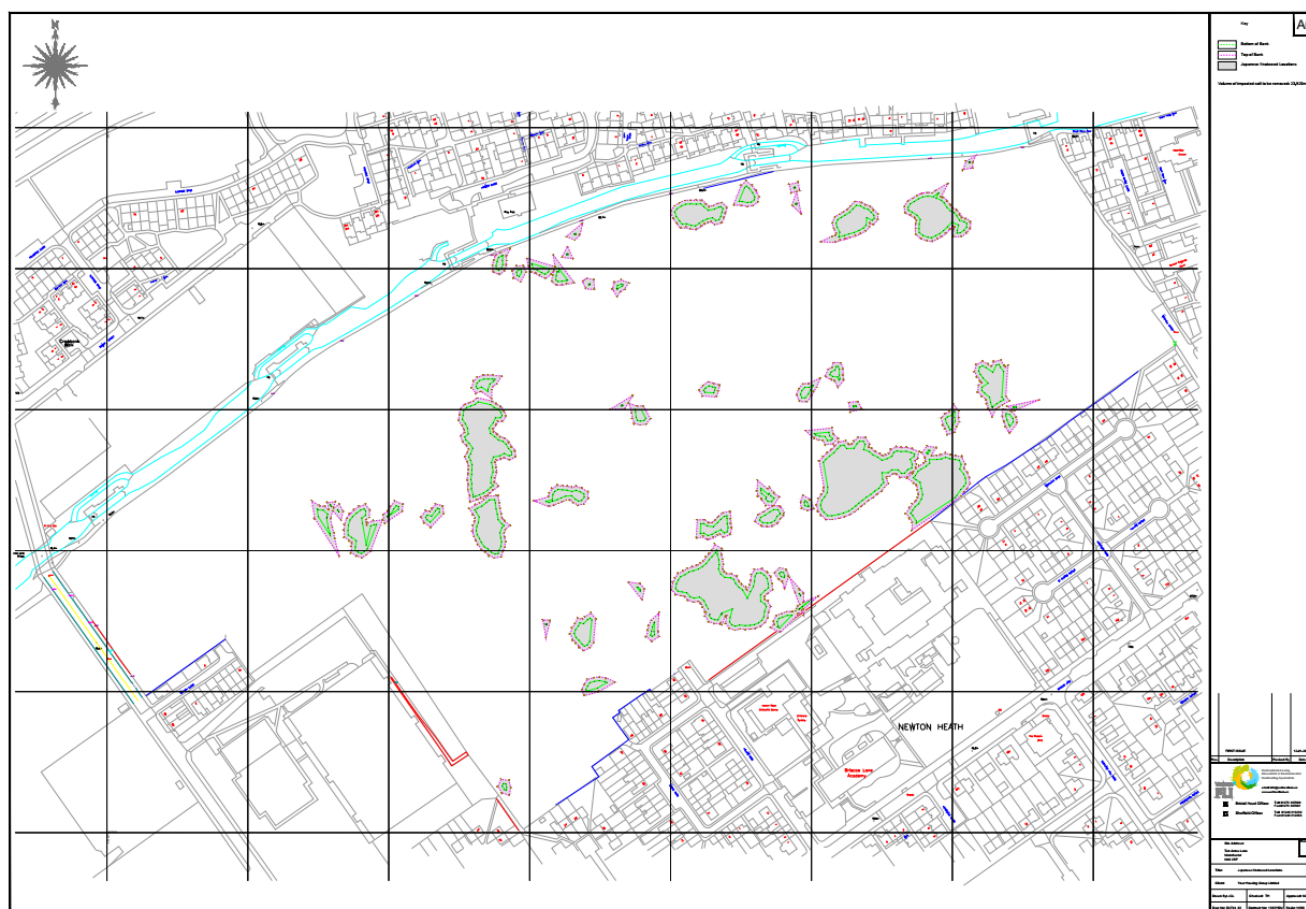
9.7.11 Full details of the proposed dust management procedures are provided as Section 09 of the *VertaseFLI (2023). Construction Management Plan & Construction Environmental Management Plan. For Nuvu Investments Ltd. Rev 04. November 2023* but are summarised below:

- Dust is considered to be generated primarily by activities such as demolition, on site vehicle movements, tipping of materials from vehicles, materials treatment operations including screening, crushing, stockpiling, and reinstatement activities.
- The VertaseFLI Site Manager, nominated deputies and all site staff, following the necessary site inductions and toolbox talk, will proactively manage the works to minimise the raising of dust and controlling risk. Such control procedures will include, where appropriate.
- The use and maintenance of good quality site roads, and the suppression of dust on haul roads through the implementation of a tractor and bowser to dampen down running surfaces.
- Enforcing speed limits of site plant along site access and haulage roads.
- Using dust suppression misters / spray bars during treatment works as required.
- Suspending certain works during unfavourable weather conditions if wind is blowing towards or dust is identified beyond site boundaries.
- Carrying out operations with the potential to generate significant dust away from the sensitive receptors whenever possible.
- Minimise tipping height from which materials are dropped from excavator buckets onto the ground or into lorries.
- Use of modern and properly maintained mobile plant.
- Implementation and maintenance of wheel washing facilities to minimise the deposition of mud / dust on the public highway.
- The VertaseFLI Site Manager / Environmental Engineer shall assess dust and its impact upon neighbours throughout the working day.

- 9.7.12 To safeguard the stability and structural integrity of the canal, the following mitigation measures will be employed:
- A suitable stand off from the edge of the towpath closest to the site boundary will be established. This is to be agreed on site with the Clients engineer/representative and The Canal and River Trust.
 - Excavations closest to the canal are anticipated to be predominantly shallow (1mbgl turnover) and will include suitable batters to be edge of the site/agreed standoff from the tow path.
 - Where deeper excavations are required close to the site boundary with the canal tow path, (currently envisaged as 1 small section of HRM), excavations will be overseen by the VertaseFLI in house temporary works designer to ensure that any risks are identified and that appropriate mitigation measures are employed. Visual inspections of the canal will be undertaken daily by the VertaseFLI site manager and/or engineer.
 - During the production of this Remediation Strategy, ochreous discharge was visually identified during a site walk over. This discharge appeared to be emanating from the Ten Acres Lans end of the site. During the remediation works, this will be investigated, and appropriate remedial measures taken.

9.8 Japanese Knotweed -Non-Native Species Management Plan.

- 9.8.1 There is extensive, low-quality vegetation across the whole of the site. This includes stands of Japanese Knotweed which is in the process of tri-annual herbicide treatment. Areas of identified Japanese Knotweed are shown below and in Appendix E as *Drawing D4744_02 Japanese Knotweed Locations*.



Drawing D4744_02 Japanese Knotweed Locations.

- 9.8.2 Upon mobilising to Site, the invasive species will be removed in the affected areas as highlighted above.
- 9.8.3 Japanese Knotweed will be hand cut to remove the above ground portion where possible. Cut material will be stockpiled in the area that it has been cut from as far as possible.
- 9.8.4 All above ground clearance works will be conducted in conjunction with the ecological clerk of works.
- 9.8.5 Following above ground clearance, obvious areas of Japanese Knotweed infestation shall first be excavated under the close supervision of a suitably qualified and experienced specialist. Prior to any excavation works, a permit to dig will be issued.

- 9.8.6 The specialist shall direct the excavation and confirm horizontal and vertical extent of these initial excavations based upon actual infestation depths and horizontal extents.
- 9.8.7 Once all infested soils have been removed, verification shall include an element of trial pitting at certain locations to confirm the absence of any viable invasive plant materials.
- 9.8.8 Excavated soils and Japanese Knotweed vegetation shall be transported to the quarantine area or filling areas as shown below or in Appendix E as *Drawing D4744_25 Japanese Knotweed Buried Cell Locations*. Any quarantine area shall be rolled and lined with a suitable protective membrane or situated on hardstanding to prevent cross contamination of the underlying soils. To prevent spillage during transport, dumper trucks will not be over filled. Dump trucks will not be permitted to travel over areas know to be contaminated with invasive weeds.
- 9.8.9 Japanese Knotweed fill areas will be lined with root membrane and upon completion of filling, covered to create a cell of Knotweed materials. This area will be surveyed as added to applicable 'As-built' documentation.

9.9 Phasing & Sequencing

- 9.9.1 Remediation works will be undertaken in a single phase but will progress through the site in two directions with two excavation teams working broadly concurrently. The remediation progression and sequencing outline is shown below Appendix E as *Drawing D4744_18 Proposed Remediation progression and sequencing*.



Drawing D4744_18 Proposed remediation progression & sequencing.

9.10 Remediation Preparatory Works

9.10.1 The following preparatory works are anticipated prior to the excavation phase of remediation works.

- Dilapidation surveys
- Existing borehole condition survey and installation of Monitoring Wells
- Ecological Surveys
- Erect Site Wide fencing/hoarding and Tree Protection
- Remove vegetation and root balls.
- Removal of Fly tipped waste.

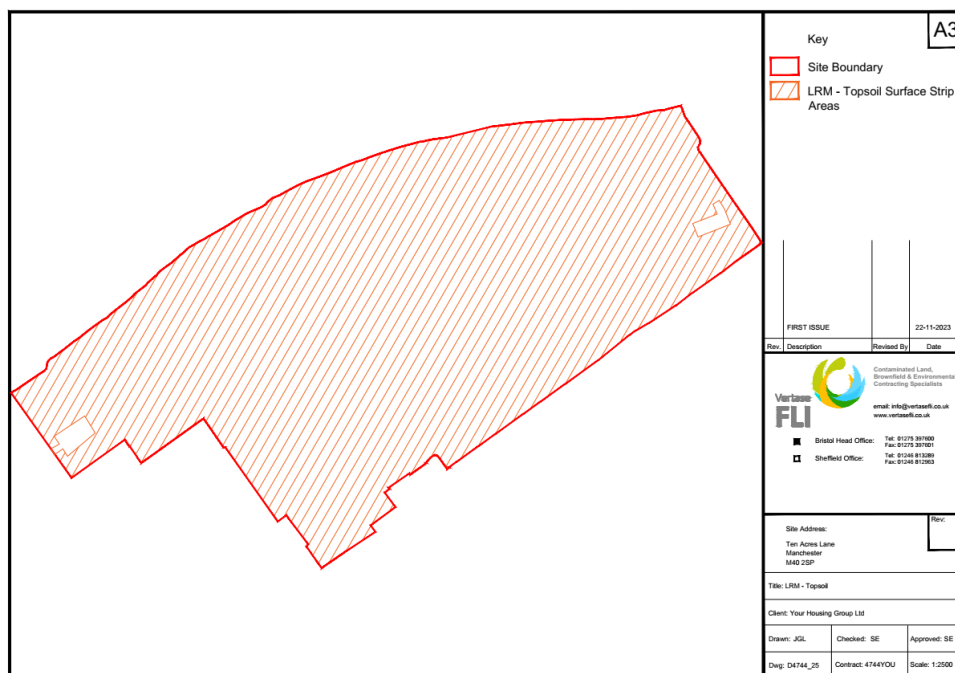
- Excavate, sort and stockpile Japanese Knotweed (please refer to Section 9.8 for details on the proposed treatment of Japanese Knotweed)
- Removal surface vegetation and root mat materials
- Construction of Access/haul road into site
- Groundwater sampling and analysis

9.11 Remediation Compound & Processing/Treatment Area

- 9.11.1 The remediation compound comprising welfare, contractor parking, storage etc. will be situated at a pre-agreed location accessible to the Site entrance.
- 9.11.2 All processing of soils will be undertaken in a dedicated treatment/processing area constructed to the north of the site, on a newly installed concrete slab.
- 9.11.3 The slab will be appropriately bunded to ensure no run off of surface water to surrounding land. Suitable drainage will be installed to ensure that surface water/leachate run off is collected and treated prior to discharge to foul sewer under a trade effluent discharge consent from United Utilities.

9.12 Topsoil

- 9.12.1 Topsoil will be segregated from engineering material. Root balls will be separated for off-site recycling or shredding for retention in landscaping on site. All topsoil will be sampled, tested and assessed for re-use on site where possible. Details of suitable and unsuitable materials for retention or disposal will be provided to the client.
- 9.12.2 Areas of topsoil are shown below and in Appendix E as *Drawing D4744_25 LRM Topsoil*.



9.13 Additional Site Investigation

9.13.1 The CSM which underpins the detailed risk assessment, which in turn informs the remediation strategy, makes the following key assumptions:

- 1) The contaminant concentrations in the Made Ground have been accurately characterised by WA and the maximum measured concentrations reported by WA in perched groundwater for each contaminant are representative of the entire mass of Made Ground (i.e., there are not substantial pockets of Made Ground/perched groundwater with significantly elevated contaminant concentrations relative to the maximum already recorded).
- 2) The hydraulic conductivity of the glacial till is equal to or less than 1×10^{-7} m/s.
- 3) There is no hydraulic connectivity between perched groundwater in the Made Ground and the surface water in the Rochdale Canal.

9.13.2 The additional site investigation during the remediation works will seek to confirm that these assumptions hold true. The additional data shall

support post-remediation risk assessment as part of the verification of the effectiveness of the remediation.

9.13.3 The proposed site investigation works are split into four specific tasks as detailed below as:

- SI TASK A: Exploratory Trial Pits
- SI TASK B: Deep Borehole Drilling
- SI TASK C: Hydraulic Conductivity Testing
- SI TASK D: Use of sentinel wells to confirm absence of hydraulic connectivity with the canal.

9.13.4 Each of these tasks are described in detail below.

SI TASK A) Exploratory Trial Pits.

9.13.5 During the excavations works, soil samples will be undertaken on a frequency of 1 per 625m² (25m x 25m grid) across the site where made ground could remain below sub-formation level. Exploratory holes (whether trial pits or boreholes as per ST TASK B) will progress, where practicable, until the base of made ground is proven.

9.13.6 A responsive approach will be taken to the frequency of collection of soil samples. Depth of sampling increments will be based on significant changes in strata.

9.13.7 Arisings will be logged, and soil samples will be sent to a UKAS and MCERTS accredited laboratory for soil and leachate testing for the contaminants of concern identified in the detailed quantitative risk assessment. These comprise TPH CWG fractions, PAHs, phenol, chloroform, bis(2-ethylhexyl) phthalate, metals and cyanide.

9.13.8 In addition, 10% of soil samples will be analysed for PFAS.

SI TASK B) Deep Borehole Drilling

9.13.9 In areas limited by the deepest made ground, beyond the reach of an excavator, data would be collected by the drilling of boreholes. These would be for exploratory purposes only and would not necessarily be installed for use as permanent wells. However, the overlap of data

collection for SI as above and installation of new monitoring wells for PFAS groundwater sampling as described in Section 9.15 will be considered at site level.

- 9.13.10 Frequency of exploratory holes, frequency of soil sampling and analysis will be as per section 9.13.5, 9.13.6 and 9.13.7.

SI TASK C) Hydraulic Conductivity Testing

- 9.13.11 Existing wells (supplemented by new wells if required) around the edges of site will be used to undertake falling/rising head tests in Glacial Till, to confirm hydraulic conductivity.

SI TASK D) Use of sentinel wells to confirm absence of hydraulic connectivity with the canal.

- 9.13.12 Several existing sentinel wells along the northern site boundary will be identified for use in the SI works. New wells may also be installed as required.
- 9.13.13 Regularly and throughout the works, groundwater levels within sentinel wells and the canal will be monitored and communicated to the VFLI risk assessors.

9.14 Contingency Planning

- 9.14.1 The additional site investigation undertaken during the remediation works seeks to confirm the CSM on which the risk assessment, remediation options appraisal and remediation strategy are designed.
- 9.14.2 If the additional testing identifies significantly elevated contaminant concentrations relative to those already assumed by the pre-remediation CSM, VertaseFLI have developed a robust contingency plan.
- 9.14.3 The contingency plan comprises:
- a) Re-visit of the risk assessment and subsequent discussions with the EA; and

- b) Commitment to discuss with the EA and the client, additional localised source reduction within the context of the known constraints.

9.14.4 During the additional site investigation works, data will be collated and shared with the EA to enable collaborative decision making. This will ensure that decisions can be made quickly and robustly to the satisfaction of all stakeholders.

9.15 PFAS: Groundwater Sampling Prior to Remediation Works

9.15.1 VertaseFLI shall build upon the investigation work already completed in relation to PFAS. This shall include additional sampling of groundwater to undergo PFAS testing prior to commencement of excavation.

9.15.2 The additional groundwater samples shall be obtained from the high-risk materials (HRM), the low-risk material (LRM) comprising construction and other LRM (demolition waste and the made ground) to assess the PFAS concentrations in the groundwaters within these materials more comprehensively.

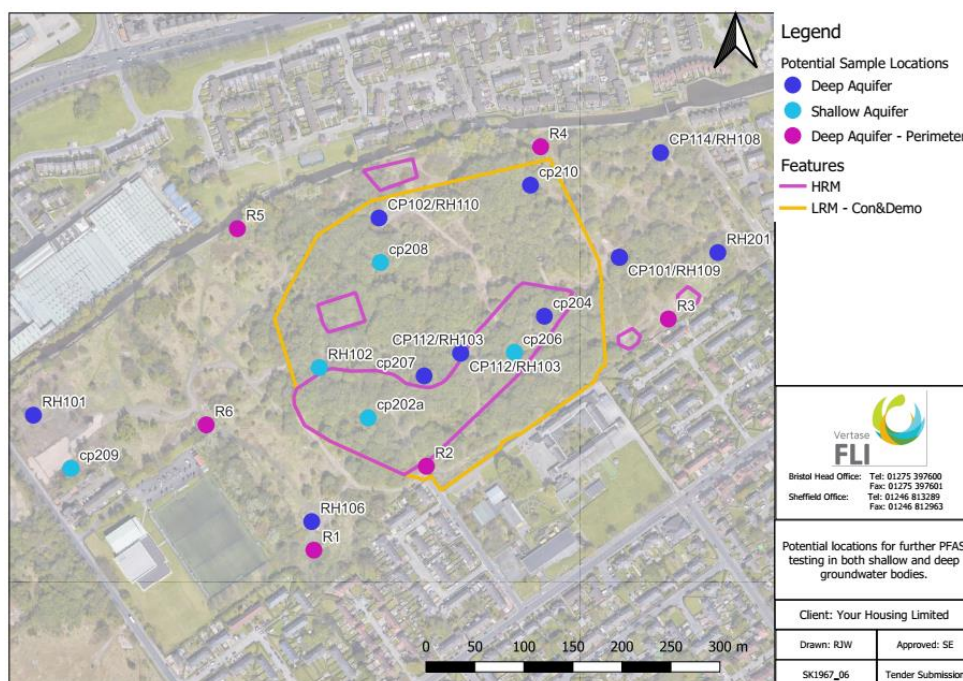
9.15.3 Groundwater samples shall also be obtained from the deeper aquifer within the bedrock from locations beneath the site and around the perimeter of the site.

9.15.4 Sampling shall be undertaken from an array of boreholes (existing or newly installed) that provides:

- A minimum of four sampling locations in the high-risk materials,
- Four sample locations in the lower-risk construction and demolition waste,
- Four sample locations in the made ground and
- Six perimeter/sentinel wells (two upstream, two midstream and two downstream of the site).

9.15.5 The site shall be surveyed to locate historic wells and to assess their condition. Where possible these historic wells shall be used for groundwater sampling. Based on a review of the historic logs for boreholes, it has been identified that there are several wells that would provide access to the shallow groundwater, leachate and deeper

groundwater for this purpose. These are shown below and in Appendix E as *Drawing SK1967_06: Potential locations for further PFAS testing in both shallow and deep groundwater bodies.*



Drawing SK1967_06: Potential locations for further PFAS testing in both shallow and deep groundwater bodies.

- 9.15.6 If needed, historic wells will be re-conditioned by purging any accumulated sediments and silts at the base of the wells, to allow for accurate groundwater sampling. Purging would be carried out following VertaseFLI protocols to prevent introduction of any external PFAS sources into the wells.
- 9.15.7 If additional wells are required to complete the proposed sampling strategy, then new wells will be installed using clean drilling techniques, with discrete sampling zones for accurate data collection.
- 9.15.8 Groundwater sampling and analysis (see section 9.16) for PFAS will be undertaken at the following times:
- Prior to excavation works: 3no monthly rounds from all locations.
 - During the excavation works: Every 6 months from sentinel wells only (outside of excavation areas)

9.16 PFAS Laboratory Analysis Strategy; Groundwater

- 9.16.1 A combination of different laboratory assessment techniques will be used to quantify the PFAS content of the groundwater samples that are obtained.
- 9.16.2 For leachate samples taken from deeper wells within the waste body, we will use an extended PFAS suite (47 compounds) to identify potential PFAS precursors and provide additional data for interpretation and risk assessments.
- 9.16.3 For groundwater samples collected from the deeper sandstone aquifer, we consider it necessary to test using an extended suite (47 compounds) and Top Assay analysis to quantify, as much as possible, any PFAS present within this groundwater body. This includes upstream samples to ensure that background concentrations are also fully quantified.
- 9.16.4 PFAS testing may be refined, depending on types and concentrations identified.

9.17 SOURCE REDUCTION: Hardstanding and Substructures

- 9.17.1 The overall volumes of materials anticipated to be excavated are as given in Section 8.0.
- 9.17.2 All areas of hard standing will be broken out and subsurface features grubbed out. Such features may include foundations, drainage and any other buried obstructions. Hard arisings will be screened (if required) and crushed on site for re-use as appropriate in accordance with WRAP protocol for Aggregate from Inert Waste as detailed in Section 11.7.

9.18 SOURCE REDUCTION: Excavation

- 9.18.1 Across the site, the Basic Excavation Depths defined in the Remediation Strategy are either natural ground or Final Floor Level minus 1m (FFL-1m), where the base of the excavation remains within artificial ground.
- 9.18.2 In any area (defined in the ground model as either LRM, LRM C&D or HRM) where artificial ground extends greater than FFL-1m, a deeper excavation protocol (Appendix F) is applicable.
- 9.18.3 LRM will be processed as per Section 9.23.

- 9.18.4 Verification will be as per Section 11.3
- 9.18.5 A clean cover system will be required for landscaping and garden areas. This will be undertaken by others during the site redevelopment phase. Suggested verification of imported clean cover material is given in Section 11.4.
- 9.18.6 Excavated LRM C&D will be processed as per Section 9.24 to provide a material suitable for use in the construction of the development platform and that does not present a risk to end users once a suitable hard cover (roads and houses) or landscape capping (gardens) is in place.
- In HRM areas, concurrent to excavation, leachate shall be recovered and treated (this is further discussed in Section 9.26). Sumps will be progressed deeper than 5.0m to facilitate the recovery of leachate.

9.18.7

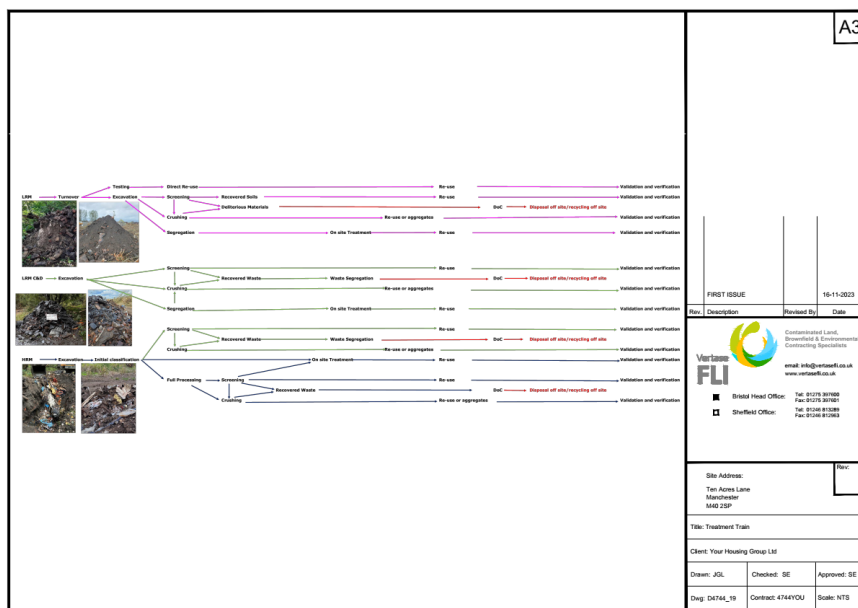
9.19 SOURCE REDUCTION: Naphthalene Vapour Hotspot

- 9.19.1 The SI works undertaken by WA, identified material which is considered to represent a 'hotspot' of naphthalene with respect to risks posed by vapours.
- 9.19.2 The exploratory hole log for TP139 indicates that the material at 2.4m bgl associated with the recorded naphthalene concentration of 13,100mg/kg, was recovered as wet material below the ingress of water at 2.2m bgl. The log also indicates that the trial pit encountered a brick obstruction in the western face of the excavation and that it was located outside of the infilled brick pits (in the area of a former building associated with the brick works).
- 9.19.3 It is considered that this maximum concentration of naphthalene recorded in the vicinity of the former brickworks building in TP139 is representative of a localised hot spot (i.e., outlier).
- 9.19.4 This is the only area identified by WA to represent a potentially unacceptable risk to human health through vapors.
- 9.19.5 This area will be carefully excavated during the remediation works based on visual/olfactory assessment supplemented by photoionization detector (PID) readings.

- 9.19.6 The excavation will extend to where grossly impacted soils are no longer encountered. Grossly impacted soil will be chased out as far as reasonably practicable.
- 9.19.7 Base and side validation will be undertaken as per Section 11.6.
- 9.19.8 The soils will be stockpiled separately to other arisings and tested for naphthalene. A suitable remediation target for the protection of human health of 1,400mg/kg is considered appropriate for naphthalene.
- 9.19.9 Should naphthalene impacted soils be identified at levels above 1,400mg/kg, these would be placed into windrows/bio piles in the treatment area.
- 9.19.10 Biopiles would be turned as appropriate to facilitate bioremediation within the soils.
- 9.19.11 Ongoing chemical testing will be conducted to monitor contaminant levels within the treated material.
- 9.19.12 Following successful treatment, chemical verification will be undertaken as per Section 11.6.
- 9.19.13 Once verified, treated soils will be screened and processed as required to comply with chemical and geotechnical specifications for reuse (Section 11.2).

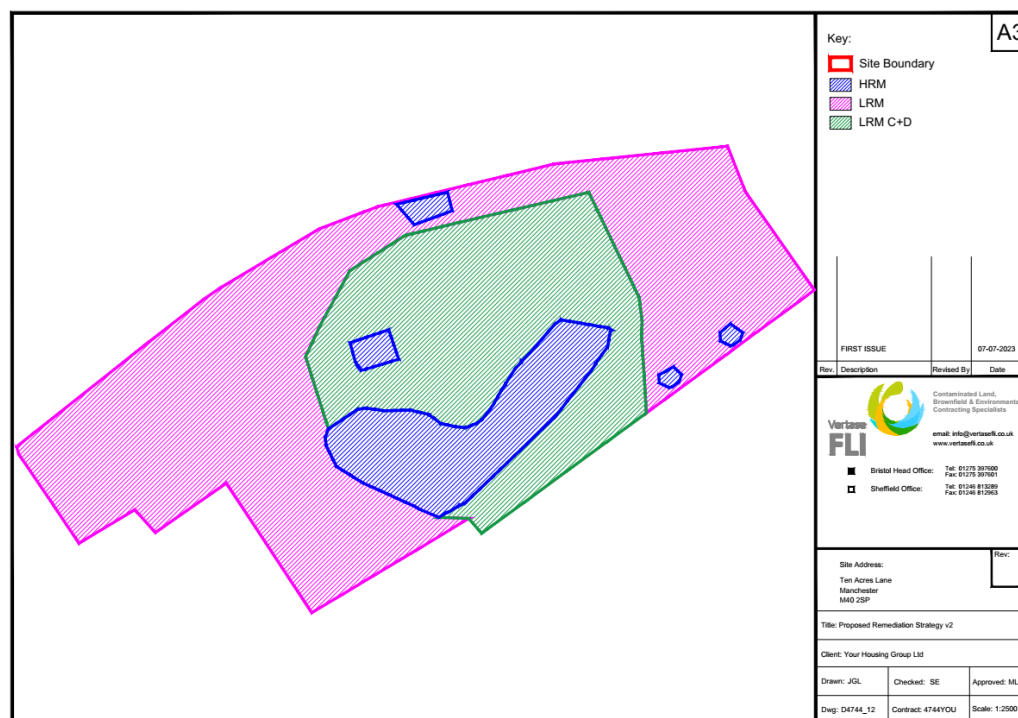
9.20 SOURCE REDUCTION: Material Treatment Trains

- 9.20.1 Material of each classification will be subject to a 'treatment train' approach to ensure suitability for re-use in the development platform as shown below and in Appendix E as *Drawing D4744_19 Treatment Train*.



Drawing D4744_19 Treatment Train

- 9.20.2 It is considered that based on the above, the treatment approaches for LRM and LRM C&D are relatively self-explanatory, however, a brief commentary on each of the main processes is provided in the following Sections.
- 9.20.3 Areas of LRM, LRM C&D and HRM are defined below and in Appendix E as *Drawing D4744_12 proposed remediation strategy v2*.



Drawing D4744_12 Proposed Remediation Strategy v2.

9.21 SOURCE REDUCTION: Processing of LRM and LRM C&D

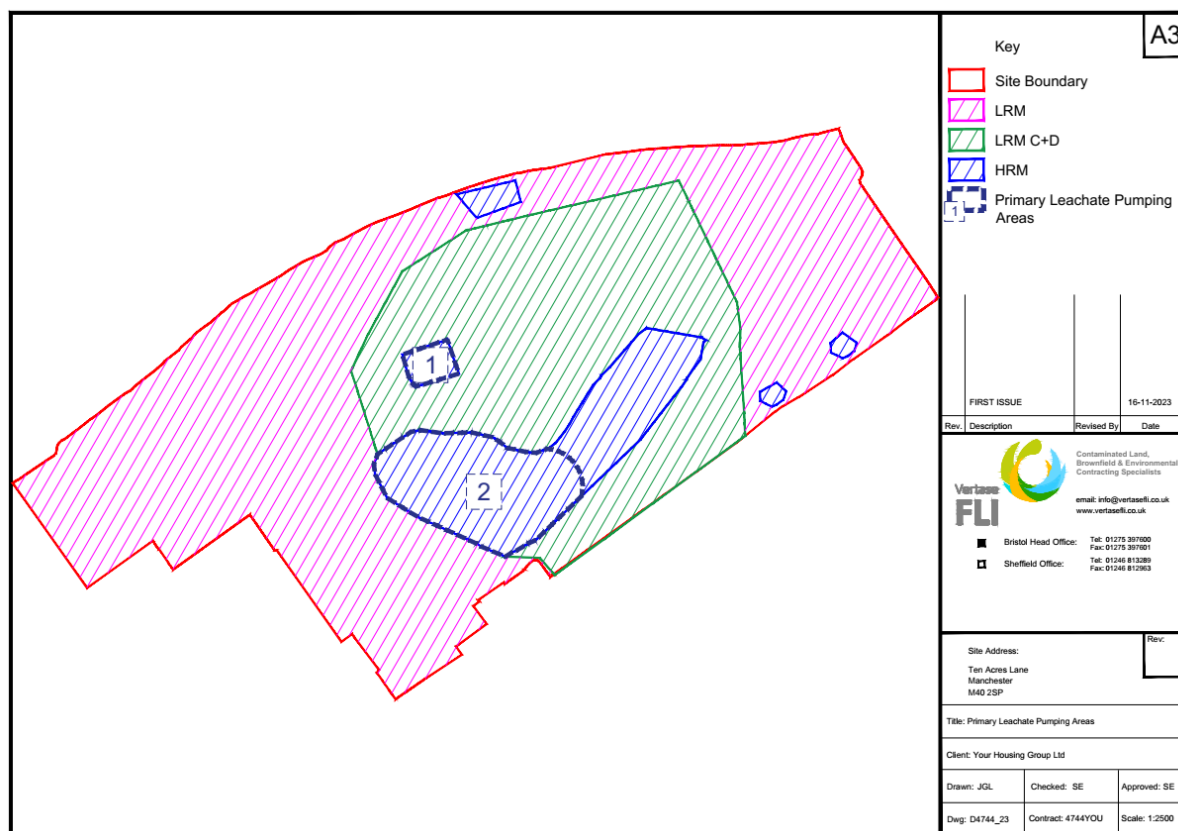
- 9.21.1 LRM and LRM C&D areas will be excavated as per the basic excavation depths (or the deeper excavation protocol where artificial ground extends greater than FFL-1m), processed and graded to ensure that the material is suitable for reuse on site. This will be undertaken utilising a combination of selective excavation, riddling at excavation, screening, crushing and segregation techniques. Recovered soils and aggregates will be retained on site for reuse with segregated deleterious materials disposed off site for recycling or disposal as appropriate. Any materials identified requiring further treatment will be sentenced to the appropriate treatment in the treatment area.

9.22 SOURCE REDUCTION: Processing of HRM

- 9.22.1 In accordance with the deeper excavation protocol (Appendix F), HRM areas will be fully excavated to a minimum of FFL-3m and a maximum of 5m where artificial ground is identified at the base of the basic excavation depth of 3m and will undergo full processing in the treatment plant. This will include size and density separation, screening, crushing and may include mechanical and hand picking. Recovered deleterious materials will be segregated for off-site recycling or disposal. Recovered aggregates, concrete, bricks etc. will be separated for crushing and grading with soils being segregated for further assessment for treatment and re-use as engineering soils.

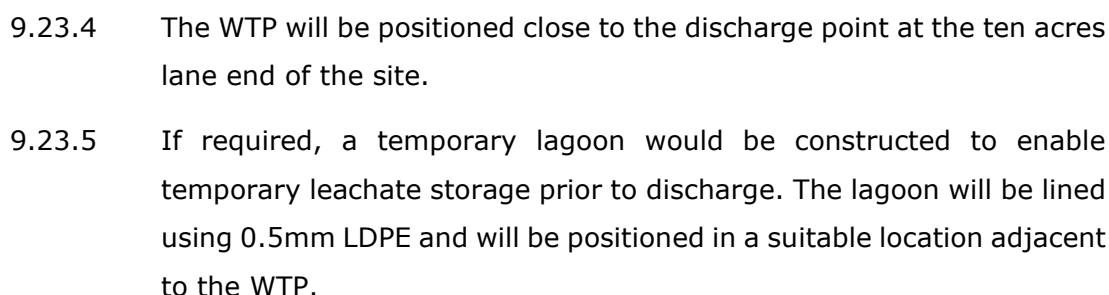
9.23 SOURCE REDUCTION: Leachate Recovery & Treatment

- 9.23.1 A significant mass of dissolved phase contaminants is present within the leachate. Boreholes/sumps shall be installed below the phreatic surface of the leachate within the Made Ground to enable the removal of leachate for ex-situ treatment to reduce and or remove the contaminant mass prior to discharge to foul sewer in accordance with a trade effluent discharge consent.
- 9.23.2 Indicative locations where leachate recovery is to be undertaken is provided as *Drawing D4744_23: Primary leachate pumping areas*, Appendix E.



9.23.3 Leachate will be pumped directly from sumps/boreholes and treated via a bespoke water treatment system (WTS) which briefly comprises the following as shown below and in Appendix E as *Drawing D1967_08 WTP Process Instrumentation Layout*.

- Pumps,
- Holding tank/s
- Silt separation tank
- Granular Activated Carbon (GAC)
- Flow meter/s
- Associated control panel.



9.24.1 Before any groundwater discharge to foul or surface water, a discharge consent will be obtained and agreed with United Utilities. Any discharge limits for foul water sewer are to be agreed upon in advance.

9.24.2 Post treatment, water will be sampled and verified against a set of criteria as defined by United Utilities (UU). Testing frequencies and analysis required will also be defined by UU.

9.25.1 The site has undergone extensive characterisation in the form of multiple phases of site investigation and assessment. However, as with any large brownfield site there may be the possibility, however remote,

that contamination not previously identified will be discovered during remediation.

- 9.25.2 This possibility is addressed via a standard condition in the planning approval, Condition 11 of Planning Ref 129197/FO/2021, outlined below.

Condition 11) If during the undertaking of site works, contamination not previously identified is found to be present, then further site works shall be suspended until the extent of contamination has been determined and defined in agreement with local planning authority. Written agreement shall then be obtained from the local planning authority to enable onsite works to recommence within the area(s) not affected by the contamination identified.

- 9.25.3 Should previously unidentified contamination be discovered VertaseFLI will comply with the planning condition and cease work in the defined area of contamination until the extent and nature of the contamination has been defined, in liaison with the regulators. If required, VertaseFLI will submit, for approval, a stand-alone strategy or amendments to the existing strategy to deal with the contamination.

9.26 Historic Wells & Other Potential Pathways

- 9.26.1 All existing monitoring wells not to be used for monitoring during or after the works are to be decommissioned, either in their entirety during the excavation works or using 'Good Practice for decommissioning redundant boreholes', prepared by the Environment Agency (dated October 2012).
- 9.26.2 Due to the vast number of investigations undertaken across the site to date and therefore the number of historic wells anticipated, verification of decommissioning will be a visual confirmation accompanied by a photograph and coordinates that all encountered wells have been removed in their entirety or grouted (with the exception of selected wells which are to be maintained for SI/ monitoring purposes).
- 9.26.3 Any encountered potential pathways such as relic drainage, services etc. will be broken out from the development platform. All drainage networks (drains/manholes) will be removed and termination points will be located within 1m of the boundary of the remedial excavations.

All terminations will be capped, surveyed, recorded and added to as built plans to inform design and future development works.

9.27 Off Site Disposal/Recycling

- 9.27.1 Disposal of unsuitable materials will confirm to the Waste Regulations, with all necessary pre-testing (if applicable) undertaken before dispatch with appropriate waste characterisation and classification assessment.
- 9.27.2 All materials disposed of offsite will be dispatched with Waste Consignment Notes or Duty of Care notes for the waste/ material types. Copies of these records will be scanned, maintained and available for inspection at any time.
- 9.27.3 Recycling of materials will be undertaken over disposal where reasonably possible.
- 9.27.4 A full audit trail will be maintained as per Section 9.34 and shared with various stakeholders as per Section 9.35.

9.28 Asbestos Containing Materials

- 9.28.1 An Asbestos Plan of Works (PoW) will be developed for the works, detailing the methodologies for dealing with non-licensed incidental asbestos finds across the Site.

9.29 PATHWAY INTERRUPTION: Engineered Fill

- 9.29.1 Site won hard materials, as verified as suitable re-use (Section 14) will be used to install an engineered layer to reduce infiltration into the site. Details for the engineering specification for this material can be found in the VertaseFLI Ground Stabilisation Works Plan in accordance with Planning Condition 08.
- 9.29.2 Additional pathway interruption measures as listed below are to be installed by others as part of the development phase remediation:
- Clean cover system comprising a minimum of 600mm clean soils in soft areas (gardens, landscaping and open space)
 - Placement of hardstanding associated with the proposed development (including drainage for surface water runoff)

- Contaminant resistant vapour membrane in buildings
- Passive ground gas protection measures in buildings
- Contaminant resistant drinking water pipes

9.29.3 Further details of remediation measures to be incorporated into the development construction are found at Section 15.

9.30 Monitoring Well Infrastructure

9.30.1 On completion of the works, all remaining boreholes/monitoring wells will be decommissioned in accordance with EA guidance: '*Good practice for decommissioning redundant boreholes and wells*', October 2012.

9.30.2 Further details are given in the VertaseFLI report to address Planning Condition 08.

9.31 Data Management & Materials Tracking

9.31.1 The collection and sharing of data during the progression of the works and the final validation data for the site are key to the successful delivery of Remediation schemes. Specifically for the Ten Acres Project, VertaseFLI have designed a database driven software system to digitally manage materials movements, testing, compliance and reporting. This is known as the VertaVerse system.

9.31.2 The system will ensure that compliance is met all times and errors in data management are reduced as well as providing a complete record of all aspects of the works.

9.31.3 The system will include an Application (App) which will be accessible through web browsers both on desktop and mobile. A portal will be available to the regulators via which they can view "live" information and data collection. It is envisaged that this will improve collaboration and efficiency in data sharing and the verification process.

9.31.4 The database will be interrogatable and all information will be collected and stored in 3D. The system will also relate to the site based 25m by 25m grid which will provide the basic resolution for data. The following information will be collected, stored, analysed and visualised within the system.

- 3D data

- Site Grid
- Phases and zones
- Volumes and quantities of materials excavated.
- Types and classifications of materials (MG Hardstanding, LRM, LRM C&D etc.)
- Observations and photographic records
- Laboratory data Chemical
- Laboratory Data Geotechnical
- Stockpile and treatment tracking
- Environmental and fugitive monitoring
- Base and side validation records
- Treatment triggers and exceedances
- Imports and exports

9.32 Sharing of Data

- 9.32.1 Initially VertaseFLI will establish set up a share drive system to allow easy access to reports and technical submissions to enable easier communications and decision-making. This system will also be made open to both the lead from the EA and the lead from the Local Authority (EHO) to enable them to view verified data as it is collected and added to the system. This will be a live system that will on completion be the full validation record for the site remediation works.

10.0 Health, Safety & Environmental Management

10.1 Health and Safety

- 10.1.1 Health & Safety shall be managed following the latest revision of the Construction, Design and Management (CDM) Regulations.
- 10.1.2 VertaseFLI holds a third-party certified Health & Safety Management System according to ISO 45001:2018 international standard for health and safety at work.

10.2 Site Welfare Facilities

- 10.2.1 Appropriate welfare facilities compliant with CDM regulations will be mobilised and maintained on site.

10.3 Personnel / Labour PPE Requirements

- 10.3.1 All personnel will be required to wear as a minimum appropriate PPE, including but not limited to safety boots (not Riggers) with toe cap and midsole protection, Hi-Vis vests, and hard-hats.
- 10.3.2 Additional asbestos PPE and RPE may be required as per the asbestos plan of works.
- 10.3.3 Any additional PPE will be job specific and detailed within the risk assessment.

10.4 Training and Competency

- 10.4.1 All personnel and plant operators must have training certificates appropriate to the work they are carrying out (CSCS cards or equivalent). Plant operators must have CPC cards or equivalent for the category of plant they are operating. In addition, if an item of plant is to be operated on the public highway, for example the tipper Lorries, the operator must hold a full, current & valid driving licence categorised for the item of plant.
- 10.4.2 All certificates & licences will be inspected by the Site Manager and copies made to be retained in the site file.

10.5 Environmental Protection

- 10.5.1 VertaseFLI operates an Integrated Management System (IMS), which includes ISO9001:2015 and ISO14001:2015 Certification. All VertaseFLI employees undergo environmental awareness training. In addition, environmental Toolbox Talks (TBTs) will be used to deliver appropriate training relating to the activities being undertaken at our sites. All projects will have a clear management structure with experienced environmental engineers who will have identified each project site-specific environmental risks.
- 10.5.2 VertaseFLI produces Environmental Policies and Procedures, Emergency Plans, Risk Assessments, Remediation Strategies and Plans of Work, amongst other documents to support our activities.
- 10.5.3 As a brownfield remediation contractor, we recycle and reuse wherever possible to reduce the use of natural resources. We ensure that we will keep up to date with legislation and regulatory changes and communicate to our employees any changes.
- 10.5.4 VertaseFLI have prepared a Construction Environmental Management Plan (CEMP) which includes measures to prevent the emission of contamination to air and into the wider environment. The CEMP has been submitted to MCC to fulfil the requirement of Planning Conditions 03 and 04.

10.6 Quality Management System

- 10.6.1 VertaseFLI are certified to ISO9001:2015, which is also included within our Integrated Management System (IMS). We have a combined Safety, Health, Environmental and Quality Policy and IMS manual, including our ISO 45001:2018 international standard for health and safety at work. Certification.
- 10.6.2 We have many procedures and work instructions to enable our employees to fulfil their roles and responsibilities. All VertaseFLI employees receive an IMS induction upon commencement with the company concerning their specific roles. Any changes to our IMS are communicated to our employees, and access to the system is available to them at all times.

10.6.3 We maintain a company training matrix which shows the competency of all of our employees. In addition, we have a 100% CSCS Site Operative certification.

10.7 Spontaneous Combustion

10.7.1 Made Ground present in some areas of the Site is known to contain some colliery overburden. For spontaneous combustion to occur in such material, three things must be present: (i) materials with a sufficient calorific value; (ii) a continual supply of oxygen; and (iii) a source of ignition. While excavation of this material shall temporarily increase its exposure to air, the material is not expected to require significant mechanical processing (e.g., particle size reduction). Coupled with the low likelihood of ignition, the risk of spontaneous combustion is very low.

11.0 Remediation Verification Plan

11.1 Introduction

- 11.1.1 It is the Verification document that is the most important aspect of the record of remediation which sets out the post remediation condition of the site demonstrating that the site is both suitable for use and does not pose any unacceptable risks to the Environment. This demonstration will be done by the provision of a 3D verification record characterising all materials that have been treated and re-use, left in place or imported as part of the remediation, supplemented by laboratory analysis. This "ground model" and Verification data will then be used to demonstrate via a post remediation risk assessment that the site meets the remediation objectives and is both suitable for use and that any initially identified risks are adequately managed.

11.2 Assessment of 'Suitability for Re-Use' - Soils

- 11.2.1 Re-use criteria to confirm the suitability of excavated Made Ground for re-use are discussed in Section 8.7 . Following excavation and treatment, all materials intended for re-use shall undergo testing to confirm compliance with the criteria before being placed and compacted. Materials shall undergo testing at a frequency of 1 sample per 500m³.

11.3 Remediation Areas Verification/Inspection

- 11.3.1 A VertaseFLI engineer will supervise all excavations and keep records of visual and olfactory observations, ground conditions and preferential migration pathways.
- 11.3.2 At the base of the excavation works in LRM Area, verification/inspection will be undertaken as per the Standard Base Validation Protocol, Appendix F.
- 11.3.3 At the base of the excavation works in LRM (C&D) or HRM Areas, verification/inspection will be undertaken as per the Dynamic Strategy -Deeper Excavation Protocol, Appendix F.

11.4 Testing of imported cover systems

- 11.4.1 We would advise that the following verification testing is undertaken following placement of cover systems (imported engineered cover system to be installed by VertaseFLI and simple clean cover to be installed by others).
- 11.4.2 The current Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) guidance document 'Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners and Consultants' (Version 3.4, November 2017) provides chemical testing frequencies for soils of different sources. However, this guidance has not been formally adopted by MCC and therefore the testing frequencies set out in the guidance on cover systems prepared by Manchester City Council (2021) titled "Planning and Contaminated Land. Technical Guidance. February 2021" shall be used herein. These testing frequencies are summarised in Table 11-1. The number of samples required to be tested is per material and per source, therefore, the same soil type imported from two sources would require twice the testing compared to a single source.
- 11.4.3 Laboratory analysis results should be compared against assessment criteria applicable to the exposure scenario such as Suitable for Use Levels (S4ULs).

Table 11-1 Testing frequencies for imported cover system verification

Soil Type / Source	Residential Gardens	Soft Landscaping
Greenfield Soils	1/200m ³	1/200m ³
Remediated Soils	1/100m ³	1/150m ³
Brownfield Soils	1/50m ³	1/150m ³
Unknown Soil Sources	1/50m ³	1/150m ³

11.5 Site Won Topsoil Verification

- 11.5.1 Site won topsoil shall be tested and verified for chemical suitability to remain on site for future use by the Client.

11.6 Naphthalene Vapour Hotspot

- 11.6.1 Following excavation of the identified naphthalene hotspot as described in Section 9.21, verification will be undertaken at the base and sides of the excavation.
- 11.6.2 Soil samples will be taken from the side of the excavation at a rate of 1 per 25m (linear). Soil samples will be taken at the base of the excavation at a rate of 1 per 100m². Samples will be analysed at a UKAS and MCerts laboratory for naphthalene. Results will be compared to the WA criteria for the protection of human health (1,400mg/kg).
- 11.6.3 Following treatment of naphthalene impacted soil as described in Section 9.21, treated soil will be sampled and analysed at a rate of at least 1 per 500m³ (or 3 per treatment bed).
- 11.6.4 Treated soil samples will be analysed at a UKAS and MCerts laboratory for naphthalene. Measured concentrations shall also be compared to the WA criteria for the protection of human health (1,400mg/kg) and re-use criteria for excavated soils as per Section 8.6 and 11.2.

11.7 WRAP Testing Site Won Hard Materials

- 11.7.1 VertaseFLI will prepare a factory Production Control Document (FPCD) to outline the operational processes and the associated quality control measures to be adopted during the remediation works, for the production of secondary aggregates from site arisings.

11.8 Imported Materials

- 11.8.1 It is anticipated that there will be a requirement to import materials as part of the remediation. Material is likely to be MOT Type 1 or SHW 6F2/6F5.
- 11.8.2 Type 1 material that is from a primary source (i.e., a quarry) will be assumed to be clean and will not be tested prior to use.
- 11.8.3 Type 1 and 6F2/6F5 from recycled sources will be tested at a frequency 1/5,000m³ to ensure that it is suitable for use when compared to the site specific suitable for use criteria.

11.9 Geotechnical Testing – Field and Laboratory

- 11.9.1 Geotechnical testing, both field and laboratory, will be defined in the VertaseFLI Ground Stabilisation Works Plan.

11.10 Post-Backfilling Ground Gas Monitoring

- 11.10.1 Post-backfilling ground gas monitoring shall comprise ground gas monitoring from monitoring wells installed into boreholes and surface emissions testing (via the use a tunable laser diode and/or flux box tests). Parameters to be recorded shall include ground gas concentrations (CO_2 , O_2 , CH_4), flows, groundwater levels in monitoring wells, weather conditions and other information relevant to the ground gas regime.
- 11.10.2 Ground gas monitoring wells shall be constructed with a response zone above the perched water table to minimise the likelihood of the response zone becoming flooded during the post-remediation monitoring period. However, it is noted that ground gas monitoring wells installed into 'young' engineered fill can provide a preferential flow path for the dissipation of pore-water during primary consolidation of the fill. This process can lead to the flooding of monitoring well response zones despite being positioned within the unsaturated zone. Furthermore, it has been found on previous sites that the pore-water within re-engineered Made Ground can contain relic dissolved methane (generated prior to re-use) that can partition into the well headspace where it accumulates between monitoring visits, which can produce misleading results if not interpreted with caution. Therefore, ground gas monitoring wells shall only be used as a line of evidence, rather than being relied upon as the only method of characterising the ground gas regime.
- 11.10.3 Surface emissions (flux box) testing shall be undertaken on a 50m grid upon completion of the earthworks during 3 separate events (within 6 months of completing the earthworks), ideally during periods of low or falling barometric pressure with dry ground conditions. A surface emissions (tunable laser diode) survey shall be undertaken to correspond with each flux box monitoring event.

- 11.10.4 All lines of evidence (i.e., degradable organic carbon content of fill, gas monitoring data, and surface emissions data) shall be used to inform an assessment of the post-remediation ground gas regime and to advise on the appropriate ground gas protection measures for inclusion in buildings.

11.11 Leachate Monitoring

- 11.11.1 It is intended that to both facilitate the excavation of the HRM material and to provide sufficient betterment to areas of the site where HRM and leachate are co-incidental, as much leachate as practicable is pumped and treated from these areas (Section 9.26). These areas are shown on *Drawing D4744_23: Primary leachate pumping areas*, Appendix E.

- 11.11.2 During this pumping, water quality will be monitored on a regular basis with samples taken fortnightly from the abstracted leachate alongside the quality of effluent flows whilst pumping is undertaken. It is expected that as pumping progresses, after initial increases in concentrations of some analytes (such as silt as it is mobilised), ultimately improvement or betterment will be seen. Lines of evidence will be collected and presented to show this improvement which will include:

- Initial estimate of contaminant loads
- Quantity of leachate recovered and treated.
- Improvements in composition and contamination load.
- Overall load reductions of contamination.

- 11.11.3 The monitoring of leachate levels (within sumps) and subsequent permeability data within the leachate areas will also be presented to provide a further line of evidence for betterment during this work.

11.12 Groundwater Monitoring (perched)

- 11.12.1 Perched water is identified in areas of made ground (i.e., LRM areas) and unlike in the leachate areas coincidental with HRM, is discontinuous in nature.
- 11.12.2 Where encountered during the turnover of materials in LRM areas, perched water will be removed and managed via the treatment system

to facilitate the necessary earthworks. No groundwater testing is required in association with this element other than that associated with compliance with the discharge to foul sewer criteria post treatment.

11.13 Groundwater Monitoring (shallow)

11.13.1 It is not expected that groundwater from the natural horizons will be encountered on site and as such no pumping of these strata are required.

11.13.2 A monitoring regime relating to PFAS has been established in section 9.15 and samples will also be collected and tested to check for no significant deterioration of contaminants of concern during the works on a quarterly basis.

11.14 Groundwater Monitoring (deep)

11.14.1 No monitoring proposed with the exception of PFAS monitoring as described in Section 9.15.

11.15 Surface Water Monitoring.

11.15.1 The site Manager/engineer will undertake daily visual inspections of the canal.

11.15.2 Follow on sampling/analysis of canal water may be undertaken during the works if required.

11.15.3 We will take routine canal samples on a quarterly basis during the works.

11.16 Post Remediation Risk Assessment

11.16.1 The current post-development conceptual site model (CSM) as described in the **VertaseFLI (2023)** Detailed Quantitative Assessment of Risk, Issue 1, Rev A, Prepared for Nuvu Investments Ltd. Dated 20/10/23, demonstrates that there are no relevant contaminant linkages for future the site users (assuming that the inclusion of engineered pathways interruptions measures is incorporated into the remediation works).

- 11.16.2 However, the CSM is underpinned by key assumptions that require confirmation during the remediation works as the subsurface conditions become better understood via additional site investigation.
- 11.16.3 Data collected during the remediation works will be used by VertaseFLI to produce an updated Ground Model and CSM. As described in Section 12.32, the newly developed database driven software system, VertaVerse, will be used to digitally manage data so that it can be interrogated by our in-house risk analysts. As data will be stored in 3D, the production of a post remediation Ground model and CSM will be highly accurate and will help to inform future decision making.
- 11.16.4 The updated ground model and CSM shall support the post-remediation risk assessment as part of the verification of effectiveness of the remediation. Consideration of the post remediation gas and vapour status of the site will be made.
- 11.16.5 In relation to PFAS, the results of the proposed PFAS site investigation will be reviewed and interpreted by VertaseFLI in-house specialists and a full report incorporating both the existing data and new data, including VertaseFLI interpretations, will be produced for review by all stakeholders.
- 11.16.6 This report will address the questions and data gaps identified. Due to the current lack of a risk assessment framework for PFAS and the inherent difficulty in quantitatively risk assessing PFAS this report will include a qualitative risk assessment, considering the updated PFAS results and CSM.

11.17 Duty of Care

- 11.17.1 All materials sent off site will be dispatched with Waste Consignment Notes or duty of care notes for the waste/material types.
- 11.17.2 Copies of these records will be scanned, maintained and available for inspection at any time and also added to the VertaVerse database.

11.18 Reporting & Project Database

- 11.18.1 Monthly Reporting
 - 11.18.1.1 VertaseFLI shall submit interim monthly reports to stakeholders during the remediation scheme to include:

- The results of ongoing environmental and geotechnical monitoring and testing with accompanying interpretation and assessment of the results against the aims and objectives of the RMS, Verification Plan and Earthworks Specification.
- Describe how non compliances have been addressed.
- Update the detailed earthworks model for the works with the results of the updates presented in the monthly report, to allow monitoring and prediction of material reuse, settlement predictions and prediction of the final remediation levels.
- Presence and actions on encountering unexpected contamination, medical waste, gas bottles, etc.
- Services Tracker.
- Environmental Monitoring (noise, vibration, dust, asbestos fibre monitoring).

11.18.2 Final Verification Reporting

- 11.18.2.1 A verification report will be produced on completion of the remediation works to satisfy Planning Condition 09 as below.

Condition 09) A verification report demonstrating the completion and effectiveness of works set out in the approved remediation and ground stabilisation works strategies shall be submitted to, and approved in writing, by the local planning authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met.

- 11.18.2.2 The report will contain a full description of the works carried out including records of the material management aspects, verification testing results, waste documentation, as-built plans, environmental monitoring and photographs of the works. The report will include (but not limited to) the following.

- A full written description of the works, detailing how the objectives and requirements of this report have been achieved,

- A photographic record of the works,
- Records, chemical testing results and information on remediation excavation and groundwater works,
- Quantities of material imported to site,
- Chemical testing results and information on the source of any imported material and plans showing where this material has been used on site,
- Chemical testing results and information on any re-used materials and plans showing where this material has been re-used.
- Plans showing locations of any additional samples obtained for testing due to unforeseen contamination along with any delineation of materials and quantities,
- Results of any additional chemical and WAC testing undertaken along with method of sample collection and transportation to laboratory, laboratory quality assurance and accreditation,
- Quantities of material disposed off site and details of the receiving site/s and copies of all Waste Transfer Notes,
- Records of any groundwater and surface water monitoring,
- Records of any borehole decommissioning works (including photographs)
- Records of any asbestos management measures employed,
- Details of any areas of unexpected contamination and the actions undertaken,
- Details of any water removed from excavations and disposed off site, including chemical testing,
- Detailed surveys of all excavations and production of 'as built' drawings for the earthworks. This may include a 3D model showing cut & fill levels as well as remediation zones across site (illustrating materials movement, placement of materials, location of testing, residual constraints etc.),

- Details and demonstration of any relevant permits or exemptions required for the works.
- Copies of Consignment Notes relating to materials movements of wastes to a licensed waste management facility.
- Details of regular dialogue and any additional liaison and agreements with regulators.
- All laboratory analysis conducted as part of the verification phase of works will be submitted to a UKAS/ MCERTs accredited laboratory to ensure the accuracy of data obtained.
- On completion, the Verification report will be submitted to the Local Planning Authority for approval. A copy of the Verification Report will be retained on site within the health & safety file.

11.18.2.3 A CDM Health and Safety File will also be produced.

12.0 Remediation Measures to be Incorporated During Construction Phase

- 12.1 On completion of the planned remedial works there may be residual risks which will need to be addressed as part of the future development. This development is subject to a further planning condition ref: 133700/FO/2022.
- 12.2 An overview of the remedial measures to be incorporated into development construction are provided in the VertaseFLI Options Appraisal Section 7.0.

13.0 References

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Appendix A

Climate Change Predictions

INTRODUCTION

This City Pack provides high level, non-technical summaries of climate change projections for an individual city or town. It uses scientific research to provide robust climate information to help decision makers plan for the future, enabling cities and towns to become more resilient to climate change.

Urban areas experience unique challenges from climate change. For example, urban environments contain surfaces which don't soak up and store rainfall, such as tarmac and paving, which might increase flood risk. Urban areas are also affected by the urban heat island effect, which results in higher urban temperatures compared with surrounding rural areas.

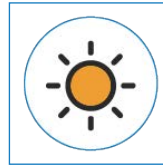


WHAT AFFECTS THE REGION'S WEATHER?

Manchester is located within the 'North West' region of the UK, which includes Cheshire, Merseyside, Greater Manchester, Lancashire and Cumbria. Here are some of the types of weather that the region experiences across a year:



The range of topography and altitude in North West England provides a varied climate, which includes both the coldest (Cross Fell) and wettest (Lakeland fells) locations in England. In low-lying areas where most urban areas are found, mean annual temperatures are around 10°C.



Sunshine hours in North West England range from around 1200 hours in the higher Pennines to around 1500 hours at the coast, with values up to 1550 reached on the Isle of Man.

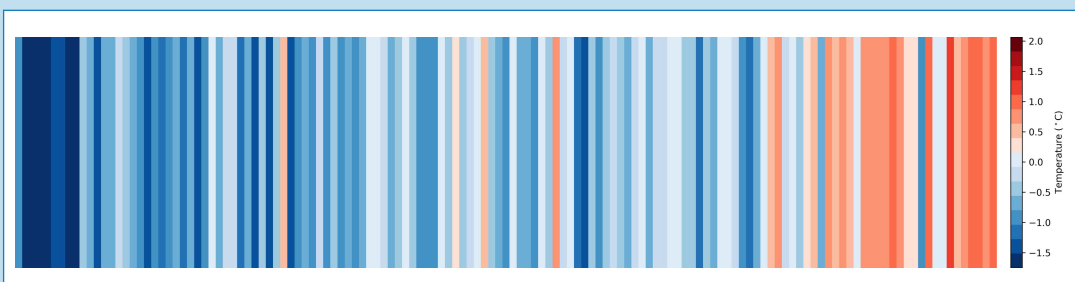


North West England includes some of the wettest places in the UK although this is localised to upland areas which are exposed to westerly maritime air masses. Areas in the lee of these uplands receive significantly less rainfall, including the large urban areas of Manchester, which receive around 800 mm per year.



North West England is one of the more exposed parts of the UK and may experience strong winds associated with the passage of deep lows. The frequency and strength of these depressions is greatest in the winter half of the year, with the strongest winds coming in off the Irish Sea from the SW to WNW.

HOW HAS THE CITY'S CLIMATE CHANGED?



Temperature Difference (°C)
Data: HadUK-Grid
Concept: Ed Hawkins

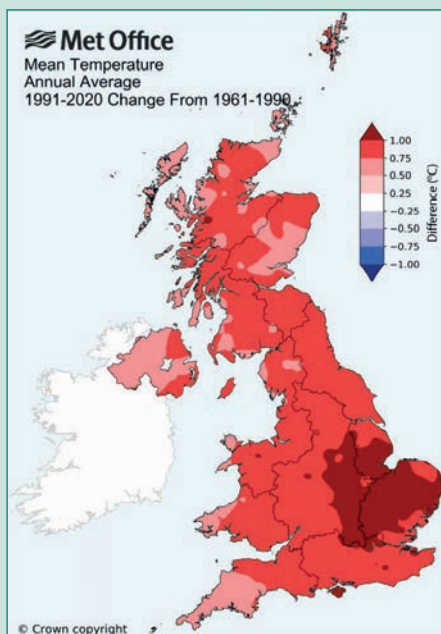
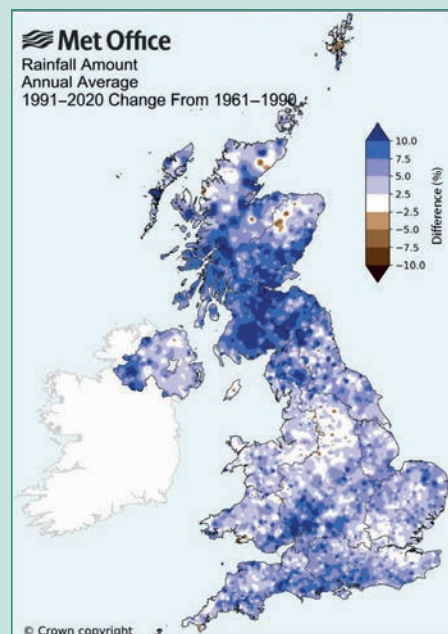
The stripes show how temperatures in Manchester have increased from 1884-2020, with many of the hottest years occurring in the last few decades.

CLIMATE CHANGE IN THE UK

OBSERVED CHANGES

How are temperature and rainfall changing across the UK?

These maps show changes in temperature (left) and rainfall (right) from 1991-2020 compared to a baseline period of 1961-1990. We can see that temperatures have risen in all areas across the UK. We can also see that whilst some areas have become drier, more areas have become wetter.



IMPACTS

Cities and towns across the UK are already experiencing the impacts of climate change. The negative impacts of climate change for urban areas may include:



HEAT

Increased energy demand for summer cooling



SEA LEVEL RISE

Increased risk of coastal flooding



HEAVY RAINFALL

Increased risk of river and surface water flooding



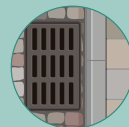
HEALTH

Increased risk to health from heat stress



DROUGHT

Risk to water supplies from drought



DRAINAGE

Increased disruptions to urban drainage system



TRANSPORT

Increased disruption to transport due to heat e.g. rail buckling



ENVIRONMENT

Increased risk to biodiversity (plants and animals)



ENERGY

Infrastructure such as gas pipes are at high risk from flooding events.

FUTURE HEADLINES

The climate is already changing, and we are already seeing impacts. But how might the UK's climate change in the future? The statements below are headline statements from the UK Climate Projections – cutting-edge climate science which provide an up-to-date assessment of how the climate is expected to change in the future:



There is an increased chance of **warmer, wetter winters and hotter, drier summers.**



Although the trend is for drier summers in the future, there may be increases in the intensity of heavy summer rainfall events.



Hot summers are expected to become more common. By 2050, every other summer may be as hot as the record breaking summer of 2018.

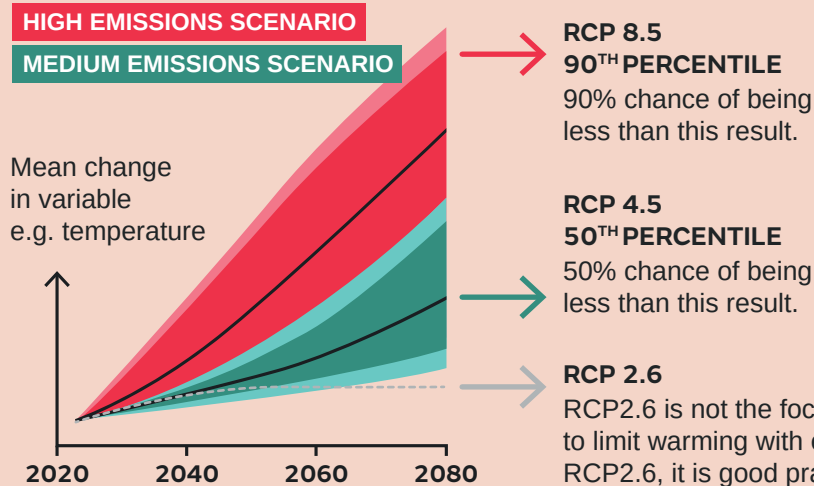


Sea level will continue to rise in the 21st century even if greenhouse gas emissions are reduced rapidly.

SCIENCE EXPLAINED

PROJECTIONS USED IN THE CITY PACK

The City Pack uses the UK Climate Projections (UKCP) Probabilistic Projections at 25 km resolution.



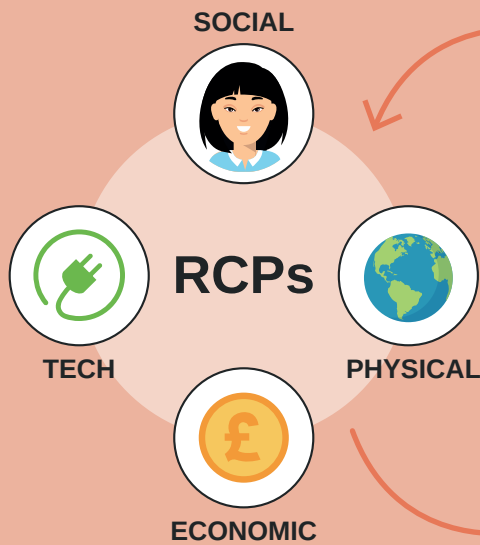
The projections are provided as a 'range':

- The first number in the range, is the median (50th percentile) result from RCP 4.5 (MEDIUM emission scenario).
- The second number in the range is from RCP 8.5 (HIGH emission scenario) and shows a more extreme result (90th percentile, except for summer rainfall rate which uses the 10th percentile, representing drought conditions).

EMISSIONS SCENARIOS

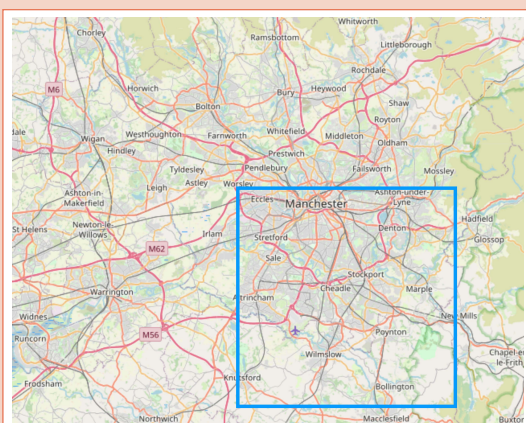
Our future climate is determined by ongoing and future greenhouse gas emissions, which are uncertain. To capture this uncertainty, we use emissions scenarios, such as the Representative Concentration Pathways (RCPs).

RCPs describe possible future emissions based on assumptions about human activity.



- RCP8.5 (HIGH)**
Global emissions grow unmitigated.
- RCP4.5 and RCP6.0 (MEDIUM)**
Global emissions are mitigated to varying levels.
- RCP2.6 (LOW)**
Global emissions are strongly mitigated and reduced. Global temperature rise is kept below 2°C.

The RCP pathways represent a broad range of possible futures and are neither forecasts nor policy recommendations.



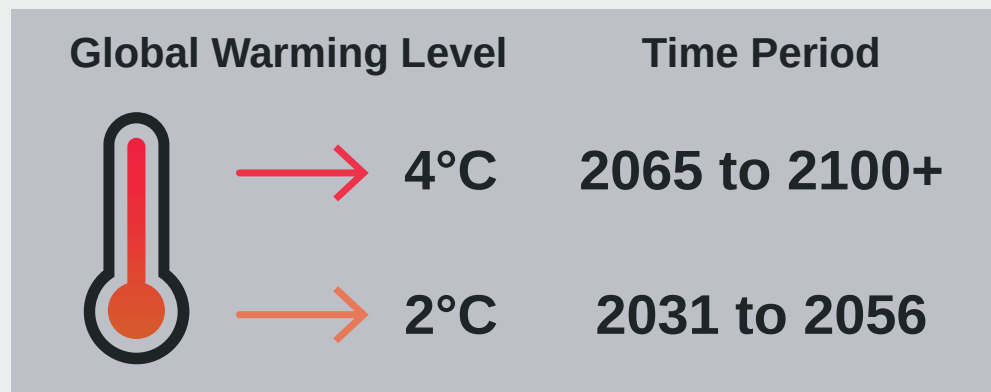
This map shows the location of Manchester and the area in focus for this City Pack. Projection information provided within this City Pack is calculated as the average (mean) value across the smaller inset box (a 25 km grid cell).

This box may include rural, coastal and mountainous areas as well as urban areas. As such, results for point locations within the grid box may differ from the average result of the box.

At 25 km resolution, detailed urban effects are not represented in the model. For urban representation, a higher resolution model is required. The use of UKCP Local (2.2 km) may be more appropriate.

UKCP RESULTS

GLOBAL WARMING LEVELS



Under a high emission scenario (RCP8.5, 90th percentile) we could reach 4°C as soon as 2065. Under a medium emission scenario (RCP4.5, 50th percentile) we wouldn't expect to reach 4°C within this century. Under a low emissions scenario (RCP2.6), with stronger mitigation, we may not reach 2°C of global warming.

These dates are not forecasts, but simply offer possible futures for comparison. Global warming level dates may not always correspond with the City results below, due to differences in spatial scales.

Global warming levels tell us about future temperature change at the global scale. What about at changes at the local scale?

		2030s	2050s	2080s	
	Summer Average Air Temperature (°C)	+0.9 to +1.9	+1.4 to +3.3	+2.6 to +6.4	↑
	Summer Maximum Air Temperature (°C)	+0.9 to +2.2	+1.6 to +3.8	+2.9 to +7.4	↑
	Winter Average Air Temperature (°C)	+0.7 to +1.7	+1.1 to +2.6	+1.7 to +4.5	↑
	Winter Minimum Air Temperature (°C)	+0.7 to +1.7	+1.2 to +2.8	+1.7 to +4.9	↑
	Annual Average Air Temperature (°C)	+0.8 to +1.5	+1.2 to +2.5	+2.0 to +4.7	↑
	Summer Precipitation Rate (%)	-2 to -21	-11 to -35	-19 to -52	↓
	Winter Precipitation Rate (%)	+2 to +11	+4 to +18	+9 to +32	↑

Results are calculated as change from the baseline period: 1981-2000.

Summer: June, July, August.

Winter: December, January, February.

Time periods are 20-year time slices:

2020-2039, 2040-2059, 2070-2089.

Precipitation is relative change (%) in mm per day.

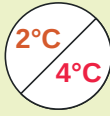
1st number in the range is RCP4.5 at the 50th percentile. 2nd number in the range is RCP8.5 at the 90th (except summer rainfall, which is the 10th percentile), calculated from UKCP 25 km Probabilistic Projections.

Results show changes in variables averaged over a season, and as such do not represent possible extreme conditions. For assessment of possible extremes, the use of UKCP Local (2.2km) may be more appropriate.

UNDERSTANDING CLIMATE RISK



We are already witnessing the impacts of a global average temperature rise of over 1°C compared to pre-industrial levels.



Without global action to limit emissions, we may exceed even 4°C of global warming.



The Paris Agreement says that we must limit global warming to well below 2°C, whilst aiming for 1.5°C.

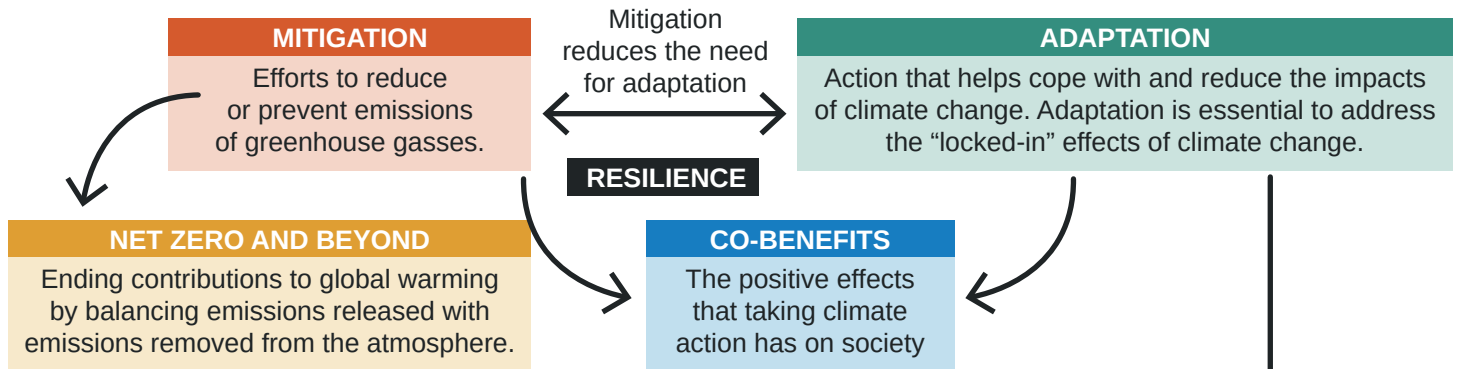


Following COP26, limiting warming to below 1.5°C above pre-industrial levels remains possible but will require bigger emission reductions than currently pledged by nations around the world. Current emission reduction pledges, made as part of nationally determined contributions, are likely to lead to warming above 2°C.



The Committee on Climate Change advises the UK to adapt to a 2°C rise in temperatures, whilst assessing the risk at 4°C.

To achieve Net Zero, and also prepare for the impacts of climate change, to which we are already committed, both mitigation and adaptation approaches are required.



Adaptation and mitigation both help to reduce the risk a city will face from climate change. Mitigation will help to limit the hazard, whilst adaptation can help to reduce exposure and vulnerability.

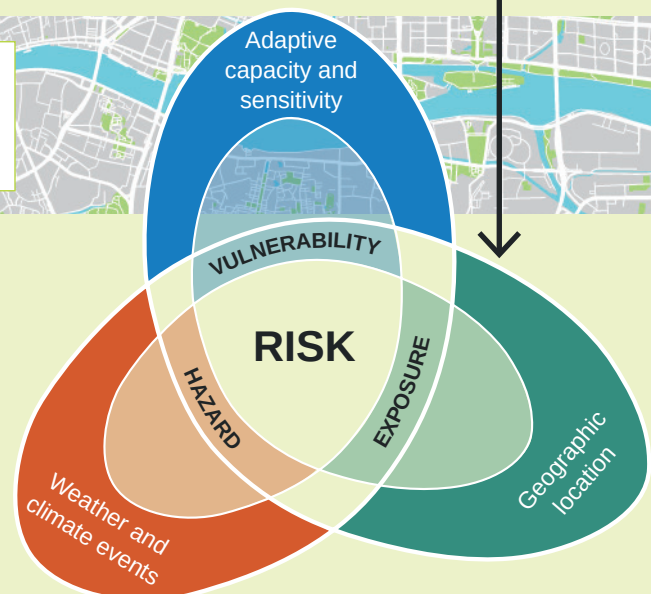
RISK

The risk posed from a changing climate, and the potential for resultant impacts, depends on three key factors:

HAZARD: weather and climate events which may have adverse effects. The occurrence, duration and intensity of which may change due to climate change.

EXPOSURE: the location of people, property and other economic resource, relative to a hazard.

VULNERABILITY: the likelihood of the exposed people, property and other economic resources suffering adverse effects from the hazard. Vulnerability is in turn affected by the capacity of people and places to adapt or respond to the hazard.



This City Pack contains information about some of the climate and weather **HAZARDS** the city may face in the future. This helps to inform about risk within the city, which in turn provides an evidence base for decision making about adaptation and mitigation.

LOCAL INFORMATION

Co-ordinating climate action in Manchester

MANCHESTER
CLIMATE CHANGE PARTNERSHIP

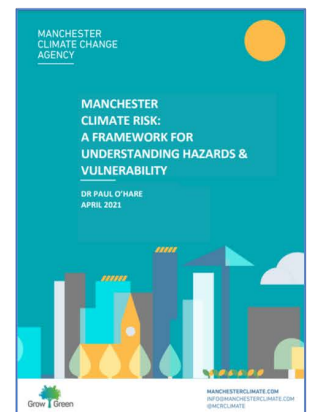
In 2019 Manchester declared a climate emergency. We recognise the part we will have to play in limiting the impacts of climate change and creating a healthy, green, socially just city where everyone can thrive.

Manchester Climate Change Agency (MCCA) & Manchester Climate Change Partnership (MCCP)

The Agency and Partnership are responsible for setting the strategy and championing climate change action in the city. Our climate strategy is outlined in [The Manchester Climate Change Framework](#). It has four core objectives: Staying within our carbon budgets; climate adaptation and resilience; health and wellbeing; and an inclusive, zero carbon and climate resilient economy.

Climate change mitigation

We have committed to reduce our CO₂ by at least 50% during 2020-2025, and to **zero by 2038**. However, Manchester is not reducing its emissions at a rate to meet our obligations under the Paris Agreement. We are enhancing our effort to rapidly cut emissions by setting ambitious actions for local government, businesses and citizens.



Climate risk, resilience and adaptation

Whilst climate mitigation is vital, **climate adaptation and resilience is urgent**. We are assessing our climate risk. [Manchester's climate risk: a framework for understanding hazards & vulnerability](#) establishes a structure for this work that can be used at city-scale and by individual sectors and organisations.

We have developed a vision for climate resilience – **MCR: Manchester Climate Ready**. This includes actions for city-wide stakeholders and citizens, enabling us to respond to the climate emergency with ingenuity and a collective ambition to create a city that is happier, healthier, and more socially and economically just.

Playing our part in responding to climate change

Working in partnership: MCCP is a consortium of 60 organisations across 10 sectors, comprising 20% of the city's economy, with influence over the remaining 80%. We work to drive down emissions and adapt to climate change through collaboration and partnership. We ask organisations to publicly declare their commitment to climate action and have established a City-Business Climate Alliance (CBCA)



Nature based solutions: collaborating with other European cities, Manchester led the [Grow Green Project](#) which delivered the [West Gorton community park](#), demonstrating the delivery of community amenity with climate resilience. The park 'drinks' water with swales and permeable paving that reduces run-off and with a view to alleviating flood risk. We are integrating lessons from this project into forthcoming large-scale strategic developments across the city.

Supporting communities and residents: Our [In Our Nature](#) programme supports residents to understand the benefits of climate action through community engagement and delivery of neighbourhood level projects including active travel, local food growing and creating eco-streets.

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Authored by Sam Nicholson and Paul O'Hare on behalf of Manchester Climate Change Agency.

LINKS AND REFERENCES

DATASETS

UK Climate Projections
– Land and Marine



Climate Stripe
historical dataset



Regional Climate
Summaries



UK State of the
Climate Report 2020



Global Warming Levels
and UK Impacts



CITY PACKS AND ACCOMPANYING RESOURCES

City Packs



Infographic on
the co-production of
the first City Pack with
Bristol City Council



Case Study on the
uses of the City Pack



FACTSHEET / EXPLANATION RESOURCES

Headline findings
for the UK



How to download
UKCP data using the
UKCP User Interface



Factsheet –
Representative
Concentration
Pathways



RESOURCE TO INFORM ADAPTATION AND RESILIENCE

Climate Change
Committee Resources



UK Climate
Resilience Programme



Core Cities Group



UK Government
Green Book – Climate
Change Supplement



If anyone would like to provide feedback or discuss the factsheets further with a member of the Urban Climate Services team, we can be contacted via email at: urbanclimateservices@metoffice.gov.uk

This work was supported by the UK Research & Innovation (UKRI) Strategic Priorities Fund UK Climate Resilience programme. The programme is co-delivered by Met Office and NERC on behalf UKRI partners AHRC, EPSRC, ESRC.

Appendix B

Ground Model



Pre-Remediation Ground Model

Rev A

VertaseFLI for
Nuvu Investments Ltd
November 2023

REPORT TITLE: Pre-Remediation Ground Model

REPORT NUMBER: Rev A

CLIENT NAME: Nuvu Investments Ltd

This report has been prepared by Vertase FLI Limited with all reasonable skill, care and diligence and is based on the resources devoted to it by agreement with the client. The report is confidential and for the sole use of the client and for the specific scheme as referred to herein. The copyright of the report is held by Vertase FLI Limited. Copies may be passed to third parties only with the express written permission of Vertase FLI Limited and then no professional liability or warranty will be extended to such parties without the express written confirmation of Vertase FLI Limited.

The report is only valid when used in its entirety.

The findings and opinions contained in this report are based on information from a variety of sources which Vertase FLI Limited believes to be reliable. Whilst this information has been accepted in good faith Vertase FLI Limited cannot guarantee its reliability or authenticity. All potential contamination, constraints or liabilities associated with the site may not necessarily have been revealed. The potential exists for variations in soil and groundwater conditions, including contaminant concentrations, between and beyond the specific locations investigated. No liability can be accepted for such variations.

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Issue 1	Revision A	23/11/2023

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Appendices

Appendix A	Historical Reports References
Appendix B	Drawings

1.0 Introduction

1.1 Appointments

- 1.1.1 Vertase FLI Ltd (VertaseFLI) was employed by Nuvu Investments Ltd ('the Client') to undertake pre-contract services to address the requirements of outstanding pre-commencement planning conditions associated with proposed land remediation works at the former Jackson's Brickworks, off Ten Acres Lane, Newton Heath, Manchester ('the Site'). Wardell Armstrong LLP (WA) has been retained by the Client as independent environmental consultant to oversee the land remediation works upon commencement.

1.2 Legal Context

- 1.2.1 Permission to undertake the proposed land remediation works was granted by Manchester City Council (MCC) (MCC application number 129197/FO/2021) subject to conditions.
- 1.2.2 The planning permission for the proposed land remediation works is intended to enable redevelopment of the site for a mixed residential and commercial end use, which has also been granted permission by MCC (MCC application number 133700/FO/2022).

1.3 Document Purpose

- 1.3.1 The purpose of this report is to build upon site investigations and previously submitted reports to better define the ground conditions and geological setting of the site, as well as provide further clarity on the deposited waste and other materials at the site.
- 1.3.2 This is required to inform the remediation scope and strategy of works and practical elements of the remediation as well as contributing to the understanding of the environmental setting and conceptual site model (CSM) for the site. The use of a detailed ground model, Pre-Remediation, will be followed post remediation with an updated "Post Remediation Ground Model". This updated ground model will contain, as well as historic information, a complete data set collected during the remediation in order to:
- 1) Confirm the CSM.

- 2) Present and assess PFAS related data collected to aid risk assessment.
- 3) Provide validation and verification data.
- 4) Provide details collected during execution of the "Dynamic Strategy".

1.3.3 The Post Remediation Ground model will utilise a bespoke designed database application that will collate and visualise all relevant data. This database will be related to the site-based grid system and data will be recorded on a 3-Dimensional basis. This database system is known as "VertaVerse" and will be a live application throughout the Remediation works. This will be available for review by the Remediation team and the regulators and will provide a full documented record of the works.

1.4 Relevant Previous Work.

1.4.1 The information contained within the reports prepared by Celtic and Wardell Armstrong has been used to inform the Pre remediation ground model. Where necessary, the information has been supplemented with primary data collected by VertaseFLI. See Appendix A for full report references.

2.0 Pre-Remediation Ground Model

2.1 Data input and Modelling approach

- 2.1.1 The site has been modelled using data from the various ground investigation reports, (Celtic 2007), (Wardell Armstrong 2019, 2020, (combined in 2022)). Data has been extracted from the site investigation locations to create a model that shows the meters above ordnance datum (mAOD) of the base of made ground across the site.
- 2.1.2 Analysis of the logs has allowed the determination and classification of the type of made ground based on this analysis. This in turn has led to the creation of a made ground model (Shown simply in Figure 1) using Surfer13 and LSS and has allowed for the volumetric assessment and definition of each material on site.

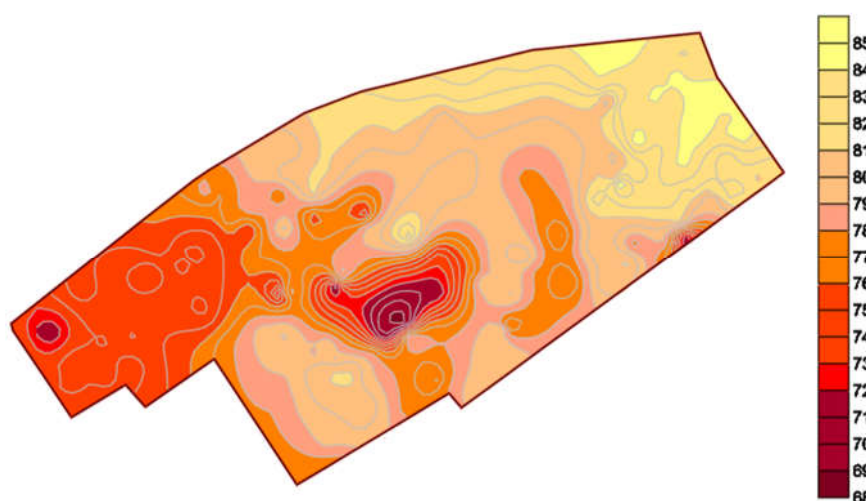


Figure 1 – Depth of Made Ground mAOD.

- 2.1.3 Figure 2 below and in Appendix B as D4744_16 shows the depth of made ground below current ground level. VertaseFLI have utilised this information to create a 'proposed dig model' (Figure 3, Figure 4, and Figure 5) which is a basis for the remediation platform or remediation formation level for the development.



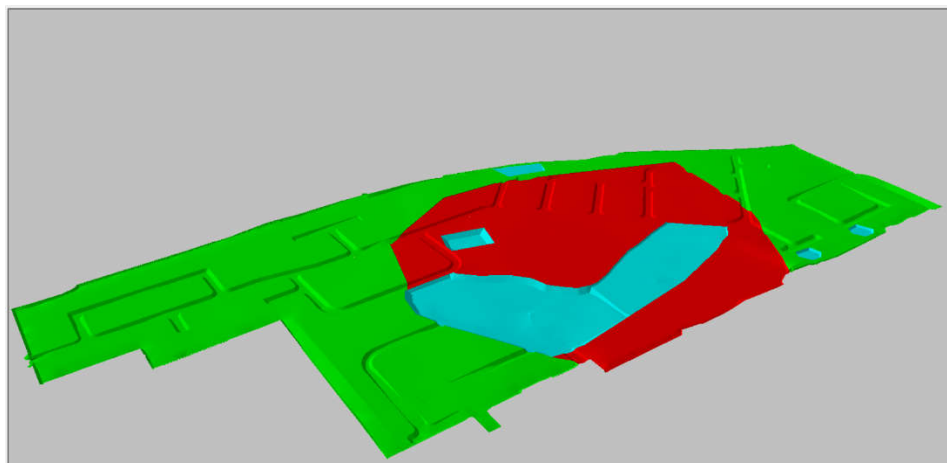


Figure 4 – Proposed Dig Model

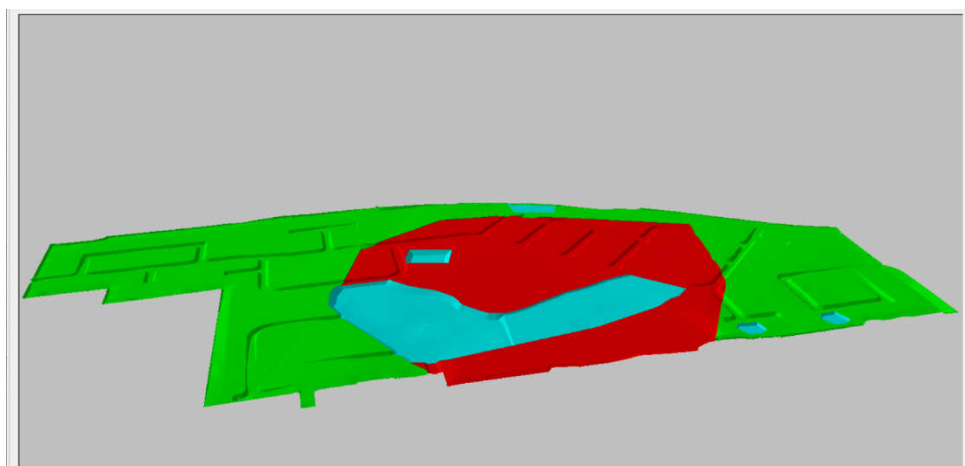


Figure 5 – Proposed Dig Model

- 2.1.4 The proposed dig model forms the basis for the excavation works and sets the areas for the implementation of the Dynamic Remediation Strategy with is detailed within the VertaseFLI Remediation Strategy.

2.2 Site Boundaries

- 2.2.1 The site is located west of the centre of Manchester in the Newton Heath area. The site is accessed via Ten Acres Lane on the Southwestern side of the boundary. The approximate grid reference for the centre of the site is SD 87556 00288.

- 2.2.2 Figure 6 below and in Appendix B as D1932_20 shows the fenced area of the site, which is approximately 19.3ha, situated by Ten Acres Lane to the Southwest, Rochdale canal to the North, Briscoe Lane and associated housing to the South and Mitchell Street to the Northeast. The site also shares a boundary with the Ten Acres Lane Sports complex to the Southwest. The area is a mix of residential, commercial, and industrial uses. On the boundary to the site in the north, east and west it is mainly residential, with commercial or derelict sites to the west.

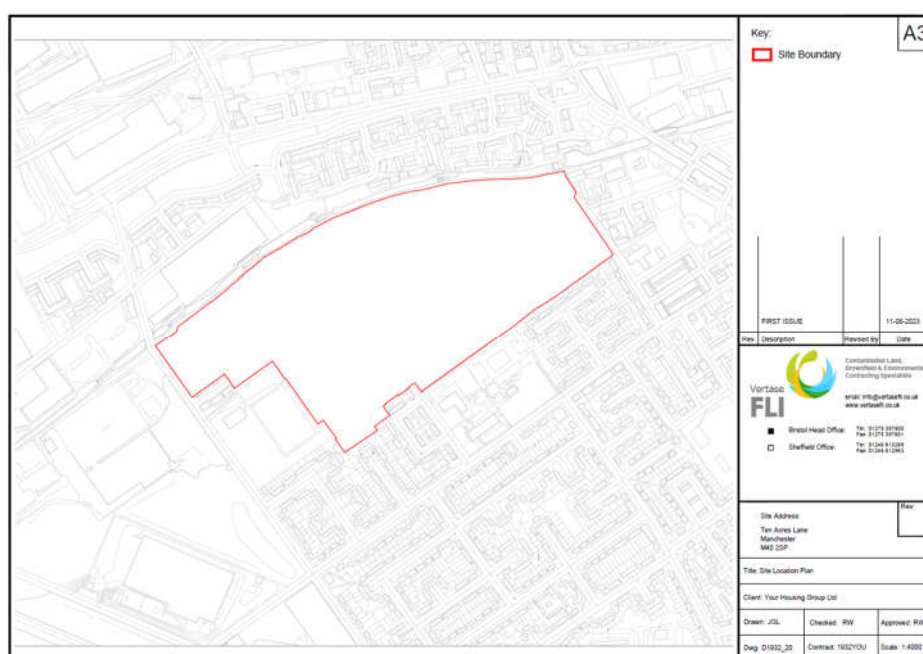


Figure 6– Site Boundary

- 2.2.3 The site has been left to become overgrown scrub land with former self set trees now removed. The aerial photos (figures 7-10) below show the site following the vegetation clearance in 2022.



Figure 7-View north – Rochdale Canal and housing dense housing and well as industrial and commercial buildings



Figure 8- View west – views of industrial and commercial in the foreground with central Manchester in the distance



Figure 9-View east – mainly housing in close proximity to site with some commercial use and the canal to the north of the site.



Figure 10-View southeast – views of housing in the immediate area with the primary school to the south of the site to the right of this photo

2.3 Historical Uses

- 2.3.1 The site has had many previous uses in the past century, including the site of two brickworks, sports pitches and most recently was used as a landfill. The history of the site, in particular the way the brick pits were progressed and filled and how this correlates with the trial pit and

borehole logs and natural strata is key to providing a full understanding of the site and hence the design of any Remediation.

2.3.2 The below figures (Figures 11-19) below give an overview as to how the site was excavated and filled and aids in the preparation of a final ground model and the interpretation of the site investigation data.



Figure 11 – 1848 OS Map – Shows Open Fields



Figure 12 – 1889 – Shows the introduction of reservoir in the north and Brickworks to the west and various waterbodies across the site.



Figure 13 – 1905 – Brickworks constructed to the east and the introduction of outlines of excavations.



Figure 14 – 1915 – Increased excavations shown.

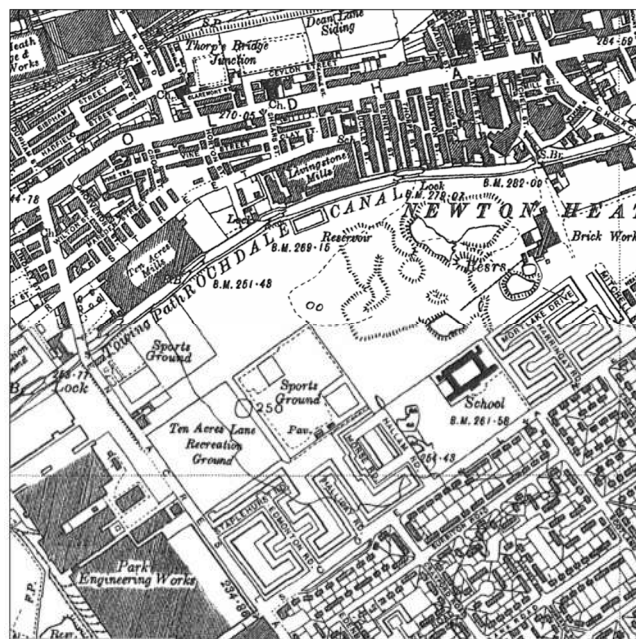


Figure 15 – 1938 – Brickworks to the west removed and replaced with sports ground, sports ground present in the southwest corner of the site.



Figure 16 – 1947 – Site largely unchanged.

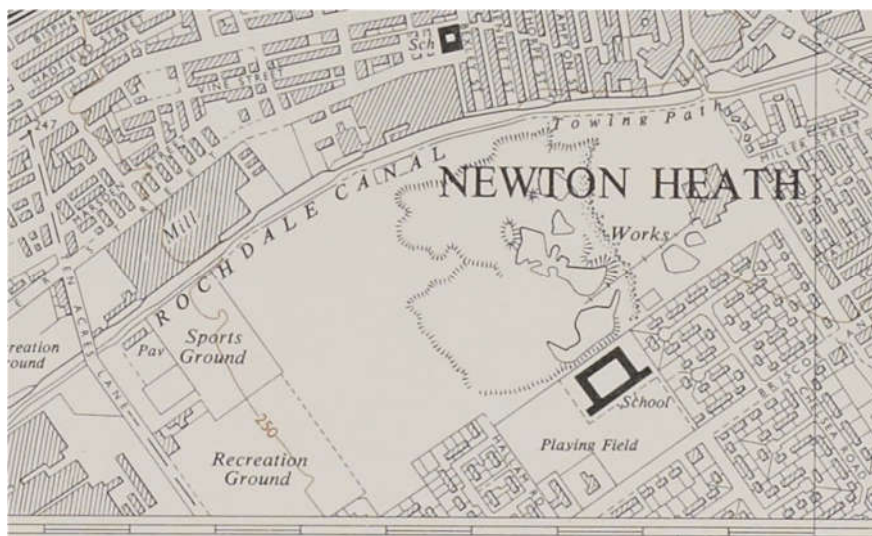


Figure 17 – 1956 – Removal of sports ground in the southwest.

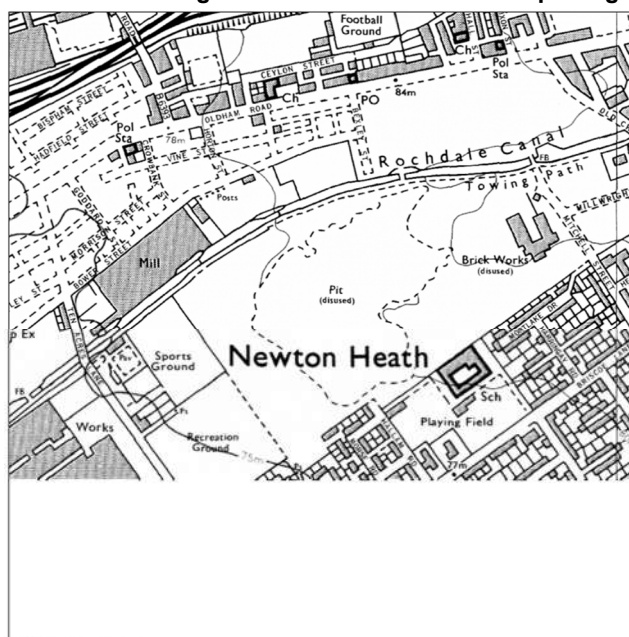


Figure 18 – 1978 - Shows brickworks and pit to the east as disused.

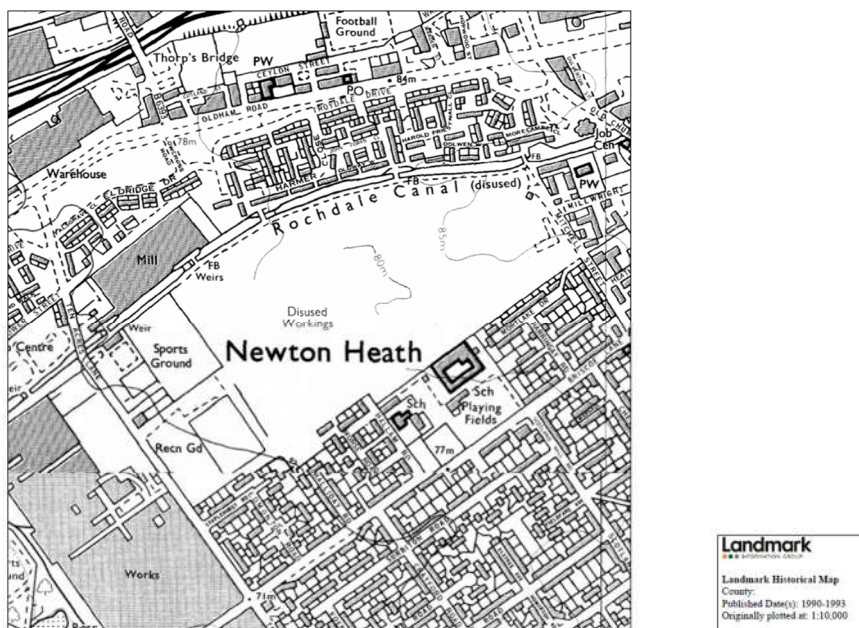


Figure 19 – 1993 – Shows the entire eastern part of the site as disused with the sports ground still present in the west.

2.4 Site Topography and Vegetation.

2.4.1 The site gently rises from west to east approximately 76mAOD to 85mAOD with a slight domed centre peaking at 86.5mAOD (Figure 20 below and in Appendix B as Drawing D1932_06)) an initial site clearance of mature trees has been completed and is shown on Figure 21 and in Appendix B as Drawing D1932_07.

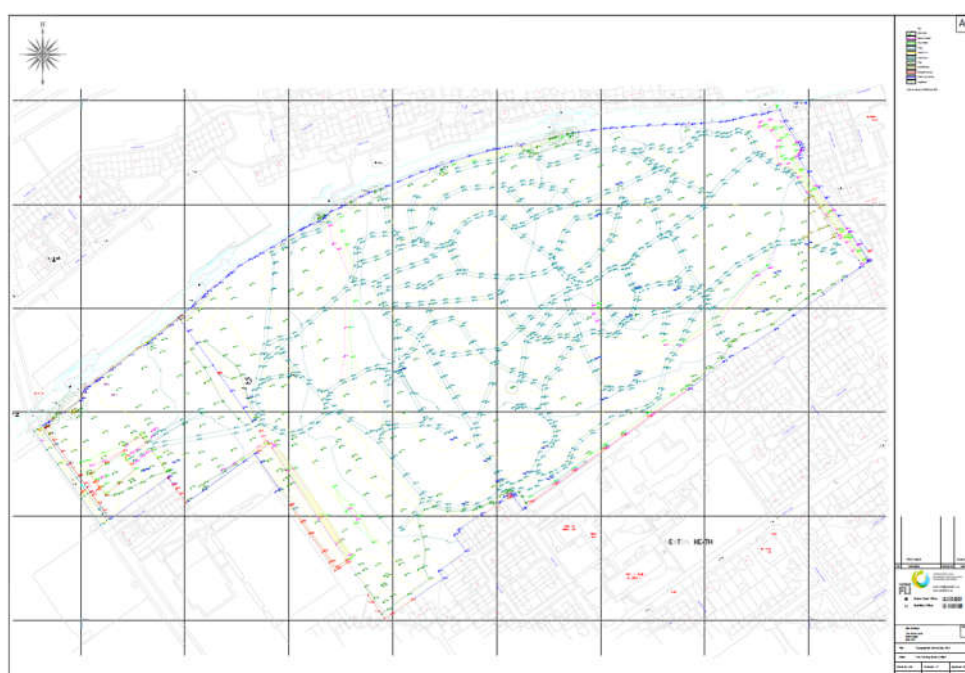


Figure 20 – Topographical Survey May 2022

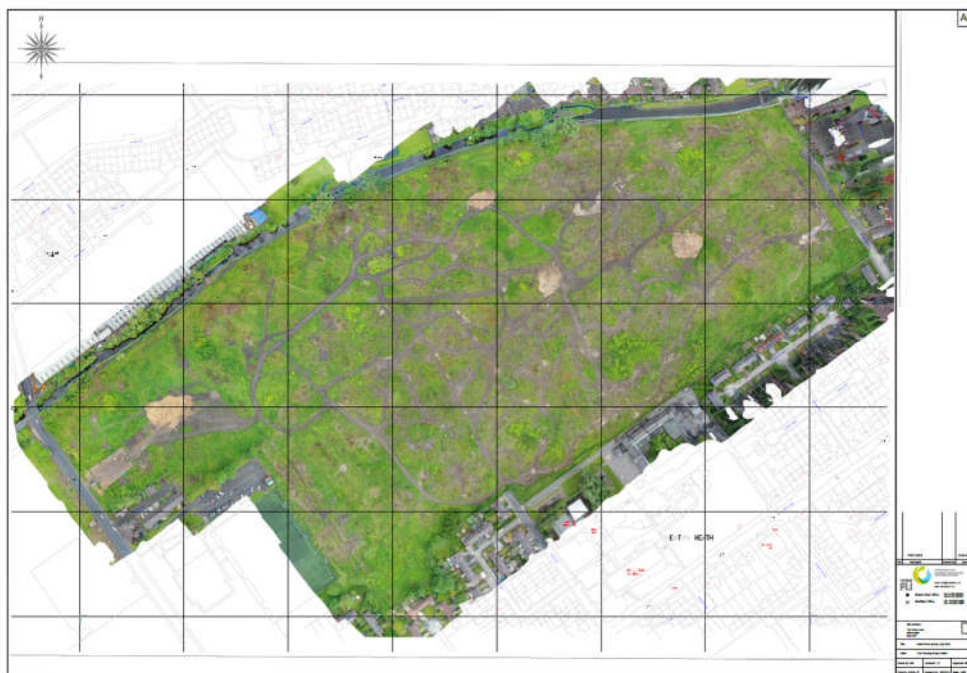


Figure 21 – Aerial Photograph showing initial site clearance June 2022

- 2.4.2 The site is currently derelict bounded by mature hedges to the north, west & south and a fence and Mitchell Street to the east.

2.5 Other Features of Note

- 2.5.1 A drainage ditch is present to the south of the site which has been installed to manage excess leachate which “overtops” the deeper fill area to this part of the site which was an historic brick pit. This is now managed and is currently pumped, treated and removed from site (Figure 22 below and in Appendix B as Drawing D1967_07).

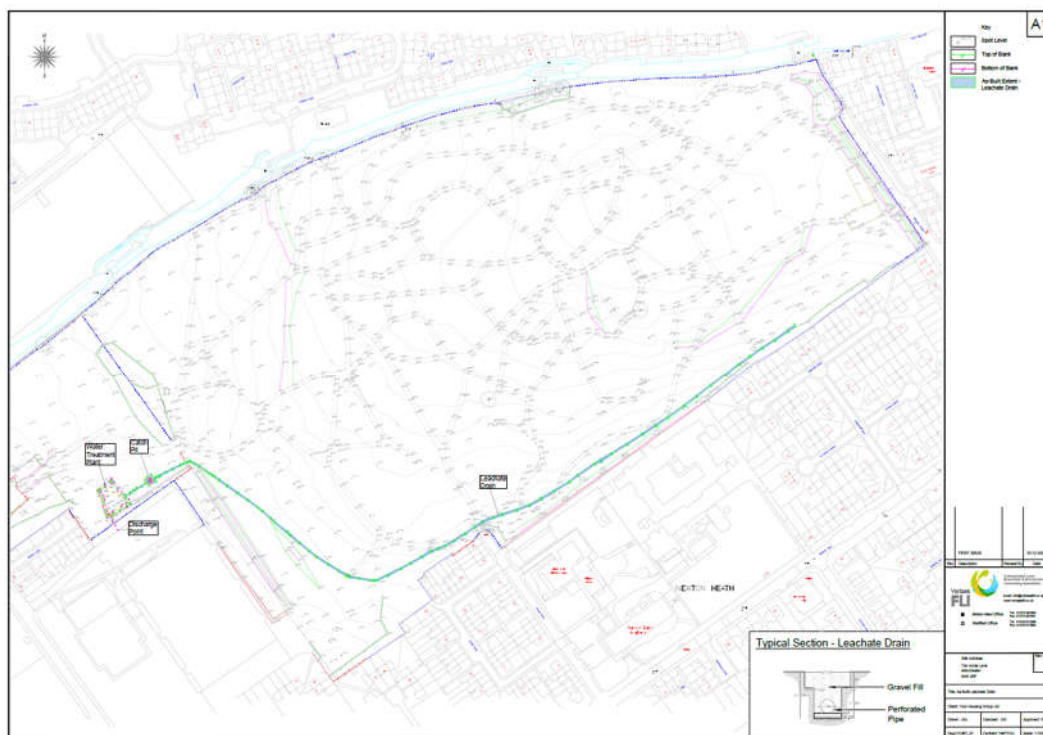


Figure 22 – Leachate Drain General Arrangement

- 2.5.2 The following figure (Figure 23 below and in Appendix B as Drawing D4744_15) summarises the preceding to show the site features presents an overview of historic features. It also highlights that now surrounded by mainly housing and commercial property and the Rochdale Canal. This general history of the site has then been cross referenced to trial hole and borehole logs along with the topographical data, photographs, and observations to construct the overall ground model.

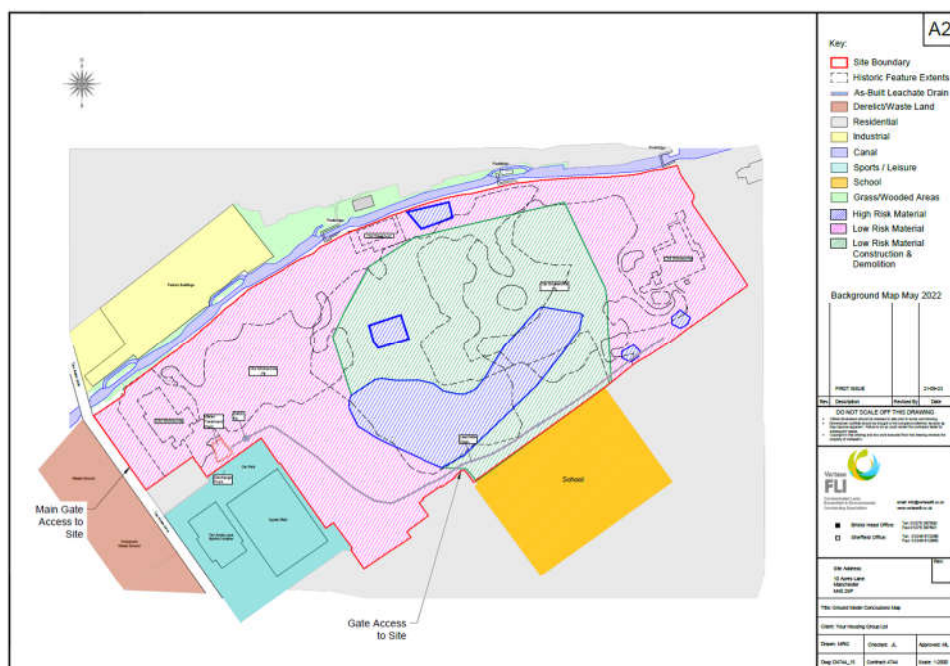


Figure 23 – Site Features

2.6 General Ground Conditions

2.6.1 Below is a summary of the current ground make up for the site for more detail refer to the historic site investigation reports, Conceptual Site model, DQRA and Options Appraisal/Remediation Strategy. References for which can be found at Appendix A.

2.6.2 Table 01 outlines a basic summary of the strata at the site.

Table 01: Summary of Strata

Strata	Description (taken from WA reports)
Made Ground	Comprises various types of Made Ground which include general granular soils, general cohesive soils, suspected combustion waste, suspected colliery spoil, construction and demolition waste and household waste.
Glacial Till	<p>Firm to stiff, fissured, brown, slightly sandy to sandy, gravelly clay with occasional lenses of predominantly medium dense, brown/grey gravelly clayey sand.</p> <p>The Glacial Till is identified to be a Secondary (Undifferentiated) Aquifer based on the BGS Aquifer Designation Map (Superficial Drift).</p>
Weathered Sandstone of the Collyhurst Sandstone Formation	<p>Extremely weak to weak, laminated, reddish brown, fine to coarse grained sandstone with well-rounded "millet seed" grains.</p> <p>The sandstone is identified to be a Principal Aquifer based on the BGS Aquifer Designation Map (Bedrock).</p>
Weathered Sandstone of the Chester Formation	<p>Reddish brown, fine to medium sand with black, red, white, and green grains and rare angular, fine black gravel.</p> <p>The sandstone is identified to be a Principal Aquifer based on the BGS Aquifer Designation Map (Bedrock)</p>

2.7 Made ground material types and classifications.

2.7.1 The next step in construction of the ground model was a review of all historical and recent site investigations. Logs, descriptions, and photographs were interrogated in order to allow the development of material type classifications. It is necessary to undertake this type of classification much in the way that natural geology is classified into

Strata. The evidence reviewed has allowed VertaseFLI to create three different material classifications of Made ground. All logs and supporting information can be found in the appendices of the relevant historical reports references for which can be found at Appendix A.

2.7.2 There are three main classifications of made ground materials which have been defined as follows:

- High Risk Materials or HRM
- Low Risk Materials-Construction and Demolition waste or LRM C&D
- Low Risk Materials or LRM

2.7.3 Further details and definitions of the above are set out in the following sections. A selection of photographs has also been included that typify each of the classifications to allow for future classification on site during the works and a greater understanding of the material types identified. Written descriptions alone can be complex and difficult to interpret.

2.7.4 High Risk Materials (HRM)

2.7.5 High Risk Materials are the materials we might reasonably and quickly identify traditionally as “waste”. The sort of material we would expect not to be readily reuseable or contain significant proportions of concrete and other materials that could and are regularly recycled for re-use as aggregates within construction. HRM could comprise the following components or a mixture of the following components. We have also added a “type” code to each of these to aid in clarity and referencing.

Type H1: Putrescible waste i.e., waste that can de-compose quickly.

Type H2: Chemical waste/Contamination above risk-based thresholds i.e., hydrocarbons, solvents, etc.

Type H3: Drums, tanks, chemical containers.

Type H4: Clinical Waste.

Type H5: Licensed Asbestos graves

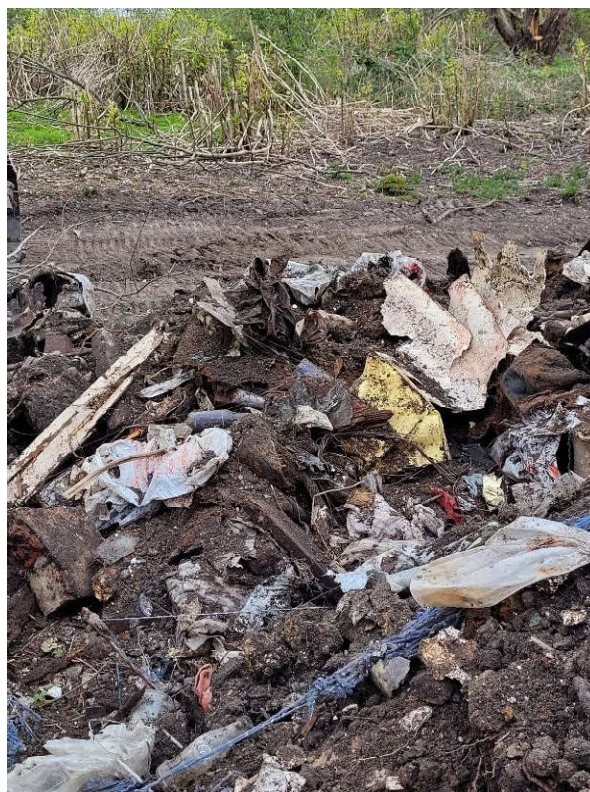
Type H6: Tires.

Type H7: Waste Electrical Items.

Type H8: Undesirable waste within a soil or rubble mass, within a grid square which is greater than 40% by volume and which may pose an ongoing risk of PFAS to controlled waters including.

- i. Plastic,
- ii. Carpets and other textiles,
- iii. Metal including household items such as pans, etc.
- iv. Rubber / PVC.

Typical Photos of HRM from the site investigation are below:



2.7.6 Low Risk Materials C&D (LRM C&D)

2.7.7 From a review of the data, it is also evident that there is a significant proportion of the waste, which is predominantly recoverable hard materials such as concrete, brick tile etc that can be segregated and crushed to reuse as engineered fill or aggregate. Whilst this material does contain some "waste" elements, the matrix is that which would be referred to as construction and demolition waste which is regularly recycled in the industry currently. This classification therefore could comprise the following components or a mixture of the following

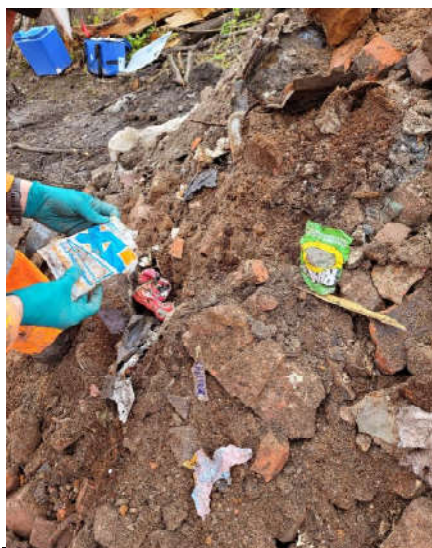
components. We have also added a "type" code to each of these to aid in clarity and referencing.

Type L1: Made ground containing construction and demolition waste and not meeting the definition of high-risk material,

Type L2: Concrete, asphalt, bricks, ceramics, glass

Type L3: Ash / clinker with other incidental materials present in small proportion (20%-40%)

2.7.8 Typical Photos of LRM C&D from the site investigation are below:



2.7.9 Low Risk Materials (LRM)

2.7.10 Remaining materials that are not naturally occurring are what would often be referred to as "Made Ground" on Brownfield sites. This material is varied in nature but importantly contains only small proportions of waste or deleterious materials.

Type M1: Coal Measure Overburden with contamination concentrations not exceeding risk-based thresholds.

Type M2: Other natural geology with contamination concentrations not exceeding risk-based thresholds.

Type M3: Ash / clinker and other made ground materials (including Topsoil, subsoil etc.) with contamination not exceeding risk-based thresholds with other incidental materials present in small proportion (<20%)

2.7.11 Typical Photos of LRM from the site investigation are below:



2.8 Groundwater and Leachate Levels

- 2.8.1 Historically there has been a lack of clarity with respect to groundwater and leachate levels at the site and their interaction with the surrounding ground both on site and in adjacent water bodies. As part of more recent works as well as historically, a number of groundwater monitoring rounds have been completed, the results of which have been assessed and analysed. Boreholes have been screened across a variety of strata/horizons and it can be seen that once these are segregated correctly there a number of distinct water bodies at the site. We have reviewed the historic data as collected by Celtic in 2007 and more recently by VertaseFLI in 2023.
- 2.8.2 There is water body within the Sandstone Aquifer which is confined by the Glacial Till. This is not in continuity with the fill materials at the site. Data from the sandstone aquifer has been contoured separately from other horizons, and it is seen to not be in direct continuity with the fill materials.
- 2.8.3 There is also a water table within the shallow natural deposits at the site which can be seen to have a different flow pattern when contoured to both the Deeper Sandstone aquifer and also to the made ground or "leachate" contours.
- 2.8.4 The flow pattern within the made ground/leachate has changed significantly over time. From the data and the flow patterns and from examination of the resulting 3D ground model, we are confident that the leachate in the site has been slowly filling the "waste pits" over time and that the daylighting or springing of water observed (and now managed) is as a result of the filling of these pits. If one looks at the below-ground topography, the leachate level, and the ground level, this can be clearly seen.
- 2.8.5 Whilst flow patterns differ, as might be expected, each of the 3 horizons are distinct. However, it is recognised that with coincidental groundwater levels in the shallow natural aquifer and the leachate in places, it is possible that a link between the made ground aquifer and the shallow natural aquifer may be present in places but not in all areas of the site.

- 2.8.6 This data has also been added to the ground model as Figure 24 to 26 below and also in Appendix B and Drawings D1932_07, D1932_21B and D1932_21, to enable the assessment of the interaction between excavations, remediation and the management/remediation or groundwater/leachate. Remediation requirements will be set out in the Remediation Strategy.

Figure 24: GW data (Celtic)

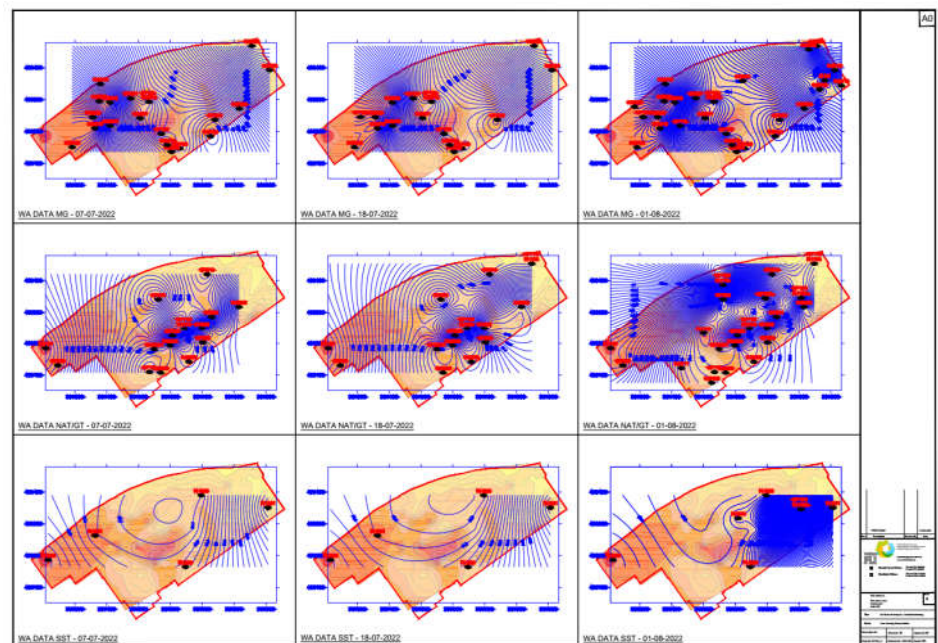


Figure 25: GW Data (WA)

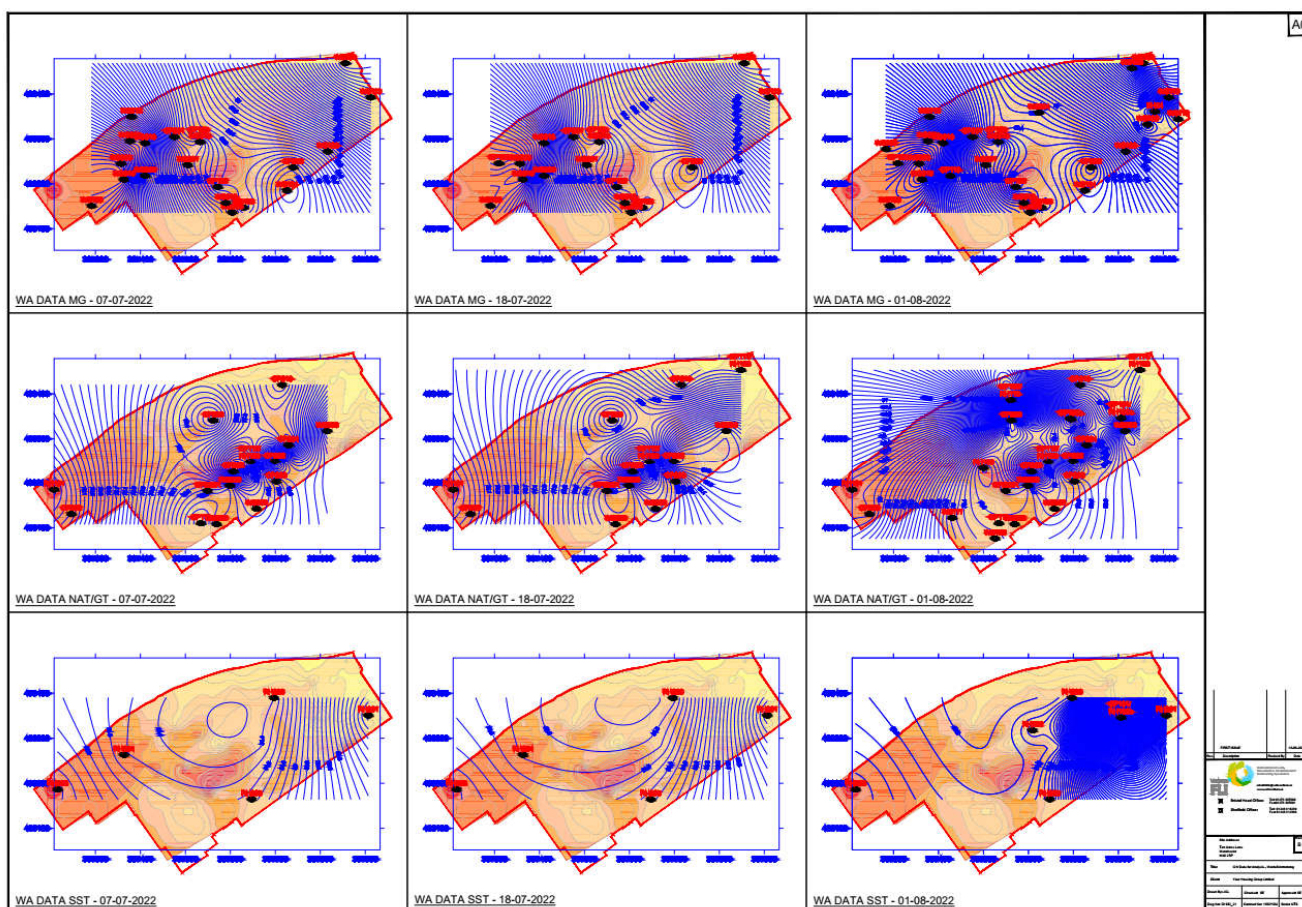
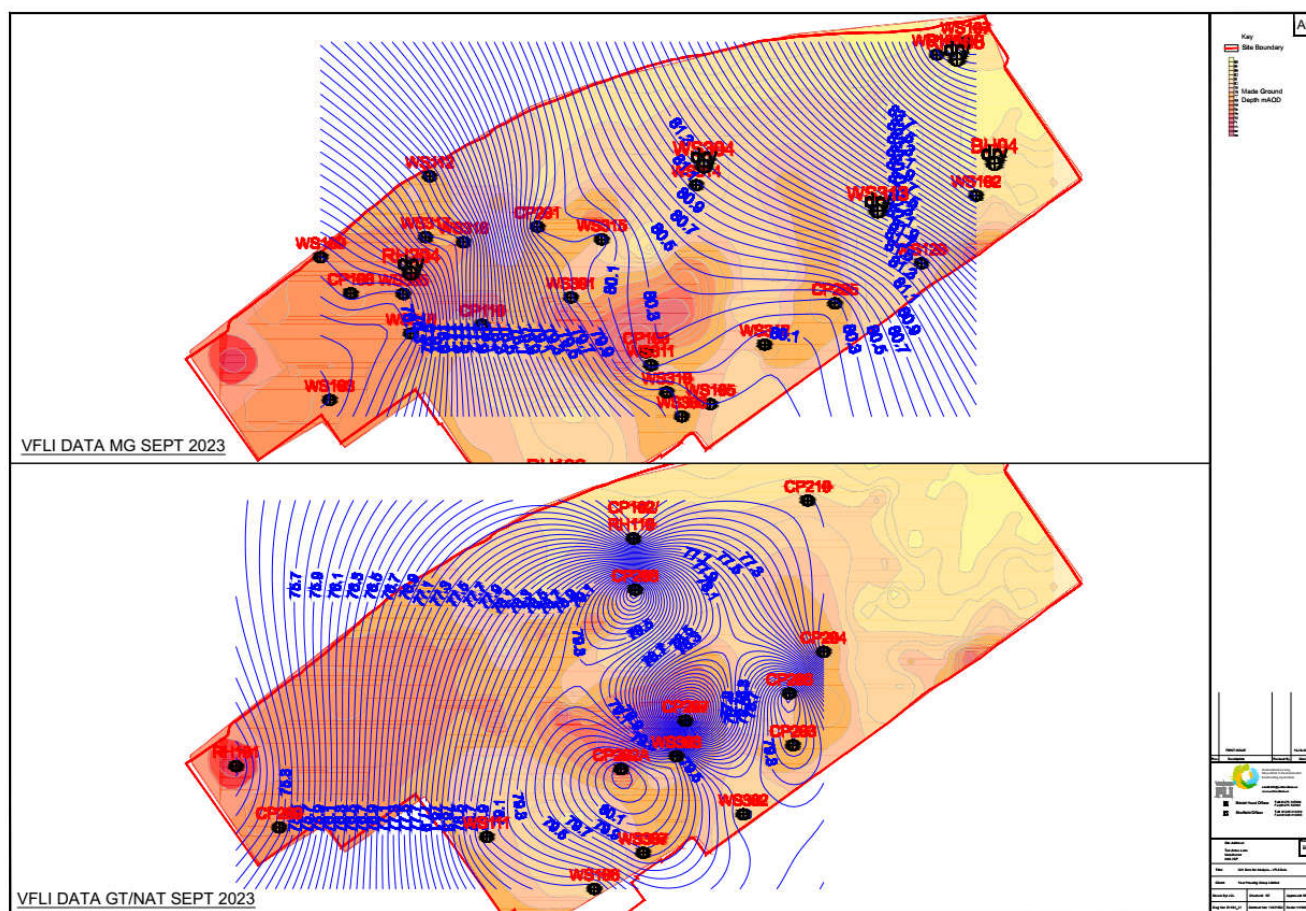


Figure 26: GW Data (VertaseFLI)



2.9 Invasive species

- 2.9.1 The site investigation works have identified non-native invasive species on site that include Japanese Knotweed. A separate invasive species management plan has been prepared and presented within the *VertaseFLI Options Appraisal and Remediation Strategy, November 2023*. and remedial works will be carried out prior to the main remediation works on site.
- 2.9.2 Figure 27 below and in Appendix B as Drawing D1932_08 shows the identified extent of invasive species on the site. It is important to note that the invasive species occur in areas of HRM, LRM C&D and LRM. Material containing Japanese Knotweed or other invasive species will be first segregated and managed for the Japanese Knotweed presence before other treatment or segregation is considered.

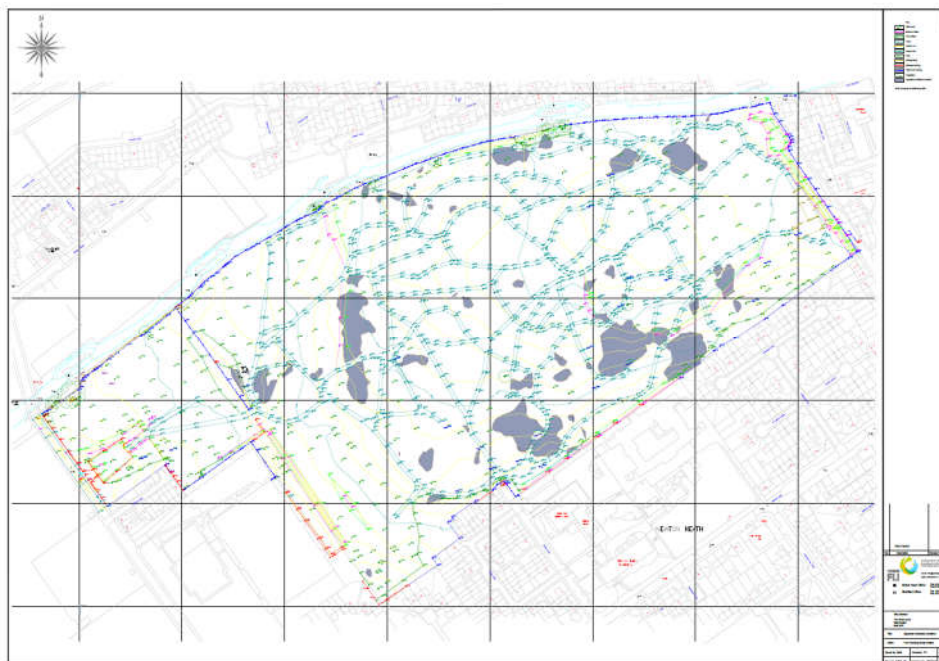


Figure 27 – Invasive Species Location Plan

2.10 Volumes and Spatial Arrangement of Materials

2.10.1 The ground model has been used to determine quantities for the main material types that are targeted for treatment. These Volumes are subject to change as the “Dynamic Remediation Strategy” is implemented but in broad terms the volumes for the basic excavation depth are as follows in Table 02 gives the volumes of material based on classification:

Table 02 – Material Volumes

Material Classification	Volume (m3)
High Risk Materials	83,778
Low Risk Materials C+D	96,110
Low Risk Materials	92,359
Total	272,247

2.10.2 Material boundaries have been defined using a combination of all the available data described in this report and utilising the 3D model constructed in LSS and Surfer. The delineation of the materials has

been done on the basis of the 3 main material types as set out above. LRM, LRM C+D and HRM. The Figure 28 below and in Appendix B as Drawing D4744_12 shows these areas in a simple diagrammatic output from the ground model.



Figure 28 – Material Locations (beneath topsoil).

2.10.3 Topsoil is widespread across the site as shown on Figure 29 and in Appendix B as Drawing D4744_25

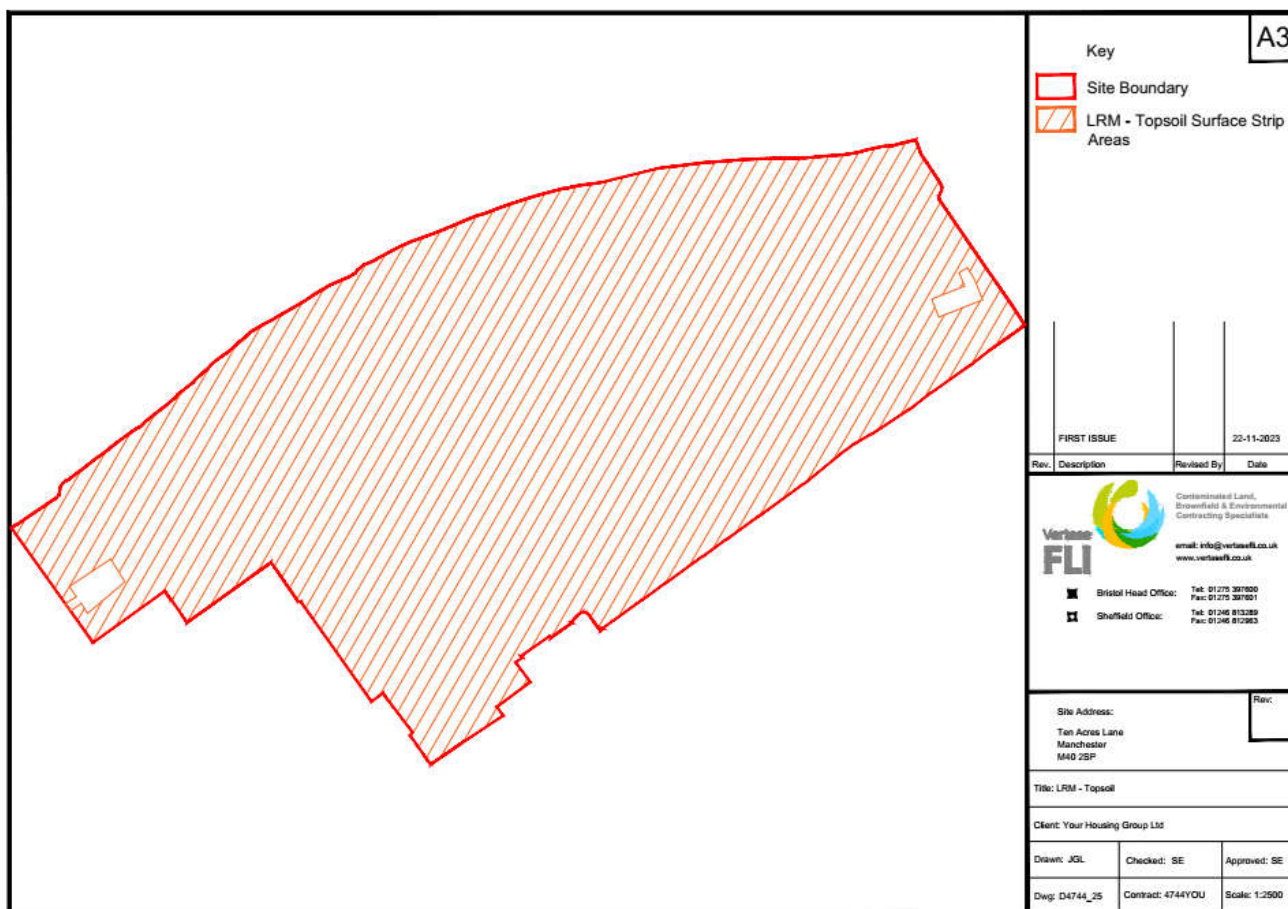


Figure 29 – Topsoil locations

2.11 Contaminant Sources

- 2.11.1 A full assessment of contaminant sources, pathways, and receptors (pollutant linkages) has been made in other reports and is not repeated here. (See References at Appendix A). Notwithstanding the “dynamic approach” to the remediation as part of the development of the ground model, an assessment has been undertaken to ensure that the currently defined hotspots that require remediation are within the stated excavation depths. The use of the VertaVerse database and the further collection of data will also ensure that any contamination hotspots that are found as part of the Dynamic Strategy or further investigation are recorded and added to the ground model.

2.12 Historic Structures

2.12.1 There is the potential for historic structures and foundations in the footprints of the historic brickwork boundaries as well as features associated with both historic sports pitch areas. Figure 30 below in in Appendix B as *Drawing D4744_14* gives an overview of areas where significant historic structures have been identified and again excavation depths have been set to ensure that these structures will be identified and removed during the remediation works.



Figure 30 – Historic Structures

2.13 Services and Utilities

2.13.1 There are several historical services connections to the site which may pose risk to both the future development and may also provide preferential pathways for contamination, vapours, and gas. These pathways are discussed in more detail in the historical reports references for which can be found at Appendix A. For the purposes of the ground model these have been incorporated to ensure that they are managed as part of the remediation works with the recording of work undertaken to these pathways added to the VertaVerse database of the site and ultimately the Post Remediation Ground Model. Figure

31 below and in Appendix B as Drawing D1967_01 shows the services and utilities currently identified on site.



Figure 31 – Services and utilities

2.14 Proposed Development Platform

- 2.14.1 The final piece of the Pre-Remediation Ground Model is the proposed topography of the site post remediation. A development platform has been designed to reflect the final site development landform. This can be seen in Figure 32 below and in Appendix B as Drawing D1932_13.

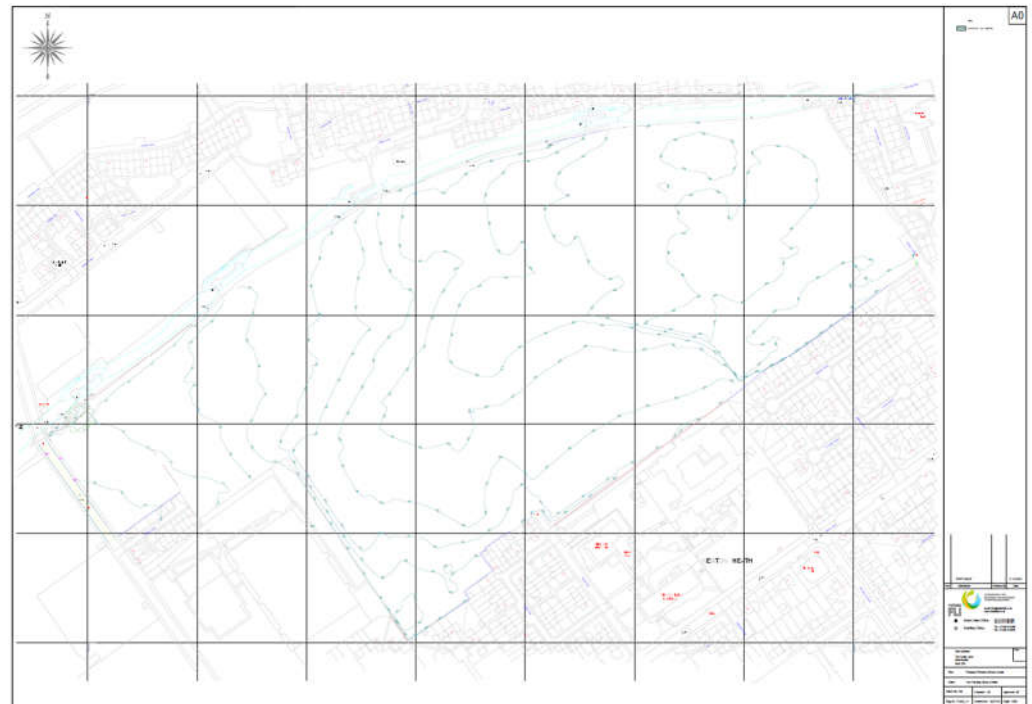


Figure 32 – Proposed Development Levels

3.0 Conclusion

3.1 Ground Model Conclusion

- 3.1.1 There is sufficient understanding of the environmental setting of the site and the ground model has inputted into the Conceptual Site Model (CSM) and understanding of the site source-pathway-receptor linkages and potential linkages. The site investigations and historical mapping for the site are extensive. When combined, they provide a robust understanding of the spatial arrangement and the 3-dimensional arrangement of the historical filling to the site. The compilation of this ground model has allowed us to understand and define the depths of filling, the spatial arrangement of the filling and the volumes of the same. This has allowed us to consider the practical elements of the scheme for both the soils remediation and leachate remediation which will now be set out in the remediation strategy. This ground model forms an essential part of this strategy development in allowing us to interrogate the various options for remediation and to assess and design the practical aspects. The use of the 3D model has also allowed us to classify the deposited materials at the site into 4 distinct categories. Topsoil's, LRM, LRM C&D and HRM each material requiring a different approach and consideration for excavation, remediation, and provision of development platform.

3.2 Post Remediation Ground Model.

- 3.2.1 It is proposed that following the agreement of the Remediation Strategy, the remediation works will be implemented. During the Remediation, the collection of additional data will take place. This will be added to existing data (where relevant) to provide a complete data set for the site, post remediation. This data will be managed through a bespoke application that has been designed specifically for this project. This is known as "VertaVerse". VertaVerse will allow for mobile data collection in the field, and it will enable coordination, sharing and publishing of the existing relevant data, laboratory and ground investigation data collected during the remediation, validation/inspection data, photographs, and other site records. This VertaVerse database will publish data to both the Remediation Project Team and other regulatory stakeholders.

APPENDIX A



Historic Report References

References

Celtic Technologies Ltd. Desk Study. R1077/06/2958. July 2006.

Celtic Technologies Ltd. Interpretative Report. R1077/08/3328. February 2008

VertaseFLI. Detailed Quantitative Assessment of Risk, Issue 1, Rev A, Prepared for Nuvu Investments Ltd. October 2023.

VertaseFLI. Remediation Options Appraisal and Remediation Strategy. Prepared for Nuvu Investments Ltd. November 2023.

Wardell Armstrong. Combined Phase I and Phase II Ground Investigation Report. May 2021. Version 1.1

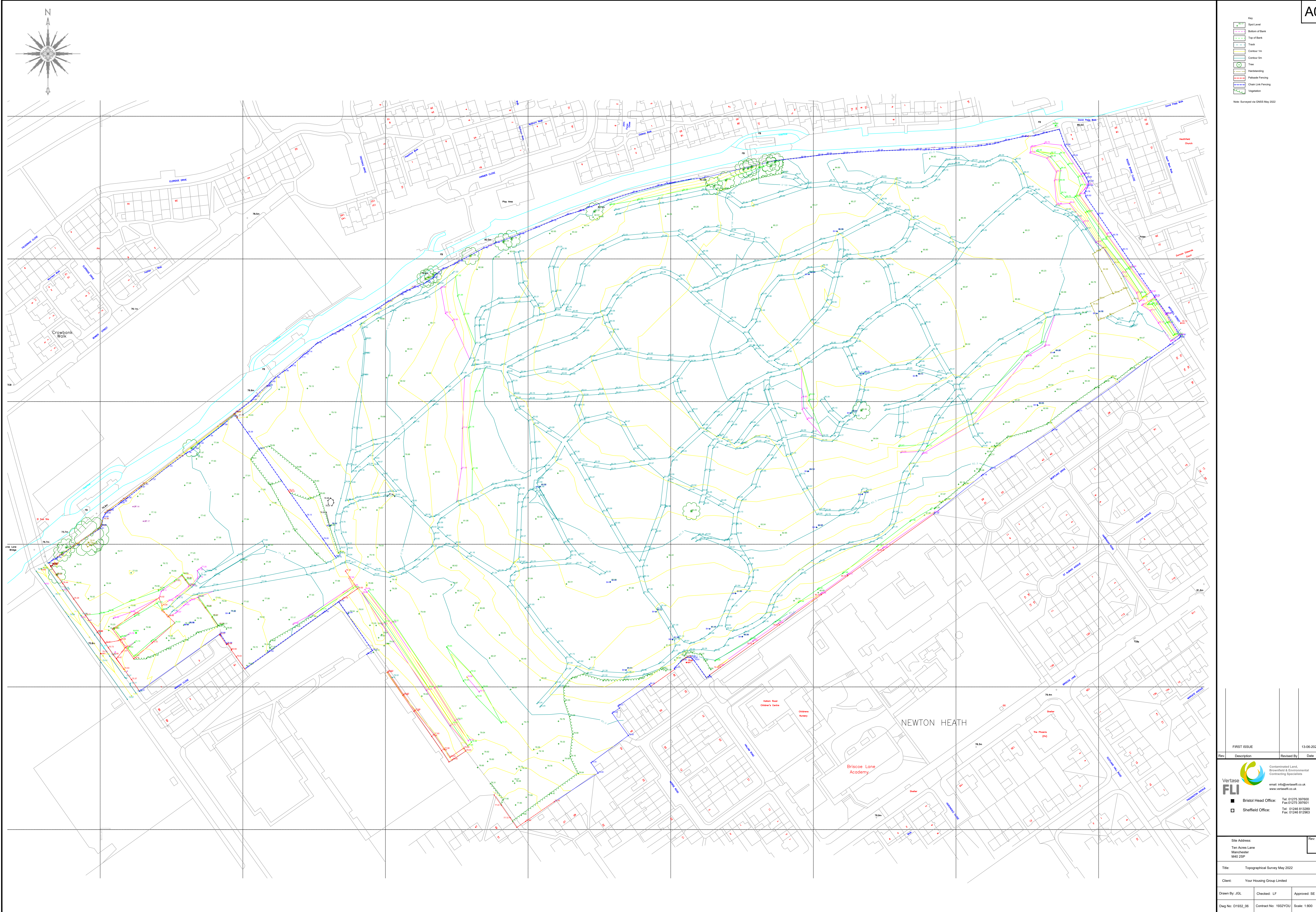
Wardell Armstrong. Updated Combined Phase I and Phase II Ground Investigation Report. October 2022. Version 1.0

Wardell Armstrong. Technical Note. Deeper Ground Conditions and Laboratory Testing Clarifications. April 2023

Wardell Armstrong. Technical Note. Hydrogeological Conceptual Site Model Clarifications. March 2023

APPENDIX B

Drawings



- Key
- Spot Level
 - Bottom of Bank
 - Top of Bank
 - Track
 - Contour 1m
 - Contour 5m
 - Tree
 - Handstanding
 - Palisade Fencing
 - Chain Link Fencing
 - Vegetation

Note: Surveyed via GNSS May 2022

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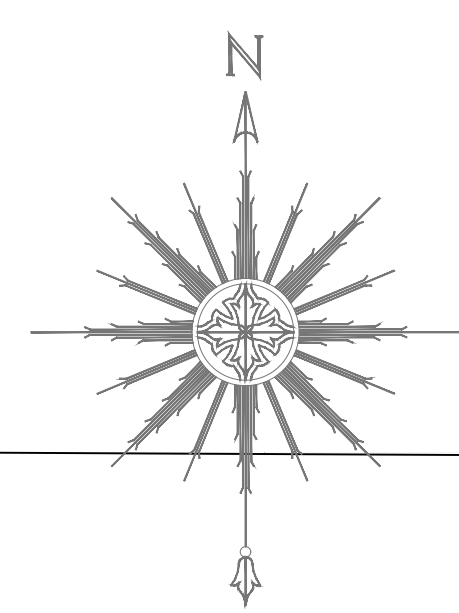
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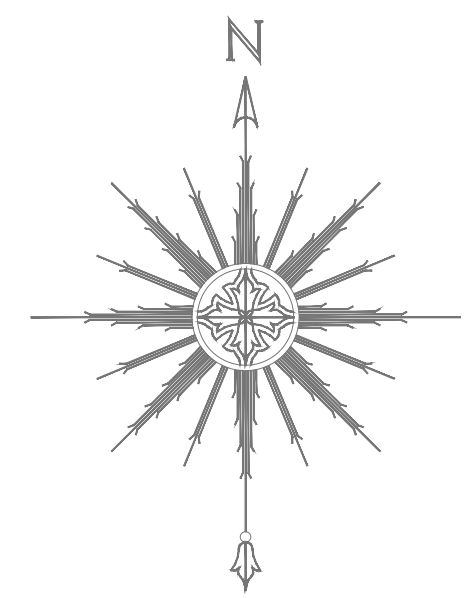
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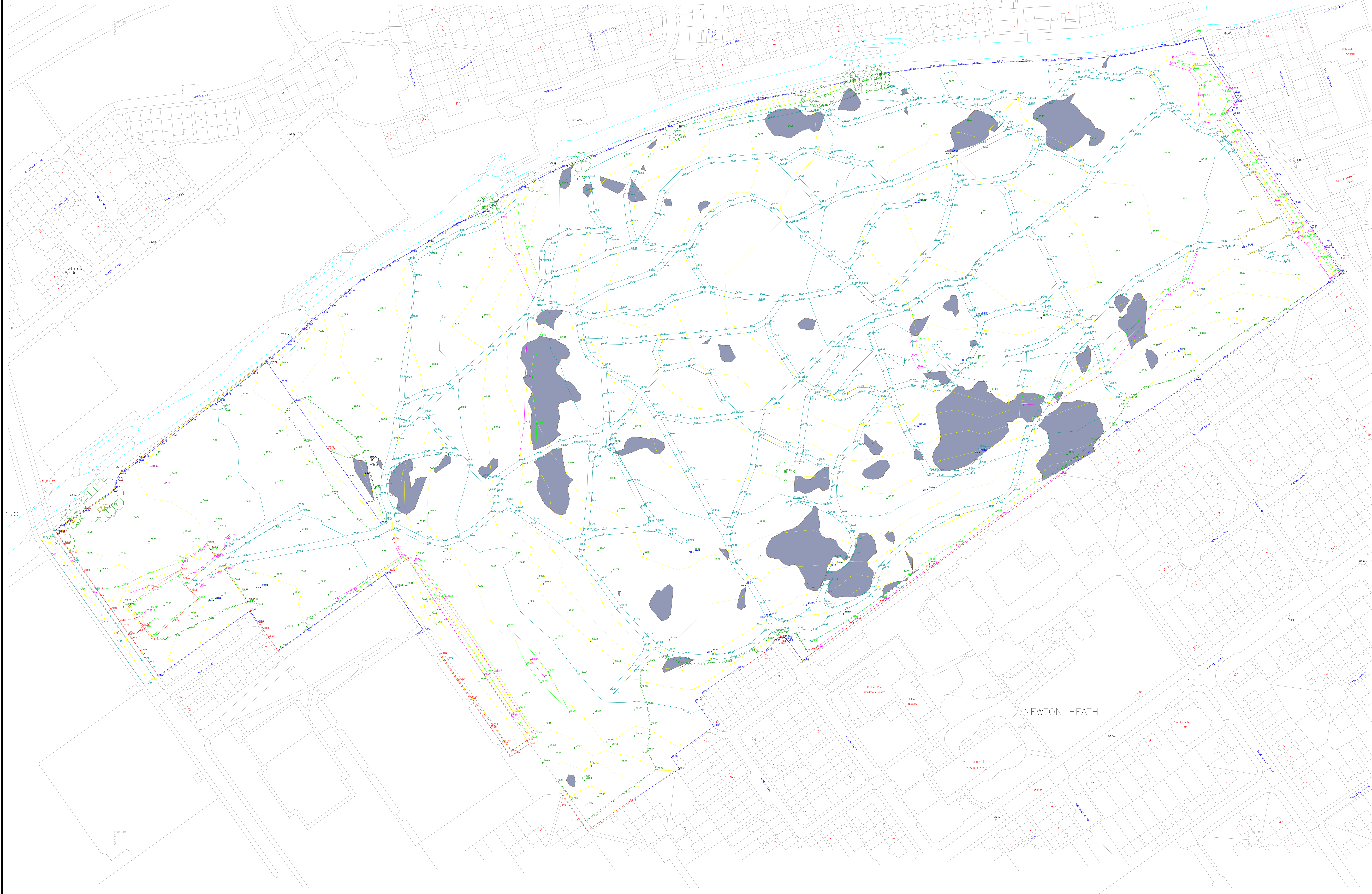


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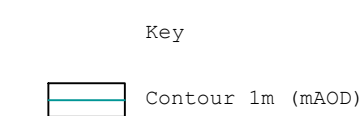


- Key
- Spot Level
 - Bottom of Bank
 - Top of Bank
 - Track
 - Contour 1m
 - Contour 5m
 - Tree
 - Handstanding
 - Pollard Fencing
 - Chain Link Fencing
 - Vegetation
 - Japanese Knotweed Locations

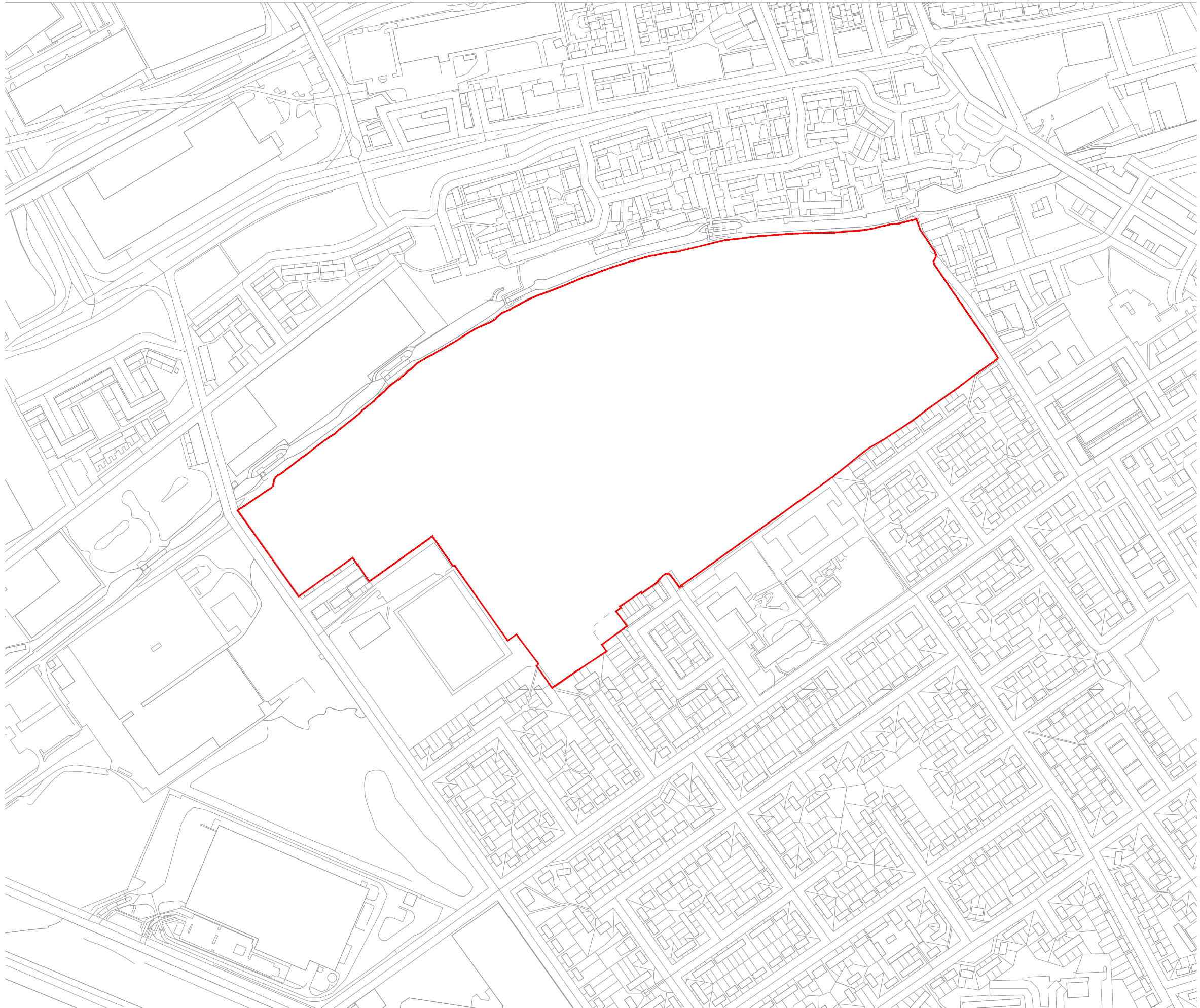
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Key:

Site Boundary

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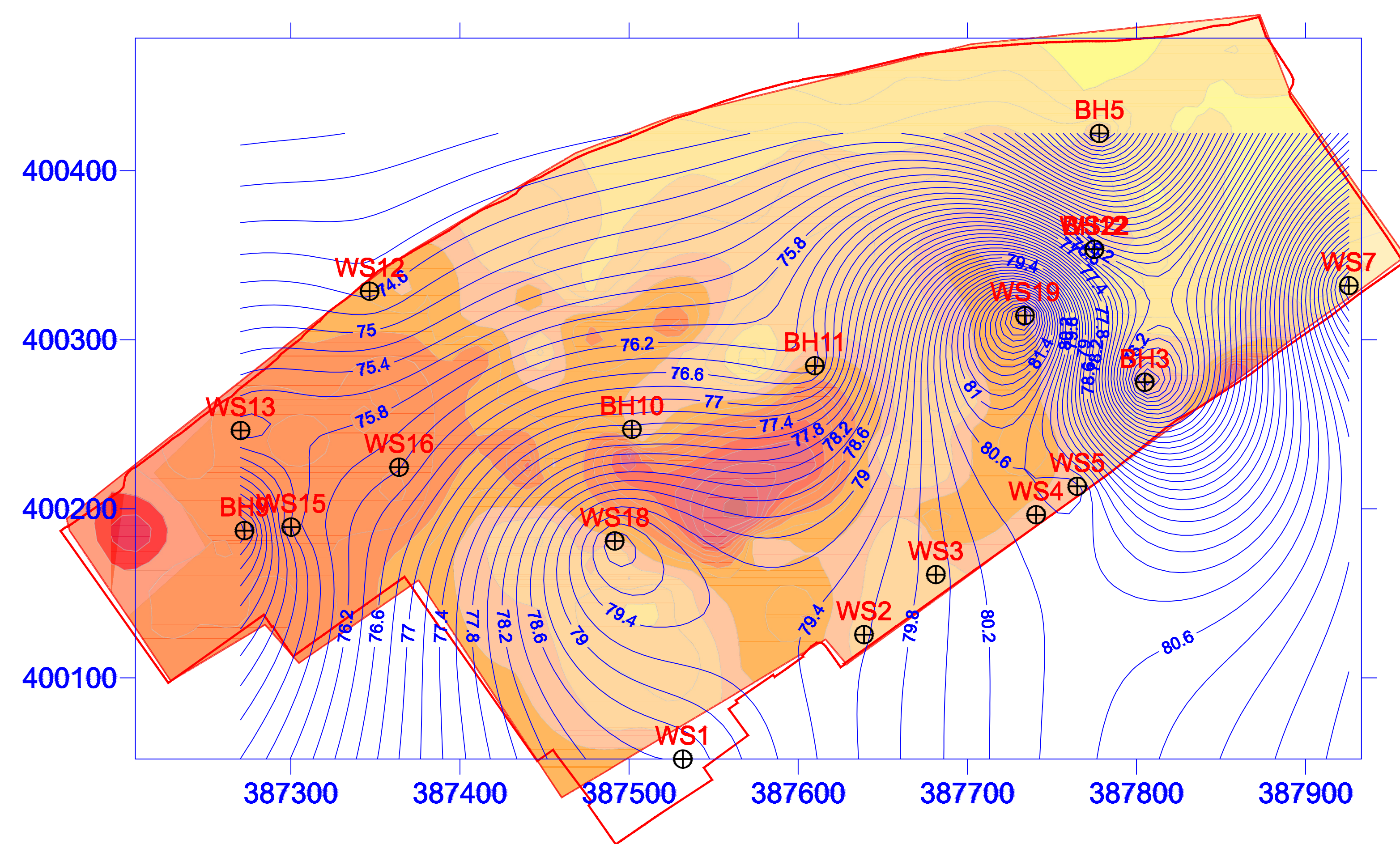
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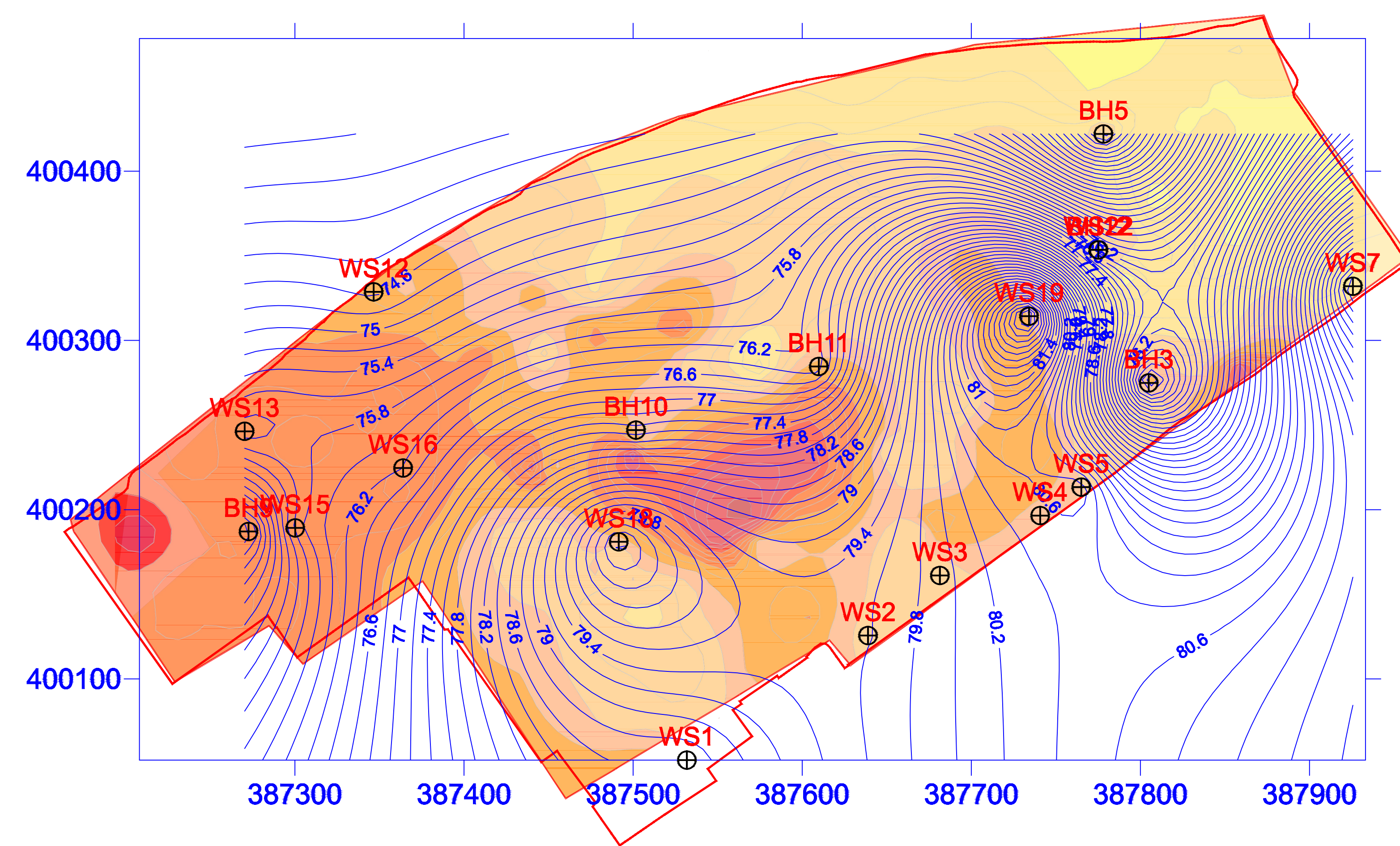
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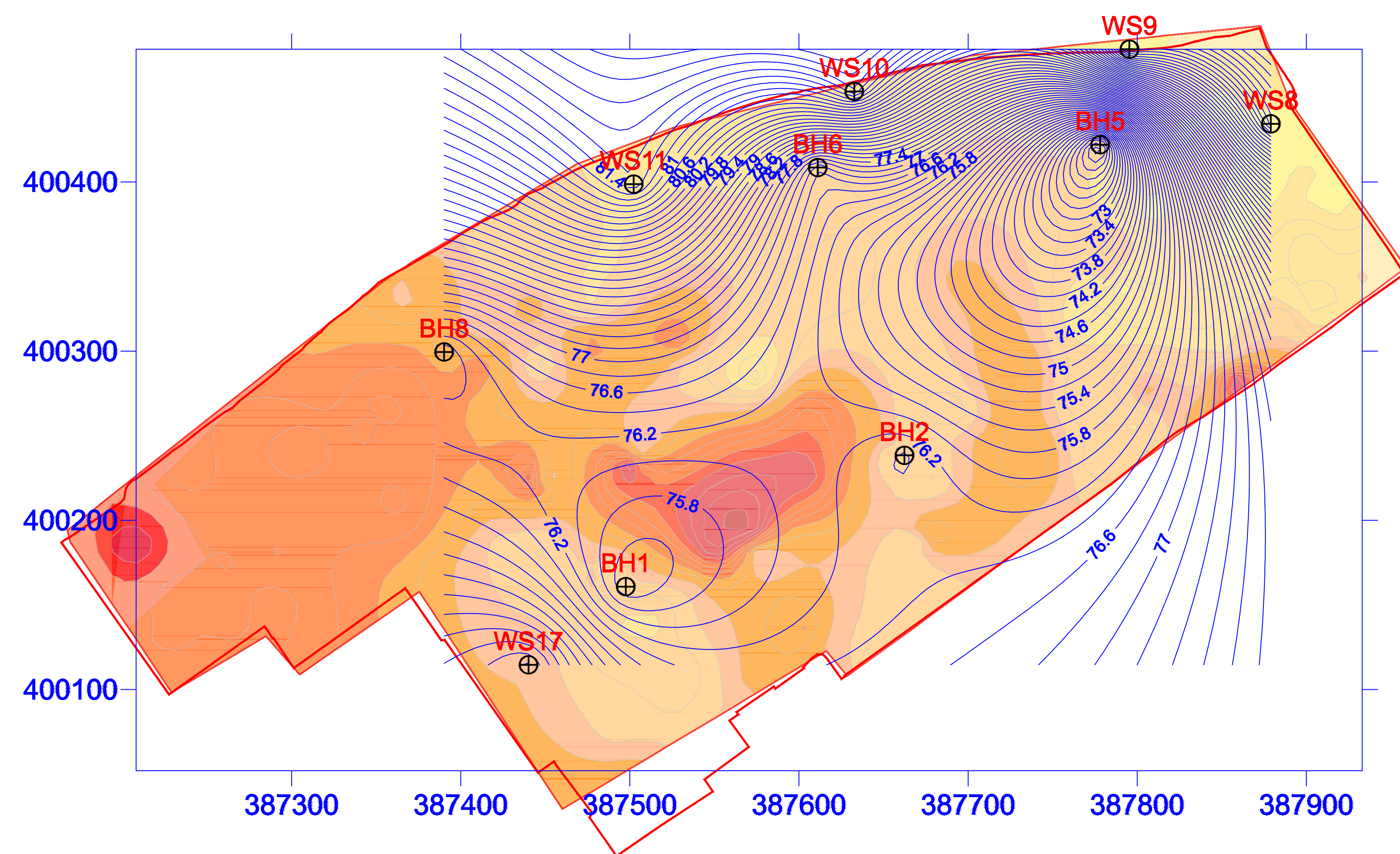
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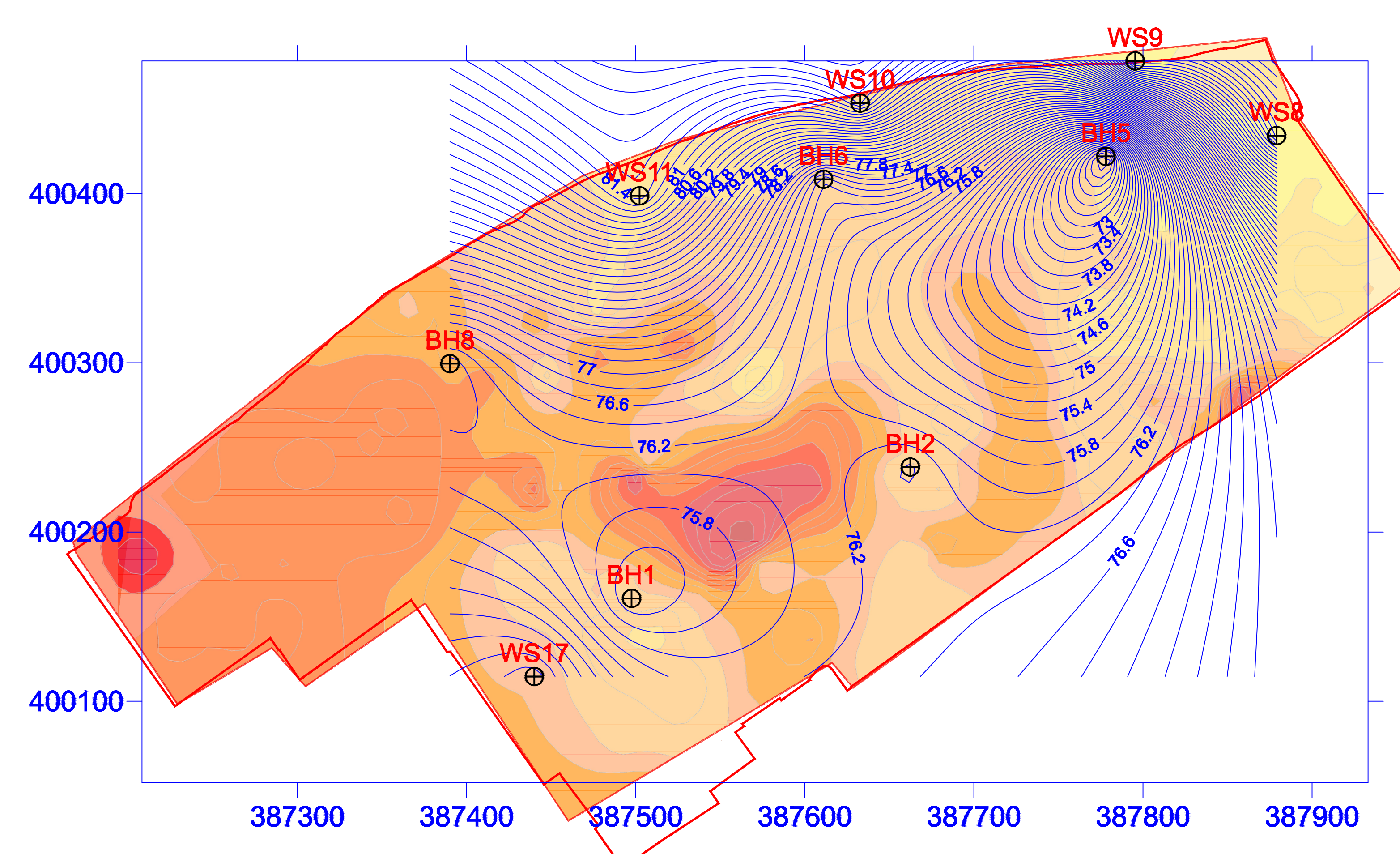
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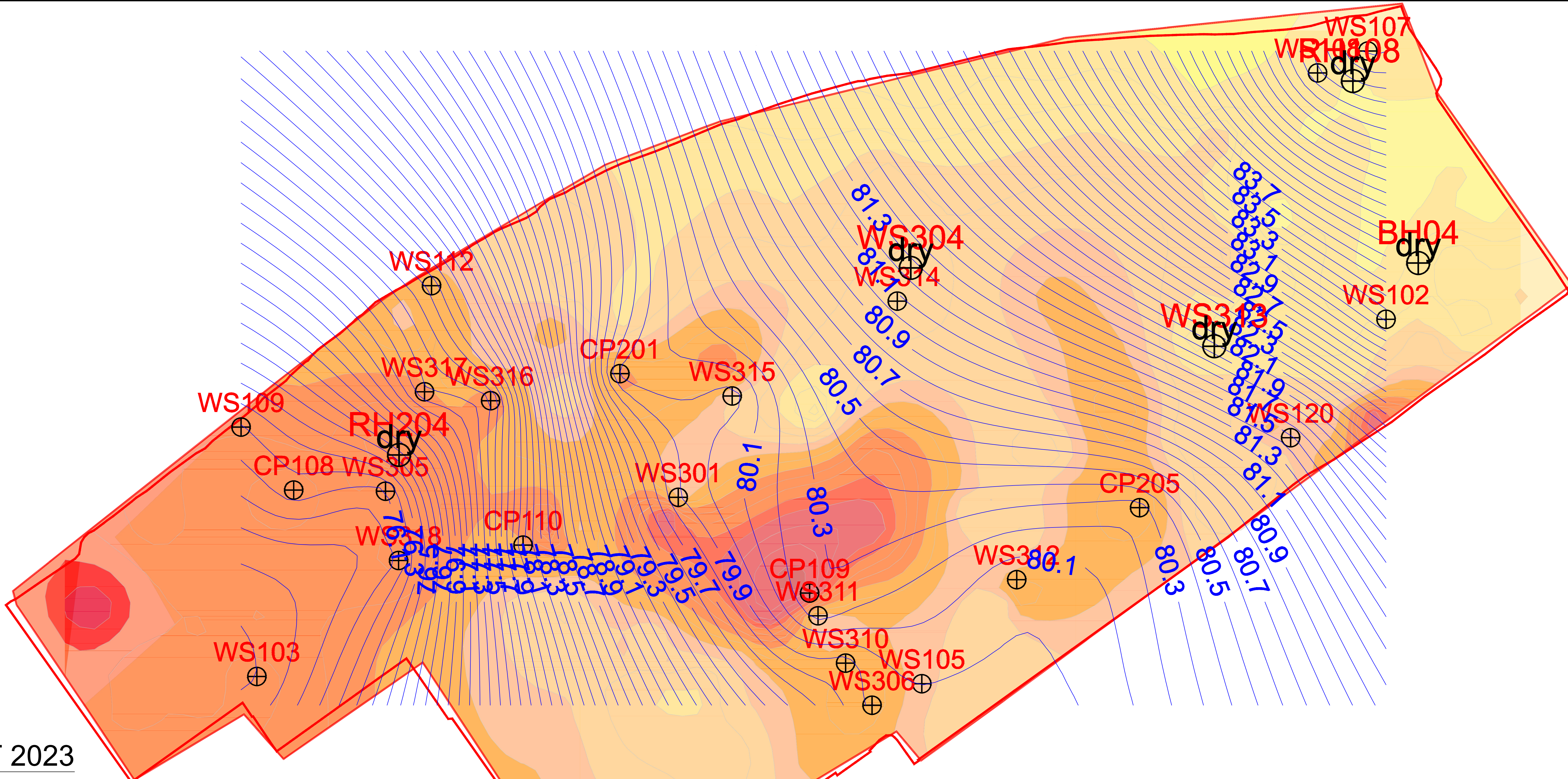


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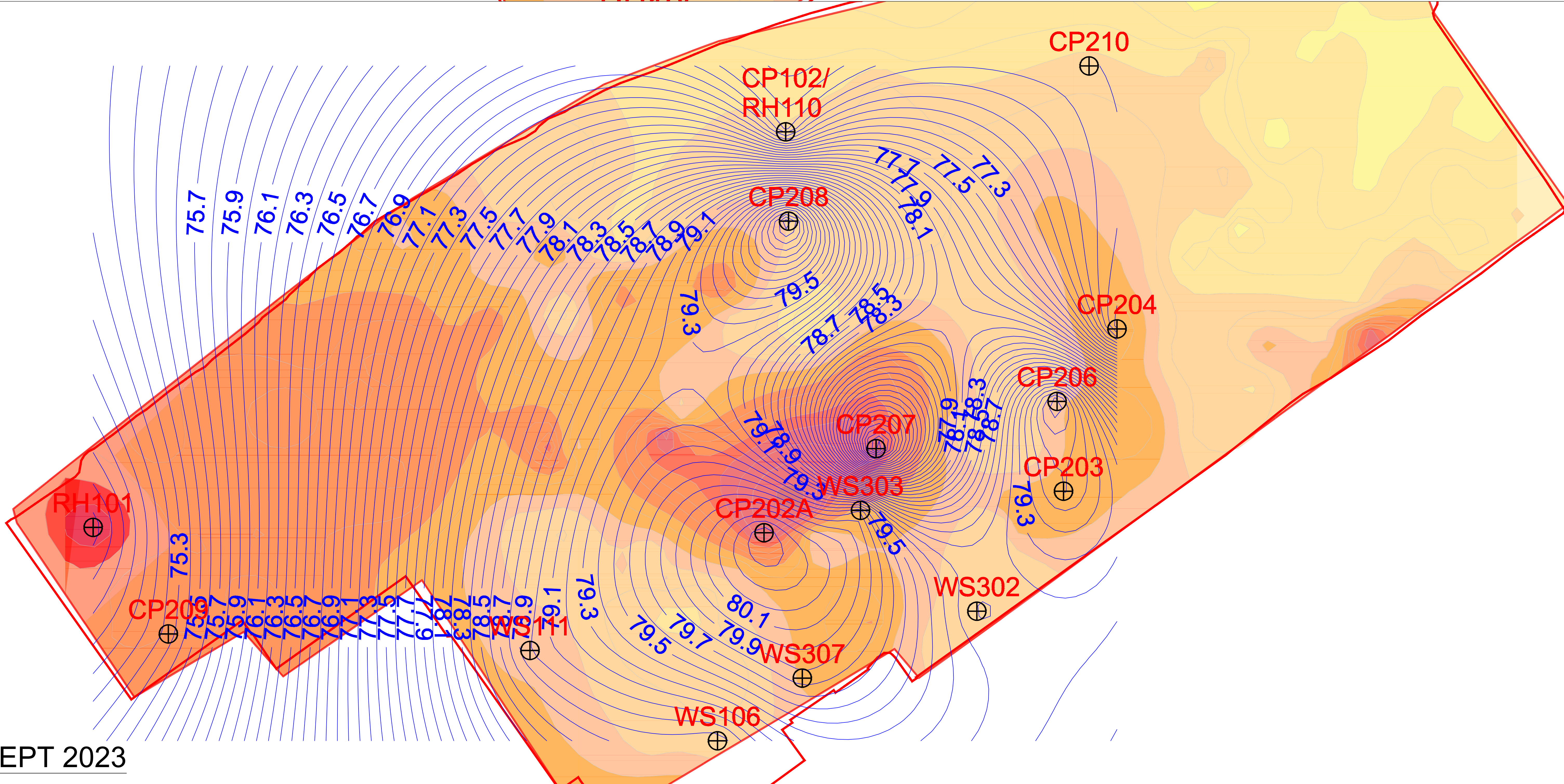


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VFLI DATA MG SEPT 2023



VFLI DATA GT/NAT SEPT 2023

Key

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Made Ground
Depth mAOD

85
86
87
88
89

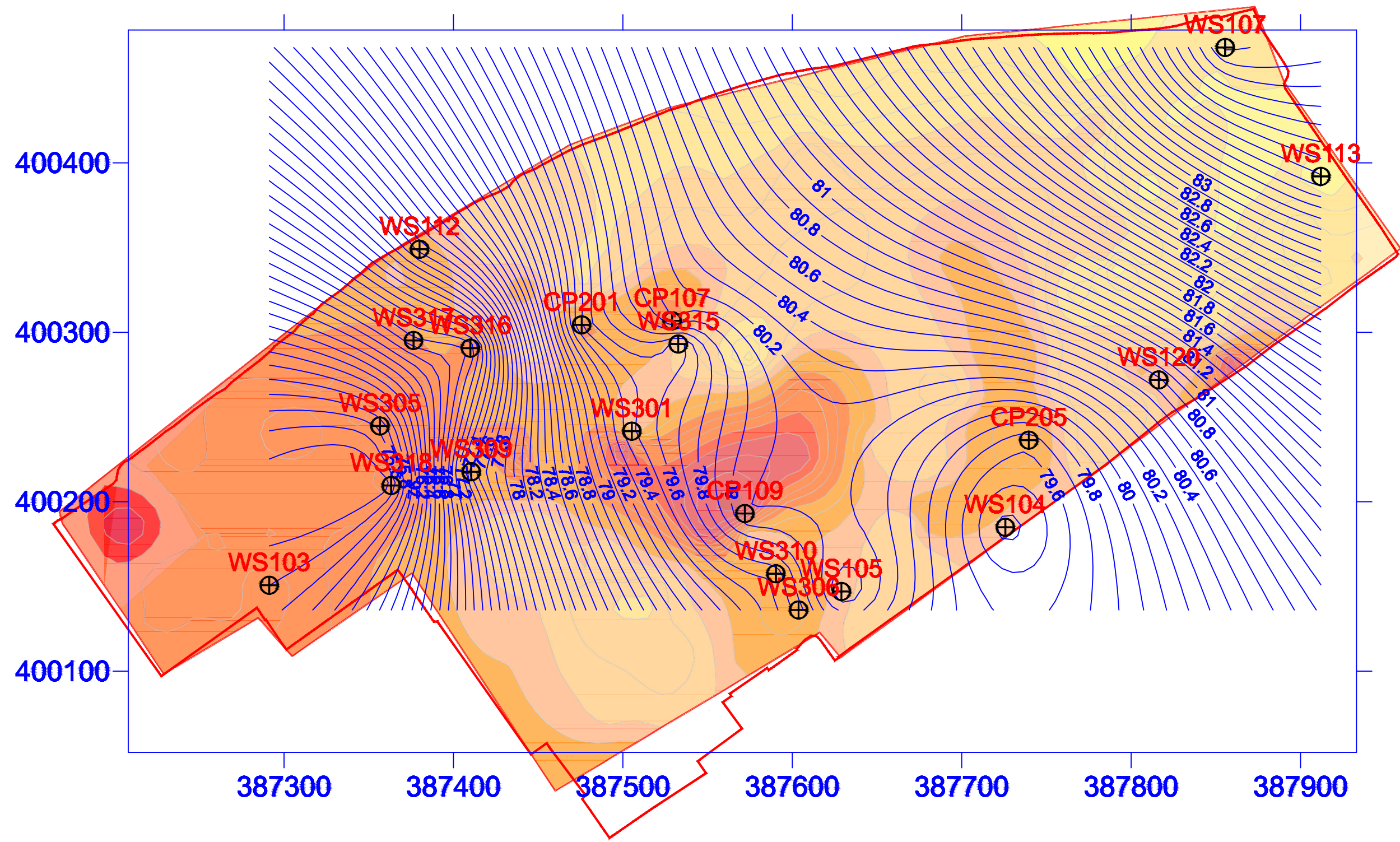
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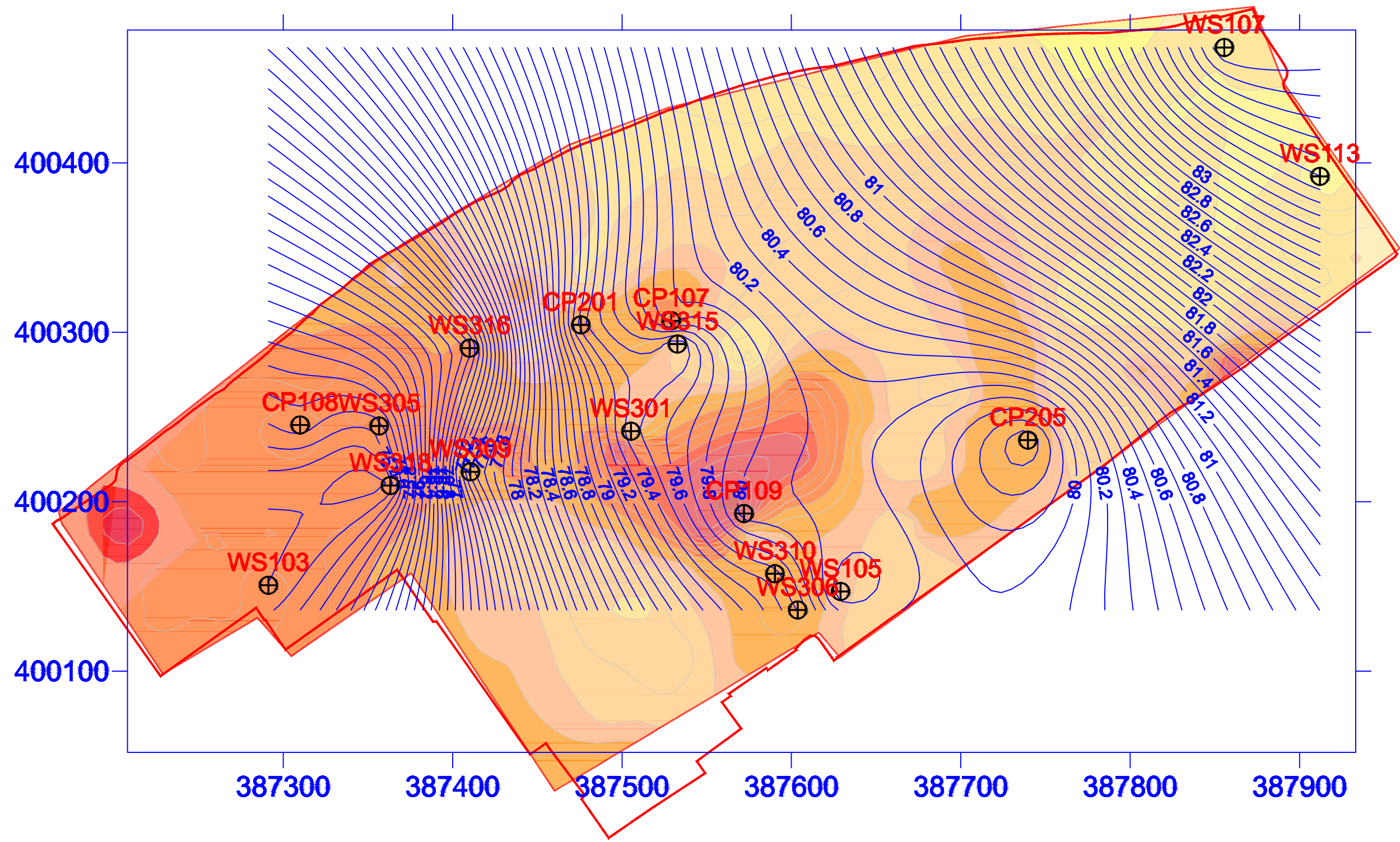
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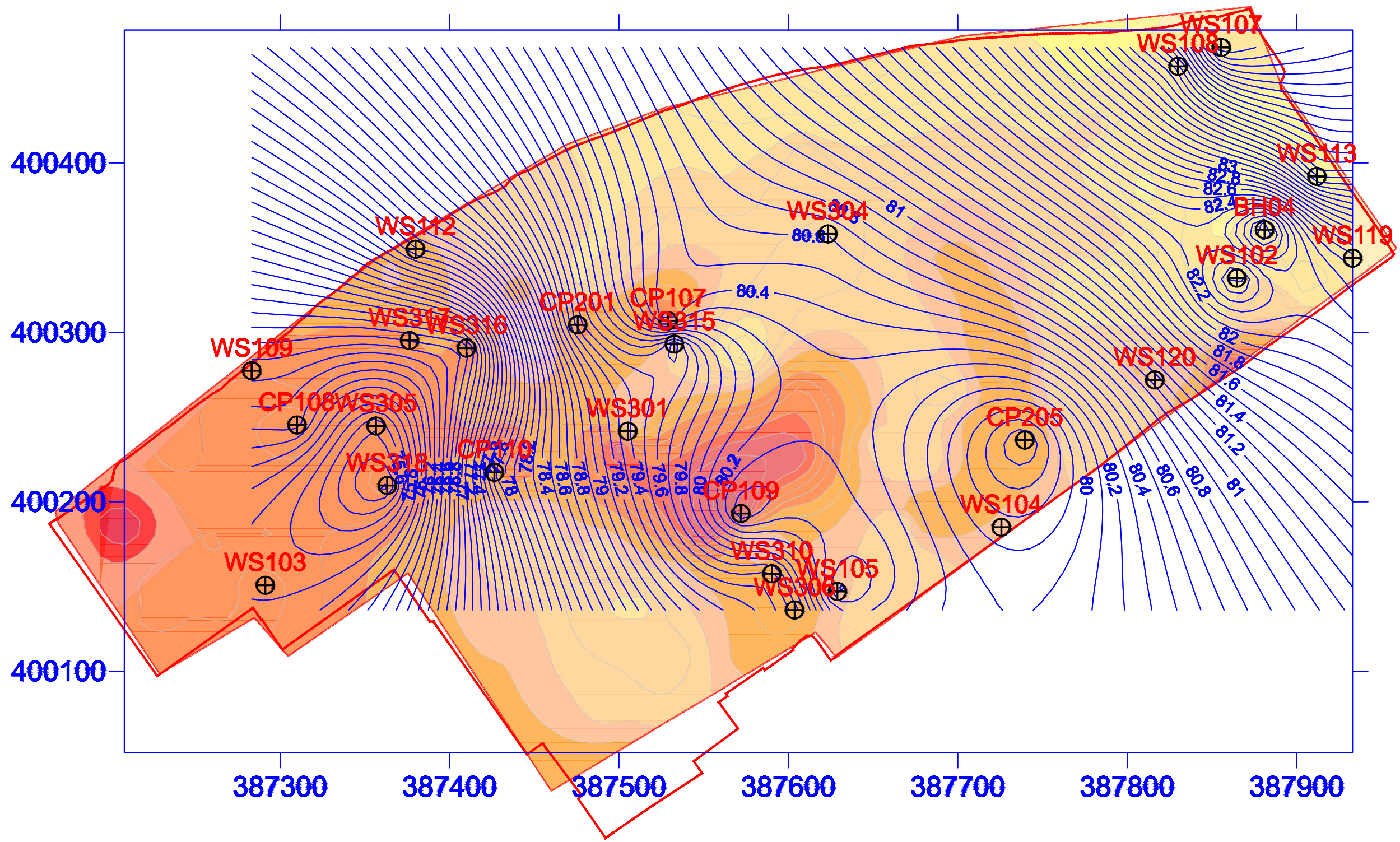
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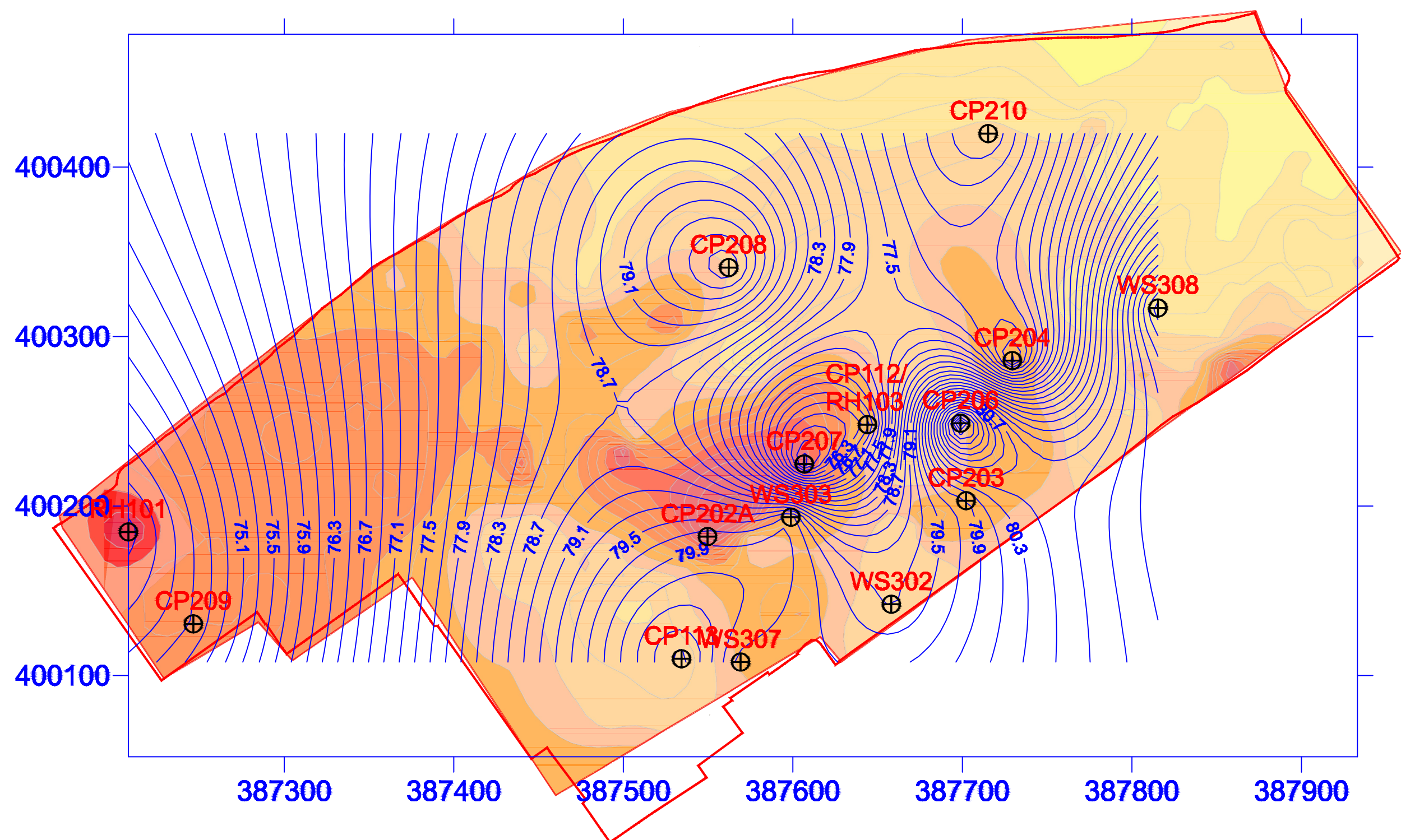
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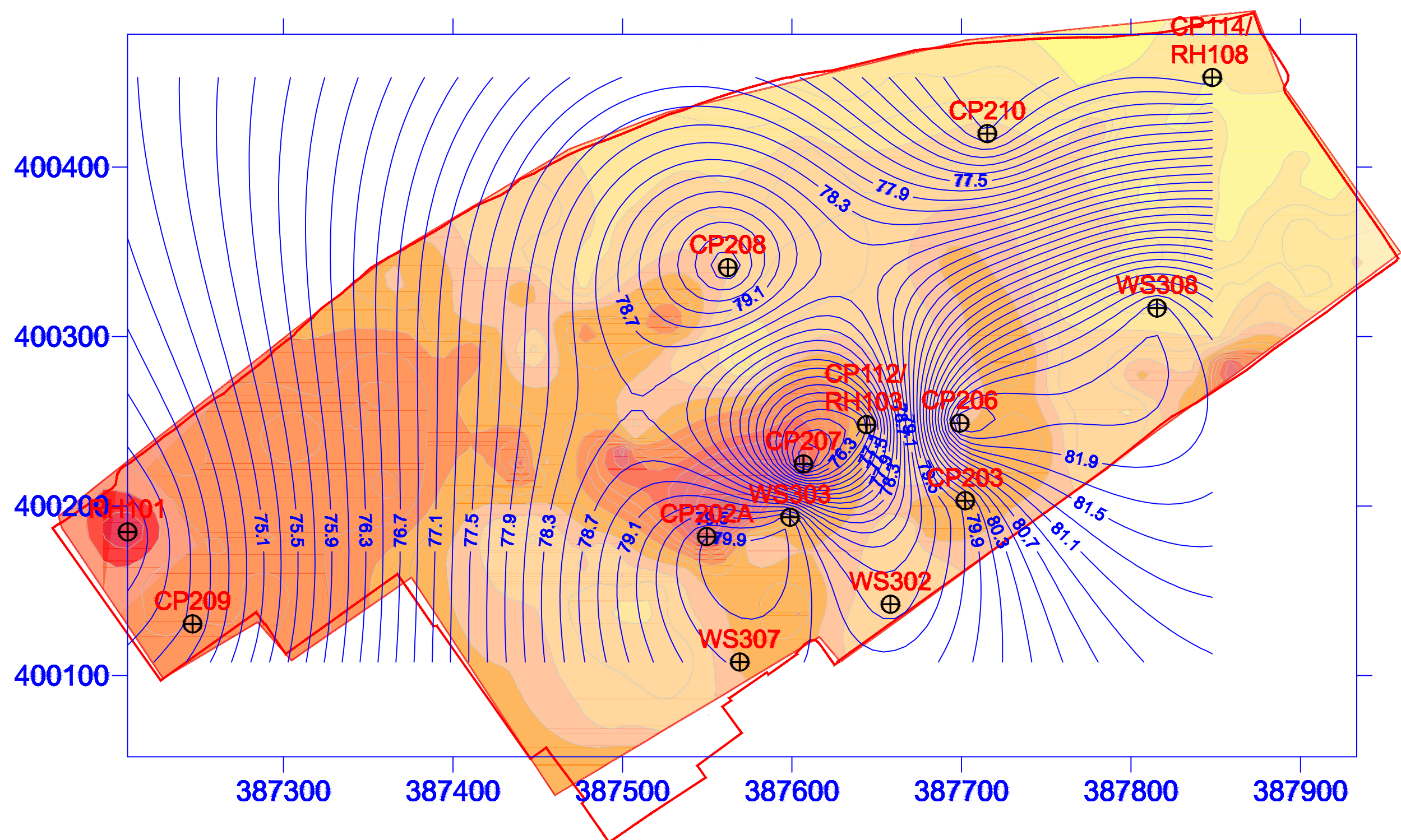
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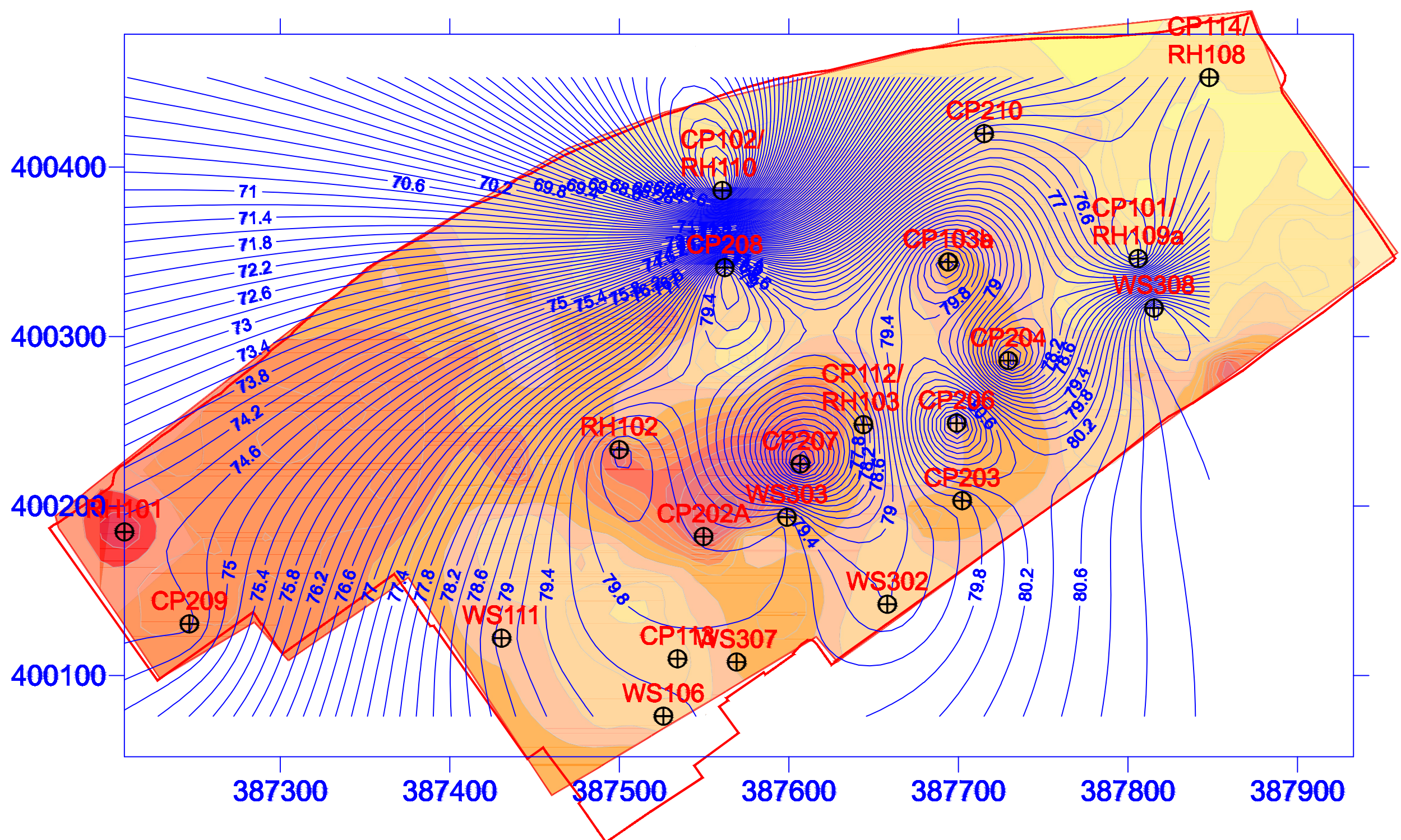
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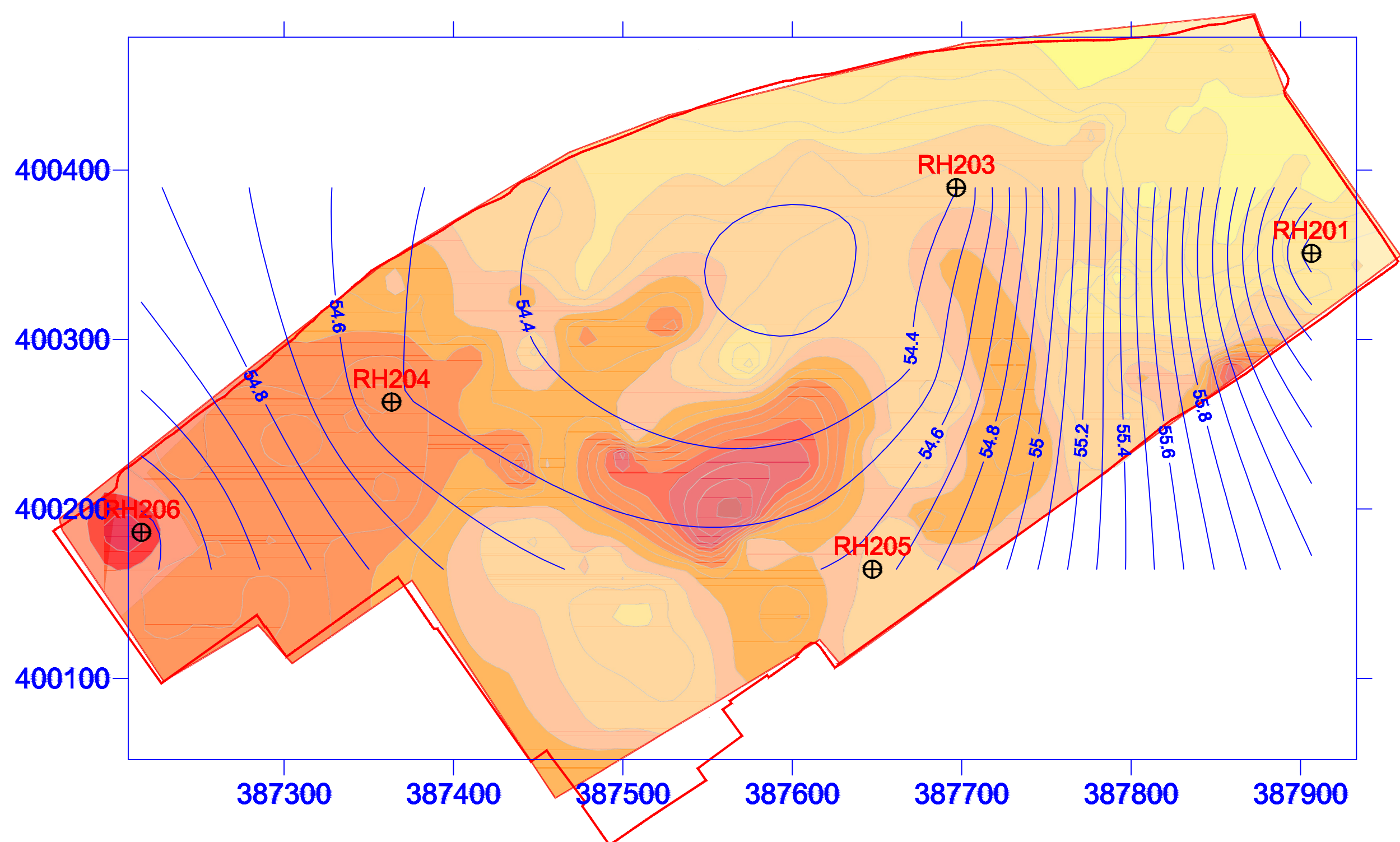
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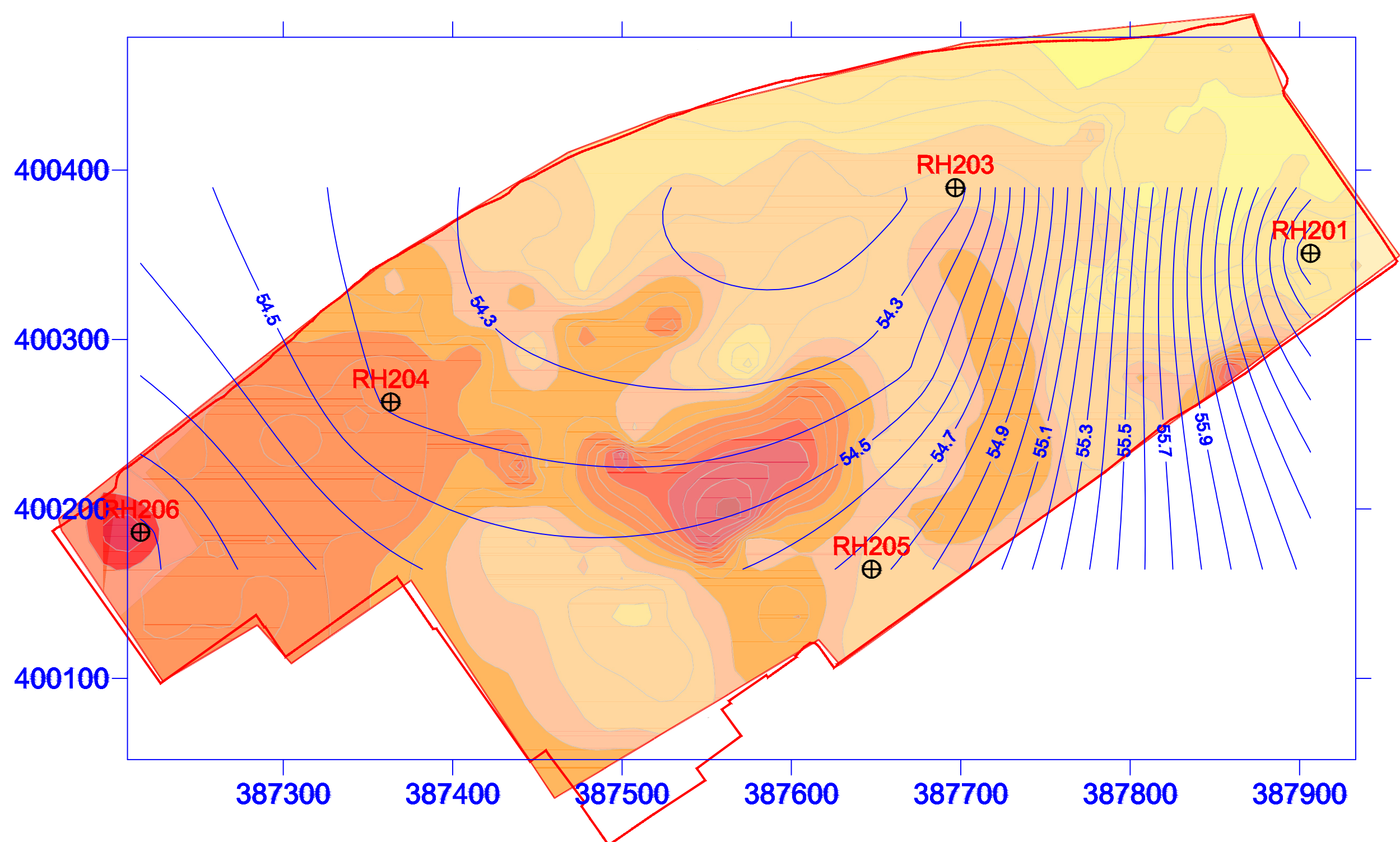
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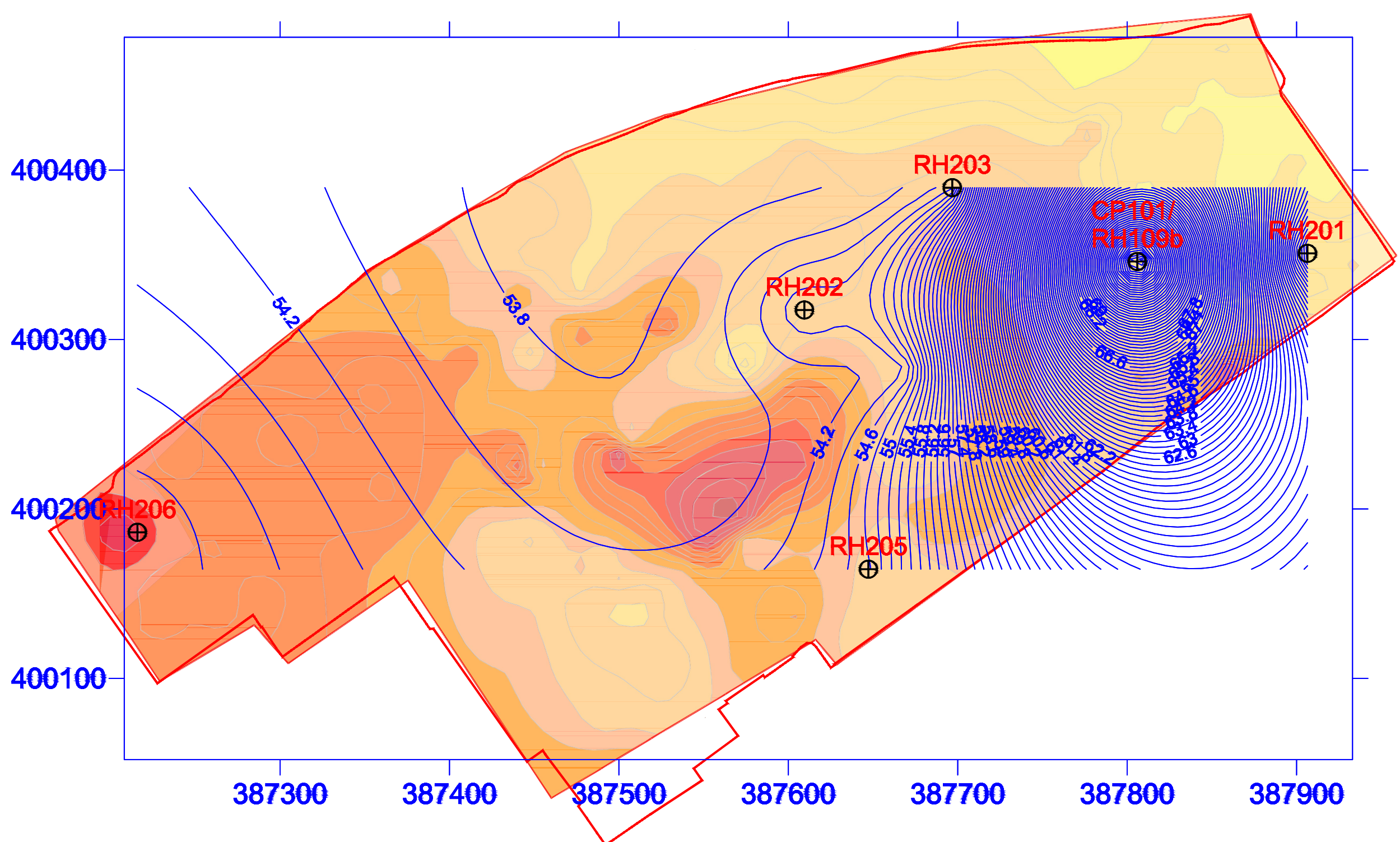
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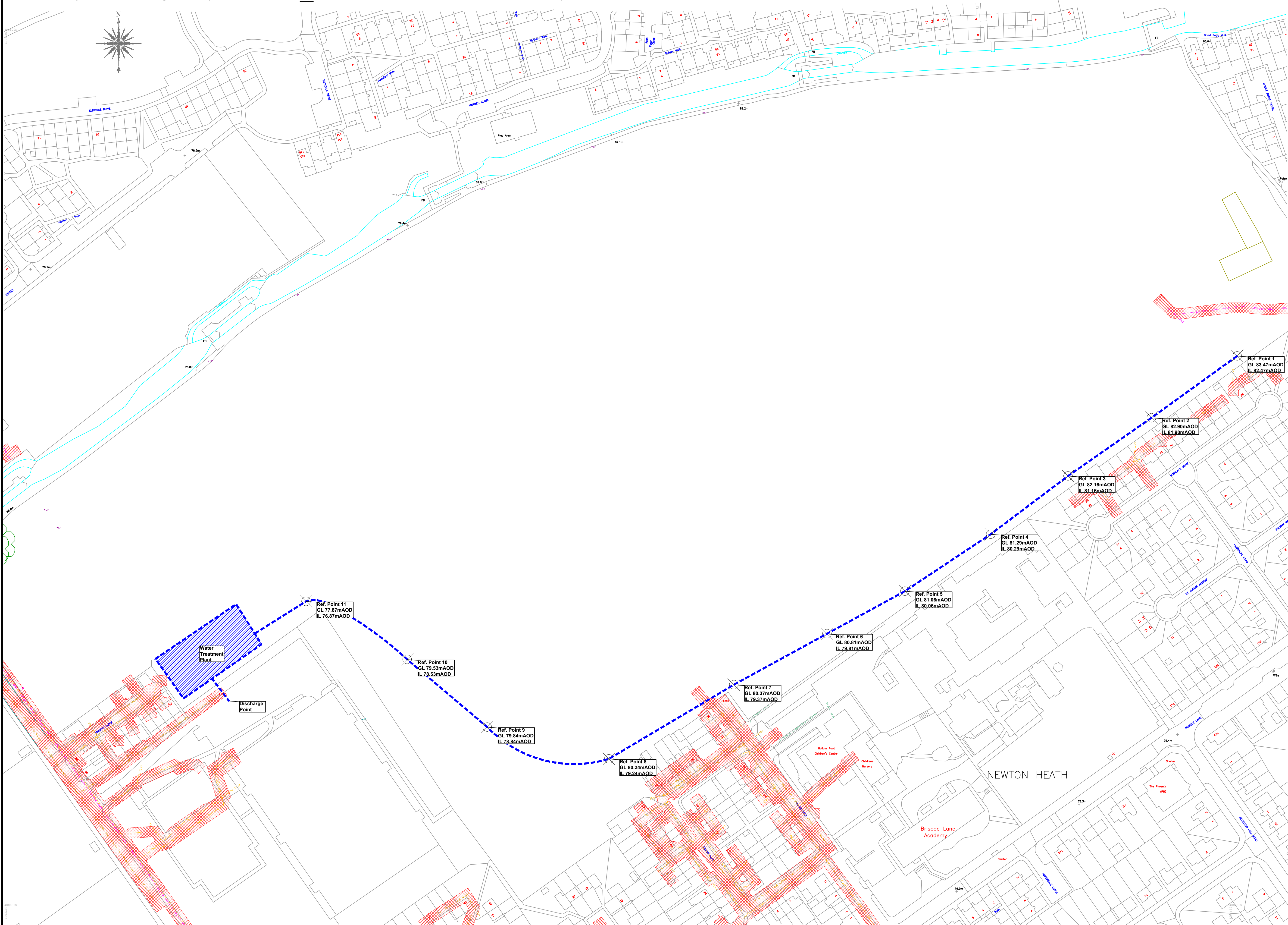


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Notes

*Permit to dig only to be issued for green or orange hatch areas. **NO** excavations in red hatch areas
 **All Areas must be CAT and Genny scanned prior to excavation.
 ***This drawing must be provided in colour at A1.
 ****Visually confirmed stage is only achieved once **all** the services have been identified and surveyed.



Key

Spot Level

Leachate Drain

Lege

Prohibited Work Areas (6 m Corridor)

Restricted Work Areas (4 m Corridor)

Permit to Dig Work Areas

Site Boundary

Low Pressure Gas Main

Intermediate Pressure Gas Main

High Pressure Gas Main

Foul Water Sewer

Storm Water Sewer

High Pressure Water Main

Low Pressure Water Main

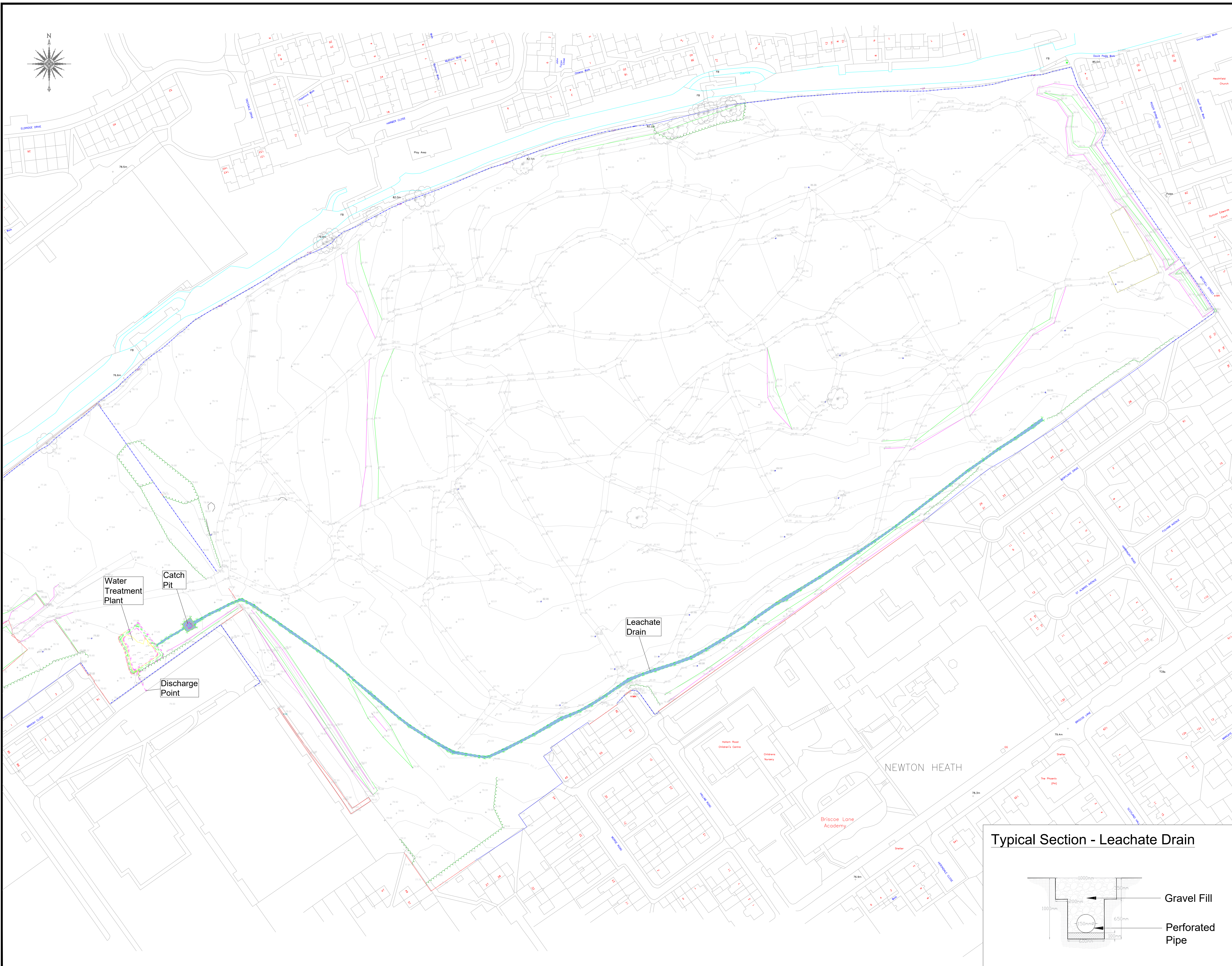
High Voltage Electricity Route

Low Voltage Electricity Route

Telecom Cable Route

Overhead Telecom Cable Route

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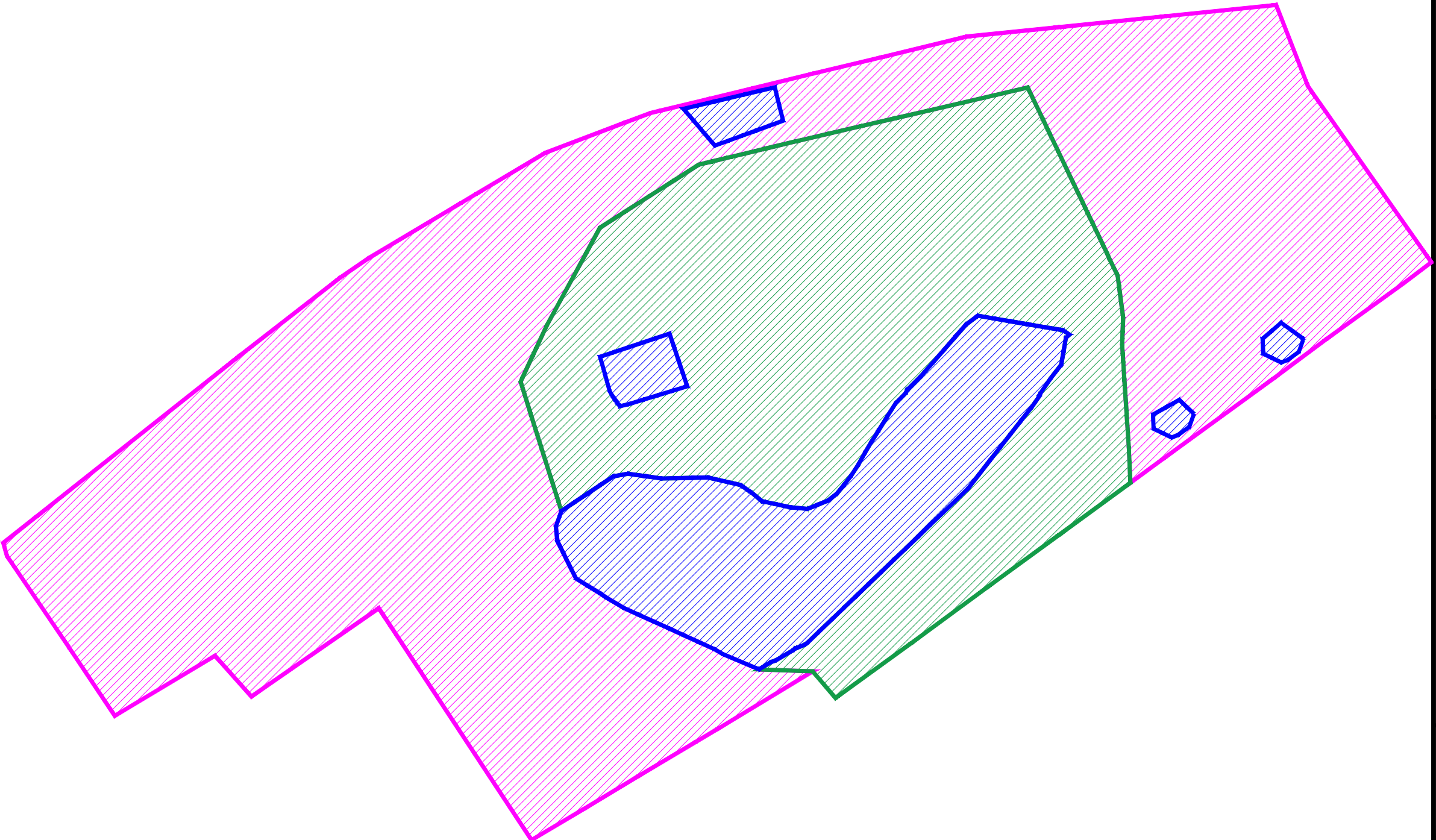


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- Key:
-  Site Boundary
 -  HRM
 -  LRM
 -  LRM C+D



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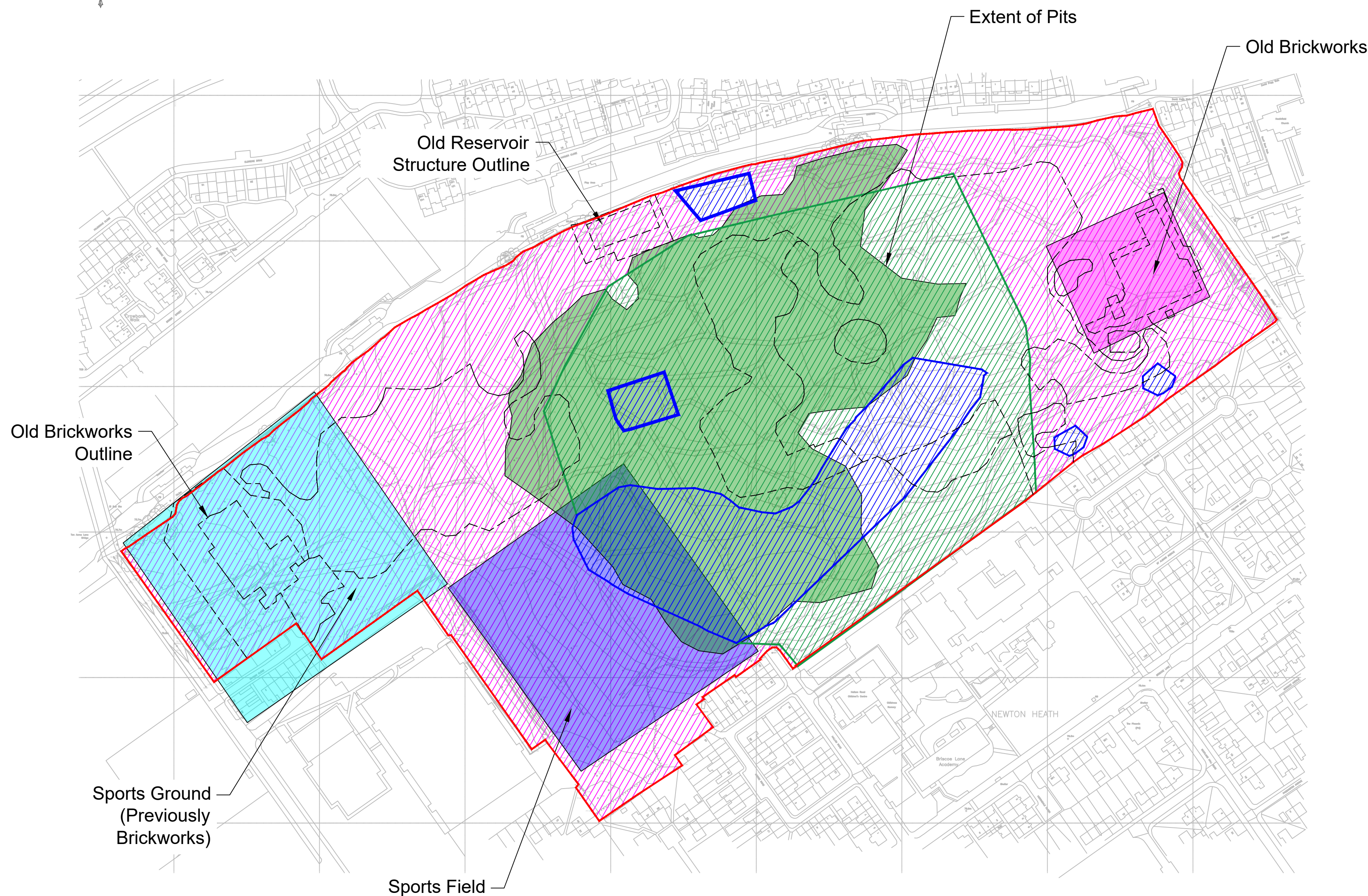
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Fax: 01246 812963

Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: Proposed Remediation Strategy v2		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: SE	Approved: ML
Dwg: D4744_12	Contract: 4744YOU	Scale: 1:2500

Key:

- Site Boundary
- High Risk Material
- Low Risk Material
- Low Risk Material Construction & Demolition
- Sports Ground
- Sports Field
- Extent of Pits
- Brickworks

Background Map May 2022



FIRST ISSUE 20-09-23

Rev.	Description	Revised By	Date
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DO NOT SCALE OFF THIS DRAWING

- Critical dimensions should be checked on site prior to works commencing.
- Dimensional conflicts should be brought to the company's attention as soon as they become apparent. Failure to do so could render the contractor liable for subsequent losses.
- Copyright in this drawing and any work executed from this drawing remains the property of VertaseFLI

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FLI**
Contaminated Land,
Brownfield & Environmental
Contracting Specialists



■ Bristol Head Office: Tel: 01275 397600
Fax: 01275 397601
□ Sheffield Office: Tel: 01246 813289
Fax: 01246 812963

Site Address:
10 Acres Lane
Manchester
M40 2SP

Title: Historic Features Map

Client: Your Housing Group Ltd

Drawn: MRG	Checked: JL	Approved: ML
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Dwg: D4744_14	Contract: 4744	Scale: 1:2000
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Key:

- Site Boundary
- Historic Feature Extents
- As-Built Leachate Drain
- Derelict/Waste Land
- Residential
- Industrial
- Canal
- Sports / Leisure
- School
- Grass/Wooded Areas
- High Risk Material
- Low Risk Material
- Low Risk Material Construction & Demolition

Background Map May 2022

FIRST ISSUE		21-09-23	
Rev.	Description	Revised By	Date

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email: info@vertasefli.co.uk
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Fax: 01275 397601

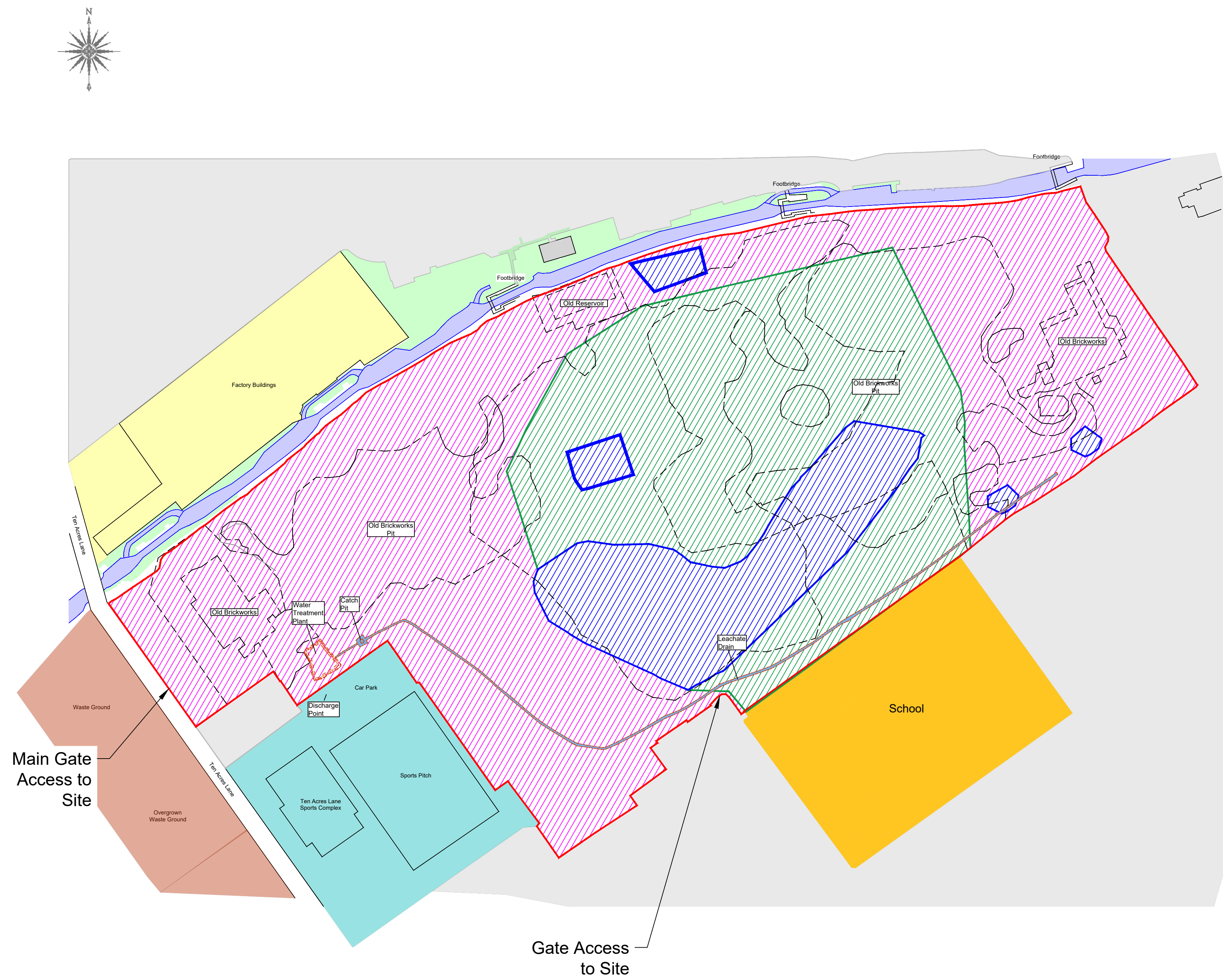
□ Sheffield Office: Tel: 01246 813289
Fax: 01246 812963

Site Address:
10 Acres Lane
Manchester
M40 2SP

Title: Ground Model Conclusions Map

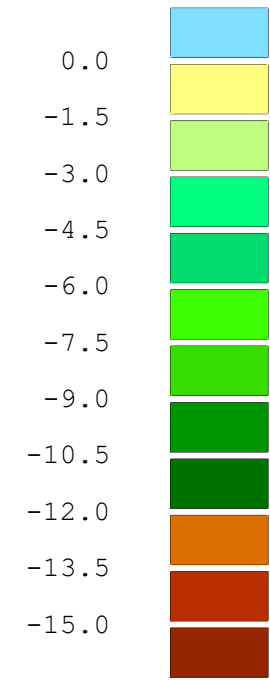
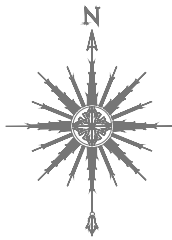
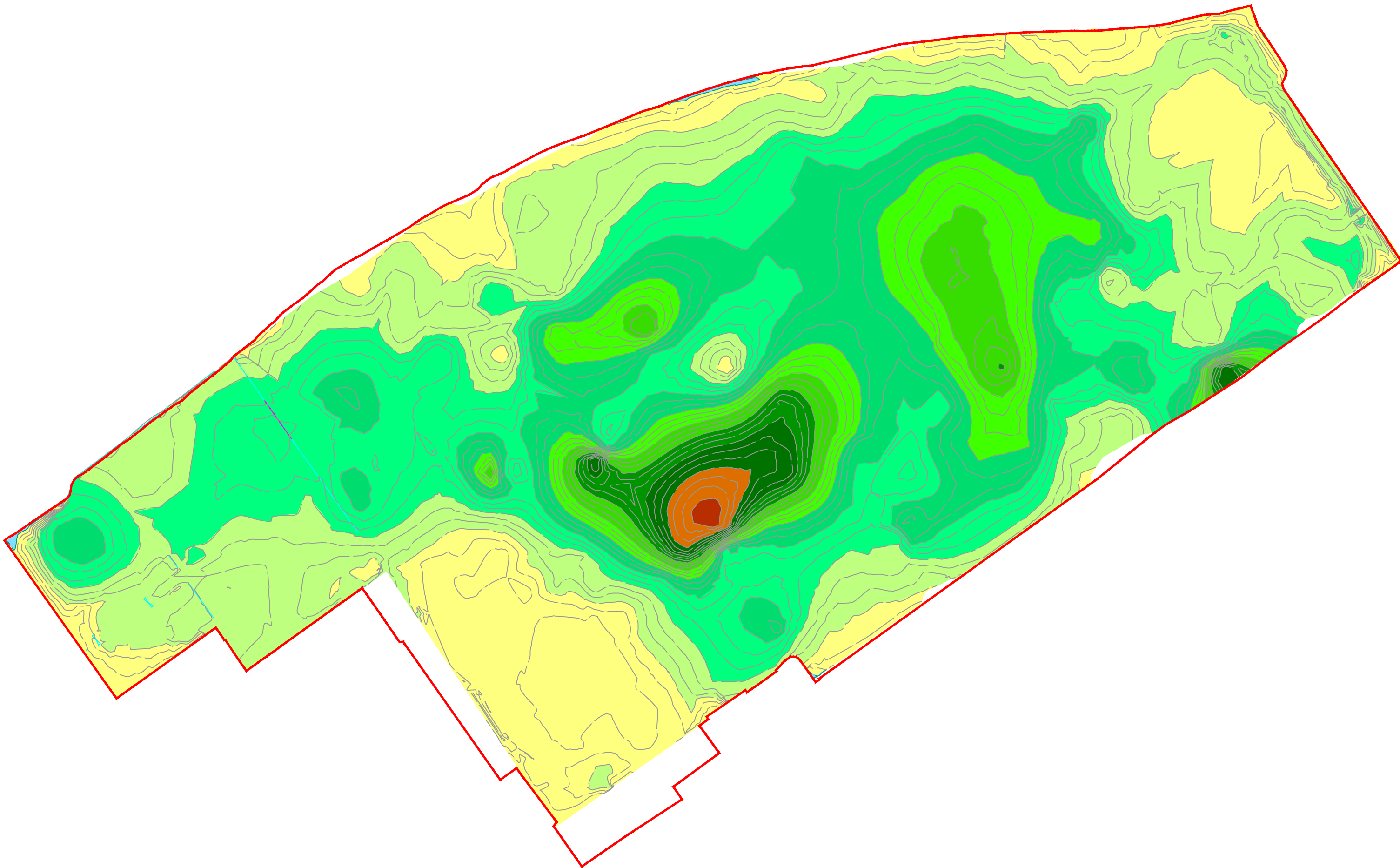
Client: Your Housing Group Ltd

Drawn: MRG	Checked: JL	Approved: ML
Dwg: D4744_15	Contract: 4744	Scale: 1:2000



Key:
 Site Boundary

Depths of Made Ground (m)



FIRST ISSUE		20-09-23

Rev.	Description	Revised By	Date
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■

Bristol Head Office:

□

Sheffield Office:

Tel: 01275 397600
Fax: 01275 397601

Tel: 01246 813289
Fax: 01246 812963

Site Address:

10 Acres Lane
Manchester
M40 2SP

Rev:

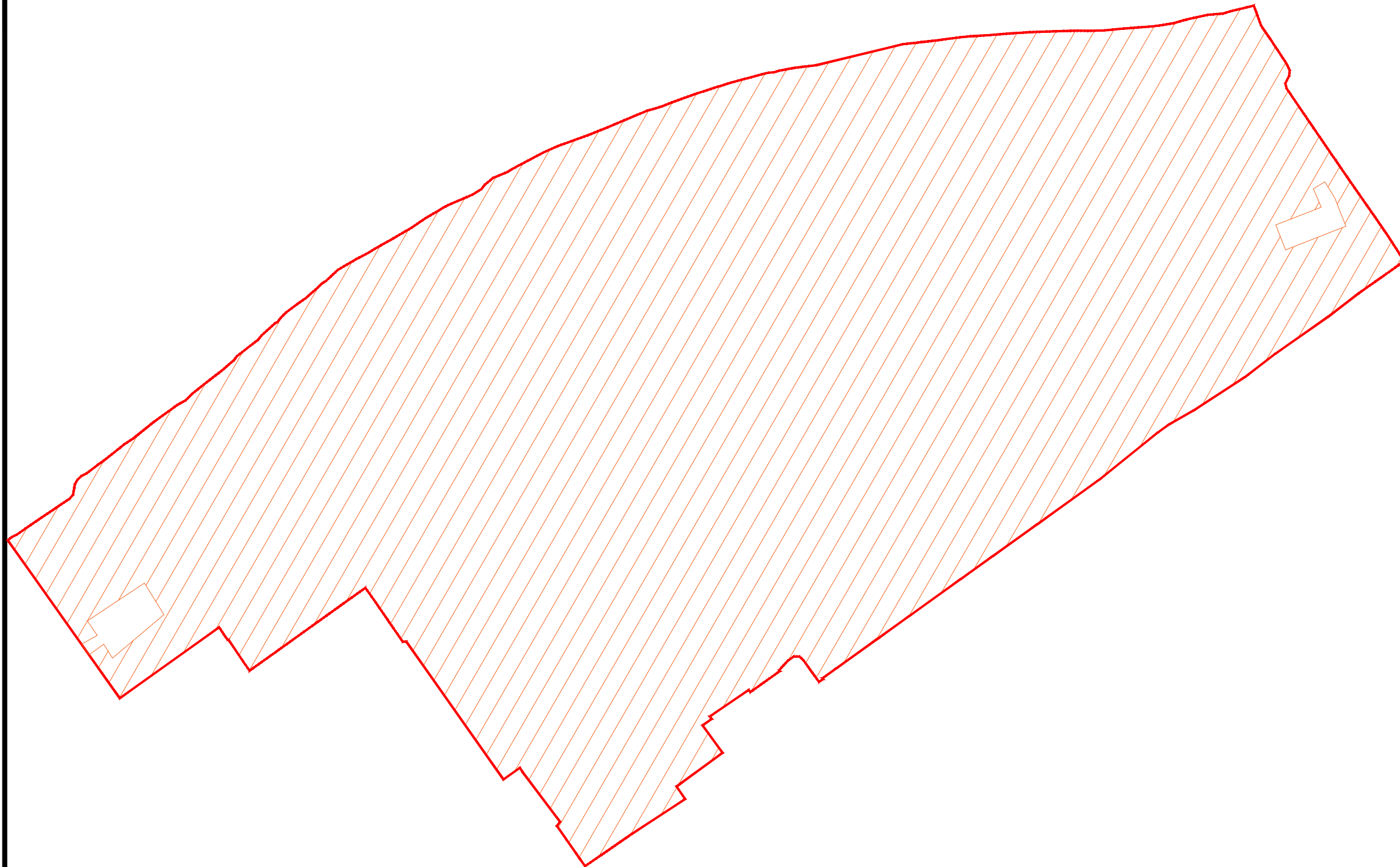
Title: Isopach - MG Contours June 2023 to OGL May 2022

Client: Your Housing Group Ltd

Drawn: MRG	Checked: JL	Approved: ML
Dwg: D4744_16	Contract: 4744	Scale: 1:2000

Key

-  Site Boundary
-  LRM - Topsoil Surface Strip Areas



FIRST ISSUE

22-11-2023

Rev.	Description	Revised By	Date
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Contracting Specialists

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www.vertasefli.co.uk

- Bristol Head Office: Tel: 01275 397600
Fax: 01275 397601
- Sheffield Office: Tel: 01246 813289
Fax: 01246 812963

Site Address:
Ten Acres Lane
Manchester
M40 2SP

Rev:

Title: LRM - Topsoil

Client: Your Housing Group Ltd

Drawn: JGL	Checked: SE	Approved: SE
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Dwg: D4744_25	Contract: 4744YOU	Scale: 1:2500
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Appendix C

Evaluation Scoring of Remediation Options

[illegible]

Appendix D

Planning Conditions

Important – Planning permission & notices of consent

Compliance with conditions

- Your planning approval or consent is attached. It will contain conditions that you must comply with.
- Please read the conditions and understand their requirements and restrictions, for example submission and approval of details or measures to protect trees.
- Some conditions will require action before you start development and it is imperative that you seek to have these discharged before any work commences.
- Whilst every effort has been made to group conditions logically, it is your responsibility to ensure that you are aware of the requirements and/or restrictions of all conditions.
- If you fail to comply with the conditions this may result in a breach of planning control and this may lead to enforcement action.
- Failure to comply with conditions may also result in the development not being lawful.
- It is in your interests to demonstrate that conditions have been complied with. Failure to do so may cause difficulties if the property is sold or transferred.
- A fee is payable for each request to discharge conditions.
- For advice on any of these matters, please contact Planning, Manchester City Council, PO Box 532, Town Hall, Manchester M60 2LA or email planning@manchester.gov.uk

Town & Country Planning Act 1990 (as amended)

Planning Permission

Applicant

Nuvu Investments Ltd
C/o Agent

Agent (if used)

Mr John Cooper
Deloitte LLP
PO Box 500
2 Hardman Street
Manchester
M3 3HF

Part 1 – Particulars of the application/development

Proposal: Site remediation works including removal of existing vegetation, ground works and other associated works.

Location: Former Jacksons Brickworks , Ten Acres Lane, Manchester

Date of application: 25 January 2021

Application number: 129197/FO/2021

Part 2 – Particulars of decision

Manchester City Council gives notice that the development referred to in Part 1 has been **Approved** in accordance with the application and plans submitted subject to the condition(s) listed below (if any).

Article 35 Declaration

Condition(s) attached to this decision

1) The development must be begun not later than the expiration of three years beginning with the date of this permission.

Reason - Required to be imposed pursuant to Section 91 of the Town and Country Planning Act 1990.

2) The development hereby approved shall be carried out in accordance with the following drawings and documents:

Environmental Statement Volume 1 January 2021; Environmental Statement Volume 2 January 2021; Environmental Statement: Non- Technical Summary Dated January 2021; received 22nd January 2021

Air Quality Statement prepared by Wardell Armstrong dated 7th January 2021;
Archaeological Desk Based Assessment ref: 21158 Issue | 15 November 2011;

Planning Statement dated January 2021; Statement of Community Involvement dated January 2021; Noise and Vibration Statement (LD10162/RC/CMD/AQA-002); prepared by Wardell Armstrong dated 18th December 2020; Arboricultural Impact Assessment (AIA) prepared by Amenity Tree Care; Tree Assessment Report prepared by Amenity Tree Care; Outline Remediation Strategy ref: JC/MP/MW/LD10162/LET-006-REV D prepared by Wardell Armstrong dated 4th December 2020; Transport Statement prepared by Vectos ref: VN201804 Issue 3 dated 7th January 2021;

2490-PLA-00-00-DR-U-0010 S2 rev.P1 (Red Line Boundary Plan) ; 2490-PLA-00-00-DR-U-0011 S2 rev.P1 (Existing Site Plan) received 25th January 2021

Combined Phase 1 and Phase 2 Ground Investigation Report Dated May 2021 ref: LD10162

Report Number : 001 Version:V1.1 Final , prepared by Wardell Armstrong received 18th May 2021;

Outline Construction Environmental Management Plan June 2021 (ref: LD10246 Report Number: 0001) by Nuvu Developments received 11th June 2021;

Planning agent email dated 7th July 2021 in regard to tree retention and protected species.

Planning agent email dated 21st July 2021 in regard to Japanese Knotweed treatment.

Reason - To ensure that the development is carried out in accordance with the approved plans., pursuant to policies SP1 and DM1 of the Manchester Core Strategy (2012).

3) Prior to the commencement of development, a detailed construction management plan

outlining working practices during development shall be submitted to and approved in writing by the local planning authority, which for the avoidance of doubt should include;

- o The routing of construction traffic;

- o Detail the vehicular activity associated with the construction including appropriate swept path assessment;

- o Details of the location and arrangements for contractor parking;

- o The identification of the vehicular access points into the site;

- o Identify measures to control dust and mud, including on the surrounding public highway

including: details of how the wheels of contractor's vehicles are to be cleaned during the construction period;

- o The details of an emergency telephone contact number for the site contractor to be displayed in a publicly accessible location;

- o For large schemes a highway dilapidation survey including photographs and commentary on the condition of carriageway/footways on construction vehicle routes surrounding the site.

- o Identify measures to reduce noise emissions;

Development shall be carried out in accordance with the approved construction management plan.

Manchester City Council encourages all contractors to be 'considerate contractors' when working in the city by being aware of the needs of neighbours and the

environment. Membership of the Considerate Constructors Scheme is highly recommended.

Reason - To safeguard the amenities of nearby residents and highway safety pursuant to policies SP1, EN9, EN19 and DM1 of the Manchester Core Strategy (2012).

4)) Prior to the commencement of the development a detailed construction environmental management plan outlining working practices during development shall be submitted to and approved in writing by the local planning authority, which for the avoidance of doubt should include:-

- Construction Logistics Plan (incl. dust and odour monitoring)
- Dust Management Plan
- Lighting drawings and specifications
- Site compound facilities plan
- Details of perimeter fencing (including location)
- Surface Water Management Plan
- Noise and Vibration Management Plan
- Non-native species Management Plan
- Air Quality Statement
- Construction Dust Assessment
- Traffic Management Plan
- Site Waste Management Plan
- Materials Management Plan
- Environmental Response Plan

Reason - To safeguard the amenities of nearby residents and highway safety pursuant to policies SP1, EN9, EN19 and DM1 of the Manchester Core Strategy (2012).

5) Prior to the commencement of on-site remediation works, the applicant shall submit, for written approval to the Local Planning Authority an additional site investigation, where necessary, based on and further to current submitted reporting, providing detailed investigation of the risk to all potential on-site and off-site receptors that maybe be affected by contamination derived from the site. The development shall be implemented in full accordance with the details so approved.

Reason- The current combined Phase I & II Ground investigation reporting submitted, does not adequately characterise site conditions in accordance with paragraph 183 of the NPPF. In particular, with regards to controlled waters, the current Phase I & II reporting submitted does provide definitive clarity regarding what groundwater and leachate (liquid in contact with waste) has been sampled. Further to this, an upwelling of liquid with a foul odour and coloration has been identified which warrants further investigation; there is a potential this upwelling is derived from the known deposited waste mass present within the site, pursuant policies EN17 and EN18 of the Manchester Core Strategy (2012).

6) Prior to the commencement of on-site remediation works, the applicant shall submit, for written approval, to the Local Planning Authority a detailed assessment of risks to human and environmental receptors (including those off-site). The development shall be implemented in full accordance with the details so approved.

Reason - To provide sufficient information to develop a detailed remediation strategy which will build on the outline remediation strategy submitted (JC/MP/MW/LD10162/LET-006-REV D) and support an options appraisal for suitable remediation measures, pursuant to policies EN17 and EN18 of the Manchester Core Strategy (2012).

7) Prior to the commencement of on-site works, the applicant shall submit, for written approval, to the Local Planning Authority a detailed options appraisal and remediation strategy giving full details of any measures required. The strategy submitted should also: i) Detail the timeframe in which remedial works are anticipated to be undertaken completed. ii) Detail with associated mapping, the phasing of remedial works that will be undertaken. iii) Detail in accordance with (i) and (ii) any anticipated environmental permit(s) or other permission(s) required for the purpose of undertaking the site remediation works proposed. iv) Detail a verification plan for validating the success of remedial works to be undertaken. The strategy shall be implemented as approved.

Reason - To ensure that the chosen detailed remediation strategy can be implemented (in accordance with a phasing plan where relevant) and that the detailed remediation strategy has any/all the necessary permits and permissions in place and that sufficient control measures are in place to avoid pollution incidents to the environment and nuisance issue to surrounding community, pursuant to policies EN17 and EN18 of the Manchester Core Strategy (2012).

8) Prior to the commencement of on-site works, a Ground Stabilisation Works Plan shall be developed, submitted to, and approved in writing by the Local Planning Authority. The Ground Stabilisation works plan should include details (per phase where relevant), as to how identified ground hazards (such as underground structures and boreholes) are to be addressed and decommissioned. Any changes to plan will require the written consent of the local planning authority. The plan shall be implemented as approved.

Reason - To ensure the protection of the development from underground hazards, pursuant to policies EN17 and EN18 of the Manchester Core Strategy (2012).

9) A verification report demonstrating the completion and effectiveness of works set out in the approved remediation and ground stabilisation works strategies, shall be submitted to, and approved in writing, by the local planning authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met.

Reason - For the ongoing protection of the Water Environment and human health from risks arising from land contamination, pursuant to policies EN17 and EN18 of the Manchester Core Strategy (2012).

10) Prior to the commencement of development, plans of the existing and proposed site levels in the form of cross sections, shall be submitted to and approved in writing by the City Council as local planning authority. The development shall be carried out in accordance with the approved details.

Reason -To ensure that the appearance of the development is acceptable to the City Council as local planning authority in the interests of the residential amenity and visual amenity of the area within which the site is located, pursuant to policies SP1 and DM1 of the Manchester Core Strategy (2012).

11) If, during the undertaking of site works, contamination not previously identified is found to be present, then further site works shall be suspended until the extent of contamination has been determined and defined in agreement with local planning authority. Written agreement shall then be obtained from the local planning authority to enable onsite works to recommence within the area(s) not affected by the contamination identified.

Works shall not recommence with the defined area of contamination until the developer has submitted and obtained written approval, from the local planning authority, of a remediation strategy detailing how the identified contamination shall be dealt with. The remediation strategy shall be implemented as approved

Reason - For the ongoing protection of the Water Environment from risks arising from land contamination, pursuant to policy EN17 of the Manchester Core Strategy (2012).

12) Piling or any other foundation designs using penetrative methods shall not be permitted other than with the express written consent of the local planning authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater. The development shall be carried out in accordance with the approved details.

Reason - For the future protection of the Water Environment from risks arising from land contamination and to ensure that the development does not contribute to, and is not put at unacceptable risk from or adversely affected by unacceptable levels of water pollution caused by mobilised contaminants, pursuant to policies EN17 and EN18 of the Manchester Core Strategy (2012).

13) No infiltration of surface water drainage into the ground, where adverse concentrations of contamination is known or suspected to be present, is permitted other than with the express written consent of the Local Planning Authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to controlled waters. The development shall be carried out in accordance with the approval details.

Reason - For the ongoing protection of the water environment from risks arising from land contamination and to ensure that the development does not contribute to and is not put at unacceptable risk from or adversely affected by unacceptable levels of water pollution caused by mobilised contaminants, pursuant to policies EN17 and EN18 of the Manchester Core Strategy (2012).

14) No development shall take place until a document highlighting a temporary surface water drainage strategy, designed in accordance with Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards, has been submitted to and approved in writing by the Local Planning Authority. The development shall be implemented in accordance with the approved temporary surface water drainage strategy.

Reason - To secure surface water drainage arrangements and to manage the risk of flooding and pollution, pursuant national policies within the NPPF and NPPG and policies EN08 and EN14 of the Core Strategy for Manchester (2012).

15) No remediation ground works (excluding the treatment of Japanese Knotweed on the site), shall take place until the applicant or their agents or successors in title has secured the implementation of a programme of archaeological works. The works are to be undertaken in accordance with a Written Scheme of Investigation (WSI) submitted to and approved in writing by Manchester Planning Authority. The WSI shall cover the following:

1. A phased programme and methodology of investigation and recording to include:
 - an archaeological evaluation through trial trenching after removal of vegetation
 - dependent on the above, furthermore detailed archaeological excavation (subject to a separate WSI)
 - a survey of the flag stone wall
2. A programme for post investigation assessment to include:
 - production of a final report on the investigation results.
3. Deposition of the final report with the Greater Manchester Historic Environment Record.
4. A scheme to disseminate the results of the investigations commensurate with their significance.
5. Provision for archive deposition of the report and records of the site investigation.
6. Nomination of a competent person or persons/organisation to undertake the works set out within the approved WSI.

Reason- In accordance with NPPF Section 16, Paragraph 205 - To record and advance understanding of heritage assets impacted on by the development and to make information about the heritage interest publicly accessible.

16) A wildflower meadow is to be implemented on site if construction works for the redevelopment of the site have not commenced within 12 months of the completion and validation of the remediation works. Details of the soft landscaping scheme to form the wildflower meadow shall be submitted to and approved in writing by the Local Planning Authority. The approved wildflower meadow shall then be implemented, within 3 months of the approval of the scheme.

Reason - To safeguard the amenities of nearby residents , pursuant to policies SP1, EN9, and DM1 of the Manchester Core Strategy (2012).

17) No removal of or works to any tree and shrubs shall take place between 1st March and 31st August inclusive, unless a competent ecologist has undertaken a careful, detailed check of vegetation for active birds' nests immediately before the vegetation is cleared and provided written confirmation that no birds will be harmed and/or that there are appropriate measures in place to protect nesting bird interest on site. Any such written confirmation should be submitted to the local planning authority.

Reason - To ensure the protection of wildlife habitats in the locality, pursuant to policy EN15 of the Manchester Core Strategy (2012) and National Planning Policy Framework.

18) Prior to the commencement of on-site remediation works, finalised details of measures intended to protect the canal corridor from pollution and contamination including :

- o how surface water is to be captured , treated and disposed of and measures to deal with any contaminated water to avoid any adverse impact on the canal.
 - o Management of water levels on the site to prevent water discharge into the canal during the works
 - o any existing drains identified on the site should be blocked off prior to the remediation of the site.
 - o Any measures including a buffer zone or physical boundary such as sandbags, silt fence , silt trench, earth bund along the sites frontage with the canal, and minimising stockpiles of materials within the site, and covering any stockpiles to avoid mobilisation due to rainfall.
 - o Measures are also necessary to reduce dust and windblown debris from the site with suitable dust suppression techniques.
 - o Full details of the proposed mitigation works intended to safeguard land stability and structural integrity of the canal should therefore be provided.
- Shall be submitted to and approved in writing by the Local Planning Authority. The development shall be implemented in accordance with the approved canal protection measures

Reason - To ensure the protection of wildlife habitats in the locality, pursuant to policy EN15 of the Manchester Core Strategy (2012) , and National Planning Policy Framework.

Informatives

Building Regulations 2010

This permission does not grant approval under Building Regulations.

Street Naming & Numbering Requirements

Manchester City Council is responsible for allocating street naming and numbering within Manchester for new developments or property conversions. Individuals or businesses are not permitted to allocate their own property numbers, building or street names.

If your development includes the creation of new dwellings (either new build or conversion of existing buildings), creation of new commercial properties or the subdivision of existing properties you must ensure that you request new or changes to addresses through us so they can be officially allocated and registered in accordance with the Public Health Act 1925 Sections 17-19 & Greater Manchester Act 1981 Section 22.

Failure to do this may result in difficulties for the developer/occupier when requiring services such as connections to utilities, phone lines and postal services and may delay your development.

You can apply online at the following address:

http://www.manchester.gov.uk/info/100011/roads_parking_and_transport/1988/naming_and_numbering_of_houses_buildings_streets_and_roads/2

Mining Information

The proposed development lies within an area which could be subject to current coal mining or hazards resulting from past coal mining. Please read the Standing Advice from the Coal Authority in Appendix A.

The applicant is advised that any requirements for licensing, hoarding / scaffolding, building maintenance and any associated temporary traffic management arrangements will need discussion and agreement with the council's Highways Applications and Network Resilience teams via Contact Manchester (Tel. 0161 234 5004).

The applicant is advised to contact the Canals & Rivers Trust's Works Engineer Gareth Taylor at Gareth.taylor@canalrivertrust.org.uk in order to ensure any necessary consents are obtained and that the scheme would comply with the Trust's 'Code of Practise for Works affecting Canals and River Trust'.

The applicant is advised that any discharged into the Rochdale Canal is likely to require prior consent of the Canal and River Trust. As such the Trust is not a land drainage authority , such discharges are not granted as of right and where they are granted they will usually be subject to completion of a commercial agreement. The applicant should contact the Trust's Utilities Team direct at utilitiesenquiry@canalrivertrust.org.uk for further advice should any discharge to the canal be proposed.

Sites of this nature are often subject to criminal damage, arson and theft. The style of fencing therefore needs to be robust and well-maintained in order to reduce opportunities for such crime / disorder.

It is recommended that the site benefit from a night-time security presence. If this is not possible, the applicant should not store valuable items or loose materials on site overnight. Any portable items should be removed from site or stored within the secure container, out of sight.

The site should be secured by a pad locked gate, a closed shackle padlock should be used.

Dusk to dawn lighting should be incorporated into the site whilst the remediation works are taking place to ensure the area is well lit during the hours of darkness.

In summary, the application is supported subject to further consideration of the above matters.

Date: 29 October 2021

Signed: 

Julie Roscoe
Director of Planning, Building Control & Licensing

Manchester City Council, P O Box 532, Town Hall, Manchester M60 2LA

Notes

1. This permission refers only to that required under the Town and Country Planning Act 1990 does not include any consent or approval under any other enactment, byelaw, order or regulation.

2 If the applicant is aggrieved by the decision of the local planning authority to refuse permission or approval for the proposed development, or to grant permission or approval subject to conditions, they may appeal to the Secretary of State in accordance with Section 78(1) of the Town and Country Planning Act 1990 within six months of the date of the notice of the decision.

The Planning Inspectorate have introduced an online appeals service that can be used to make appeals online. This service is available through the gov.uk website – www.gov.uk/planning-inspectorate. The Inspectorate will publish details of your appeal on the internet. Alternatively If you are unable to access the online appeal form, please contact the Planning Inspectorate to obtain a paper copy of the appeal form on tel: 0303 444 5000.

The Secretary of State has power to allow a longer period for the giving of a notice of appeal but they will not normally be prepared to exercise this power unless there are special circumstances that excuse the delay in giving notice of appeal.

If you intend to submit an appeal that you would like examined by inquiry then you must notify the City Council (planning@manchester.gov.uk) and the Planning Inspectorate (inquiryappeals@planninginspectorate.gov.uk) at least 10 days before submitting the appeal. Further details are on GOV.UK.

3. The statutory requirements are those set out in Section 79(6) of the Town and Country Planning Act 1990, namely Sections 70(1) and 72(1) of the Act.

4. If either the local planning authority or the Secretary of State refuses permission to develop land or grants it subject to conditions, the owner may claim that they can neither put the land to a reasonably beneficial use in its existing state nor render the land capable of a reasonably beneficial use by the carrying out of any development which has been or would be permitted.

In these circumstances, the owner may serve a purchase notice on the Council in whose area the land is situated. This notice will require the Council to purchase his interest in the land in accordance with the provisions of Part VI of the Town and Country Planning Act 1990

5. In certain circumstances, a claim may be made against the local planning authority for compensation, where permission is refused or granted subject to conditions by the Secretary of State on appeal or on a reference of the application to them. The circumstances in which such compensation is payable are set out in Section 114 of the Town and Country Planning Act 1990.

Right of challenge on planning application decision

A third party does not have a right of appeal against a decision on a planning application. Instead there is a right of challenge (a Judicial Review) which is limited to lawfulness of the procedure that we have taken in coming to that decision.

Any challenge must be based on the following and not the merit of the decision:

- Procedural irregularity
- Irrationality
- Illegality

Any application for permission to bring such a challenge (which is through the High Court) must be made within 6 weeks of the date of the decision being issued.

Appendix A



**The Coal
Authority**

Any Planning Enquiries should be directed to:

Planning and Local Authority Liaison

Telephone: 01623 637 119

Email: planningconsultation@coal.gov.uk

Website: www.gov.uk/government/organisations/the-coal-authority

STANDING ADVICE - DEVELOPMENT LOW RISK AREA

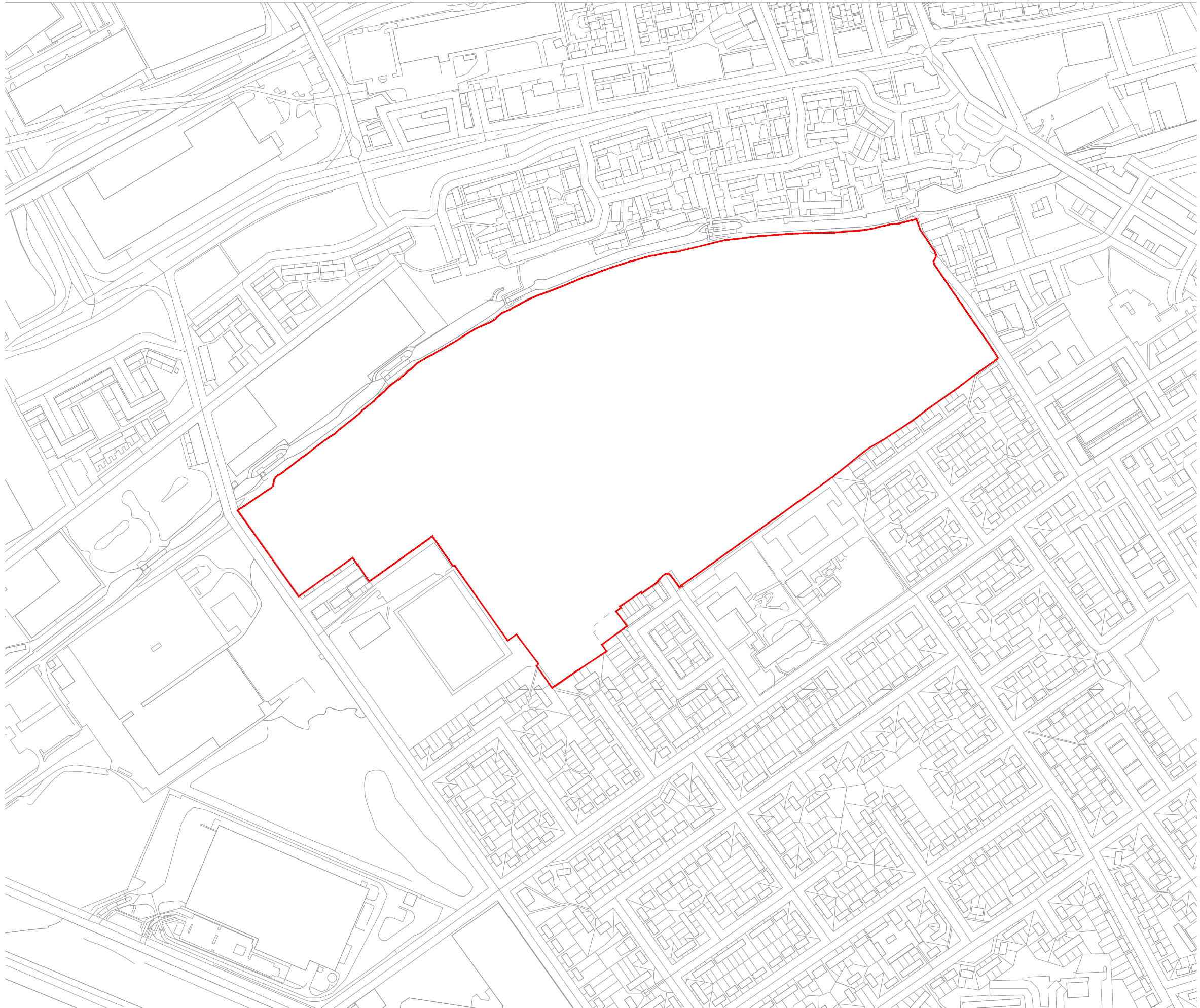
The proposed development lies within a coal mining area which may contain unrecorded coal mining related hazards. If any coal mining feature is encountered during development, this should be reported immediately to the Coal Authority on 0345 762 6848.

Further information is also available on the Coal Authority website at:
www.gov.uk/government/organisations/the-coal-authority

This Standing Advice is valid from 1st January 2021 until 31st December 2022

Appendix E

Drawings



Key:

Site Boundary

	FIRST ISSUE	11-08-2023

Rev.	Description	Revised By	Date
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- Sheffield Office:

Tel: 01246 813289
Fax: 01246 812963

Site Address: Ten Acres Lane Manchester M40 2SP	Rev:
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Title: Site Location Plan

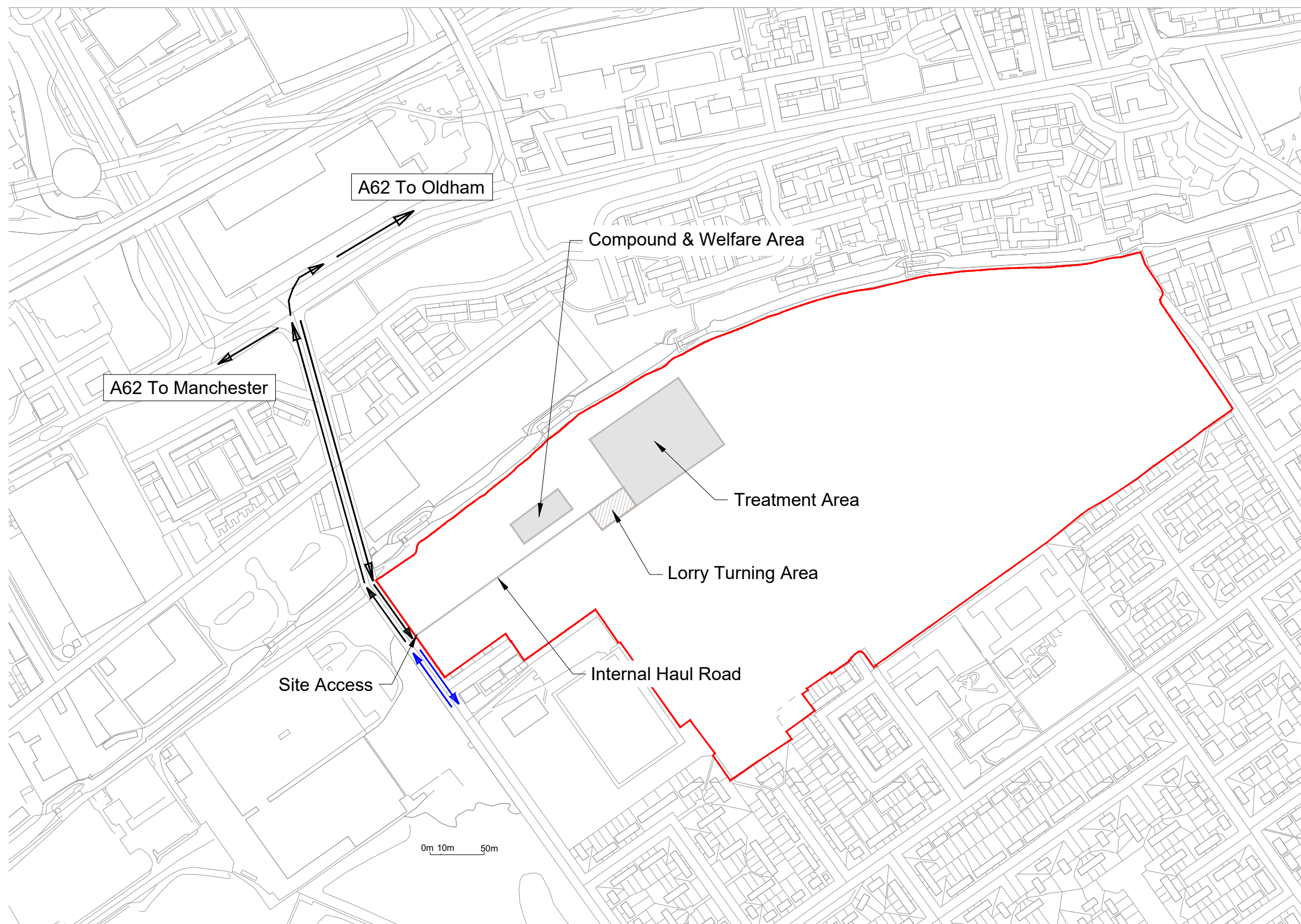
Client: Your Housing Group Ltd

Drawn: JGL	Checked: RW	Approved: RW
Dwg: D1932_20	Contract: 1932YOU	Scale: 1:4000



Key:

- Site Boundary
- HGV & Other Vehicle Route to A62 Avoiding Low Bridges
- Light Vehicle / Car Route with Low Bridges. Not Suitable for HGV's



FIRST ISSUE

18-09-23

Rev.	Description	Revised By	Date
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Contaminated Land,
Brownfield & Environmental
Contracting Specialists

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- Bristol Head Office: Tel: 01275 397600
Fax: 01275 397601
- Sheffield Office: Tel: 01246 813289
Fax: 01246 812963

Site Address:
Ten Acres Lane
Manchester
M40 2SP

Rev:

Title: Traffic Routes to & from Site

Client: Your Housing Group Ltd

Drawn: MRG	Checked: AD	Approved: MA
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Dwg: D1932_24	Contract: 1932YOU	Scale: 1:4000
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- Key
- Spot Level
 - Top of Bank
 - Bottom of Bank
 - As-Built Extent - Surface Water Trench
 - Water Treatment Plant
 - Proposed Bunds - Circa 1m High
 - Surface Water Trench - Extension

FIRST ISSUE		03-10-2023	
Rev.	Description	Revised By	Date

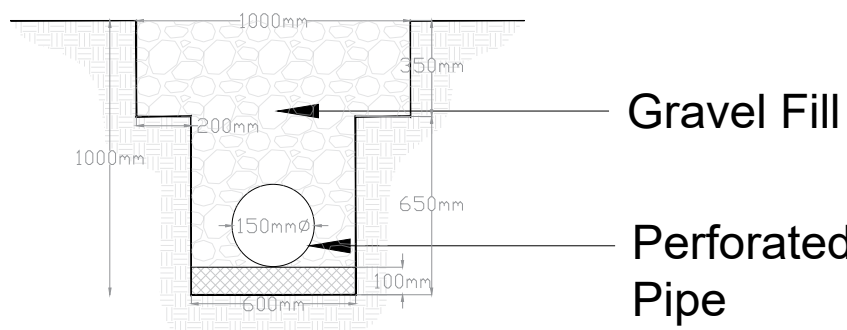
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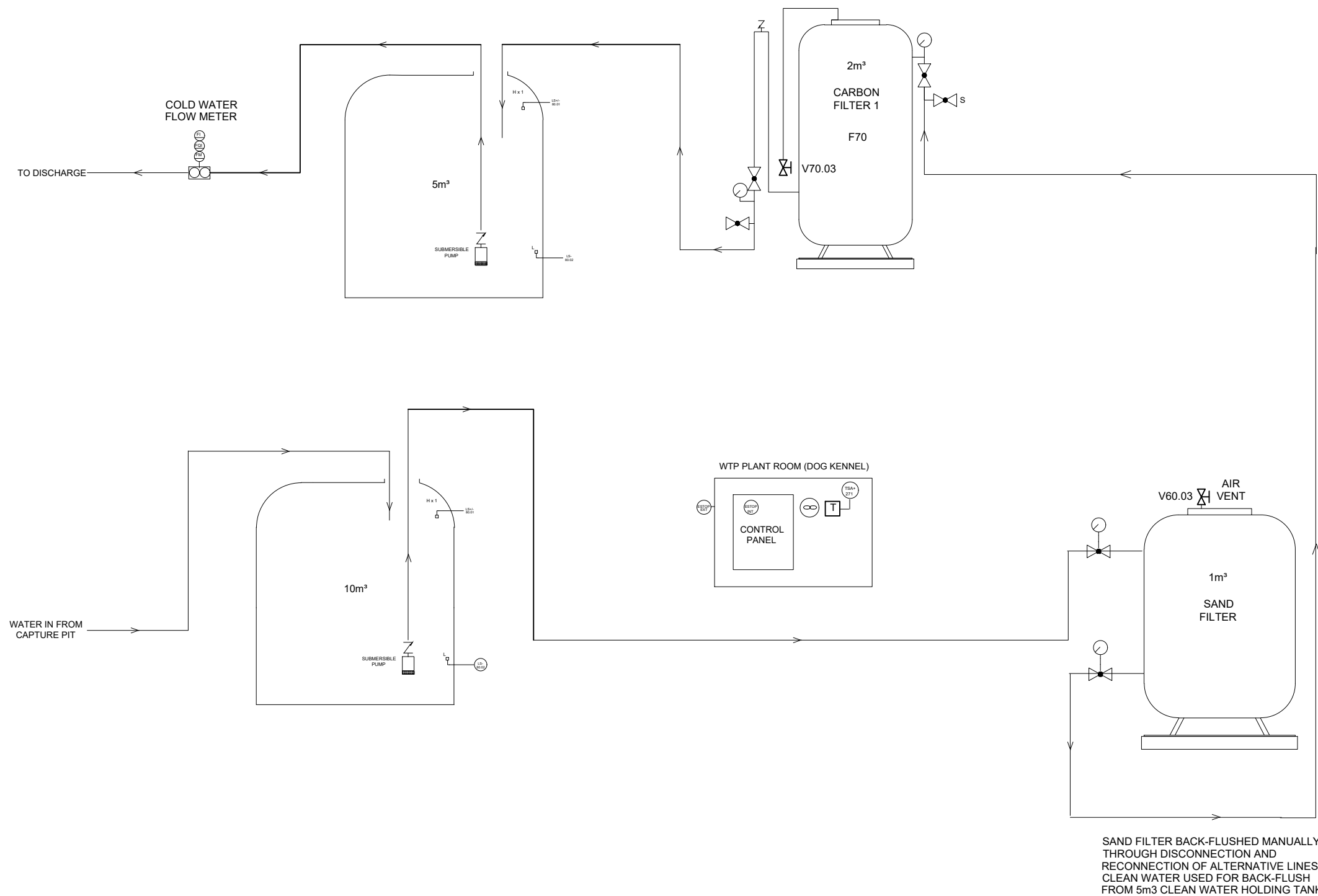
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Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: Surface Water Management Plan		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: MA	Approved: MA
Dwg: D1932_25	Contract: 1932YOU	Scale: 1:1250

Typical Section - Surface Water Collection Trench





EQUIPMENT LEGEND

- STRAINER AND NON RETURN VALVE
- BALL VALVE
- SAMPLE PORT
- GATE VALVE
- PRESSURE GAUGE
- VACUUM GAUGE
- NON RETURN VALVE
- FLOW METER
- PRESSURE REGULATOR WITH FILTER
- SOLENOID VALVE
- 3 WAY PNEUMATIC VALVE
- FILTER REGULATOR WITH PULSE COUNTER
- FLOW INDICATOR
- HIGH LEVEL ALARM FLOAT SWITCH
- HIGH LEVEL FLOAT SWITCH
- LOW LEVEL FLOAT SWITCH
- WALL THERMOSTAT
- TEMPERATURE SWITCH
- PRESSURE SWITCH
- VENTILATION FAN
- 2-WAY PNEUMATIC VALVE

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Site Address:

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Manchester
M40 2SP

Rev:

Title: WTP Process Instrumentation Layout

Client: Your Housing Group Ltd

Drawn: MRG

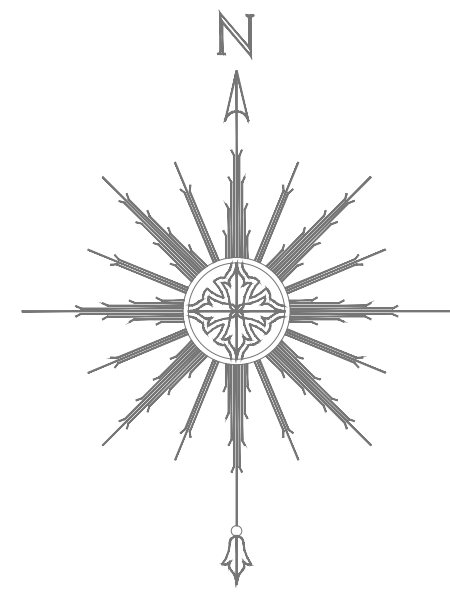
Checked: JL

Approved: JL

Dwg: D1967_08

Contract: 1967YOU

Scale: NTS



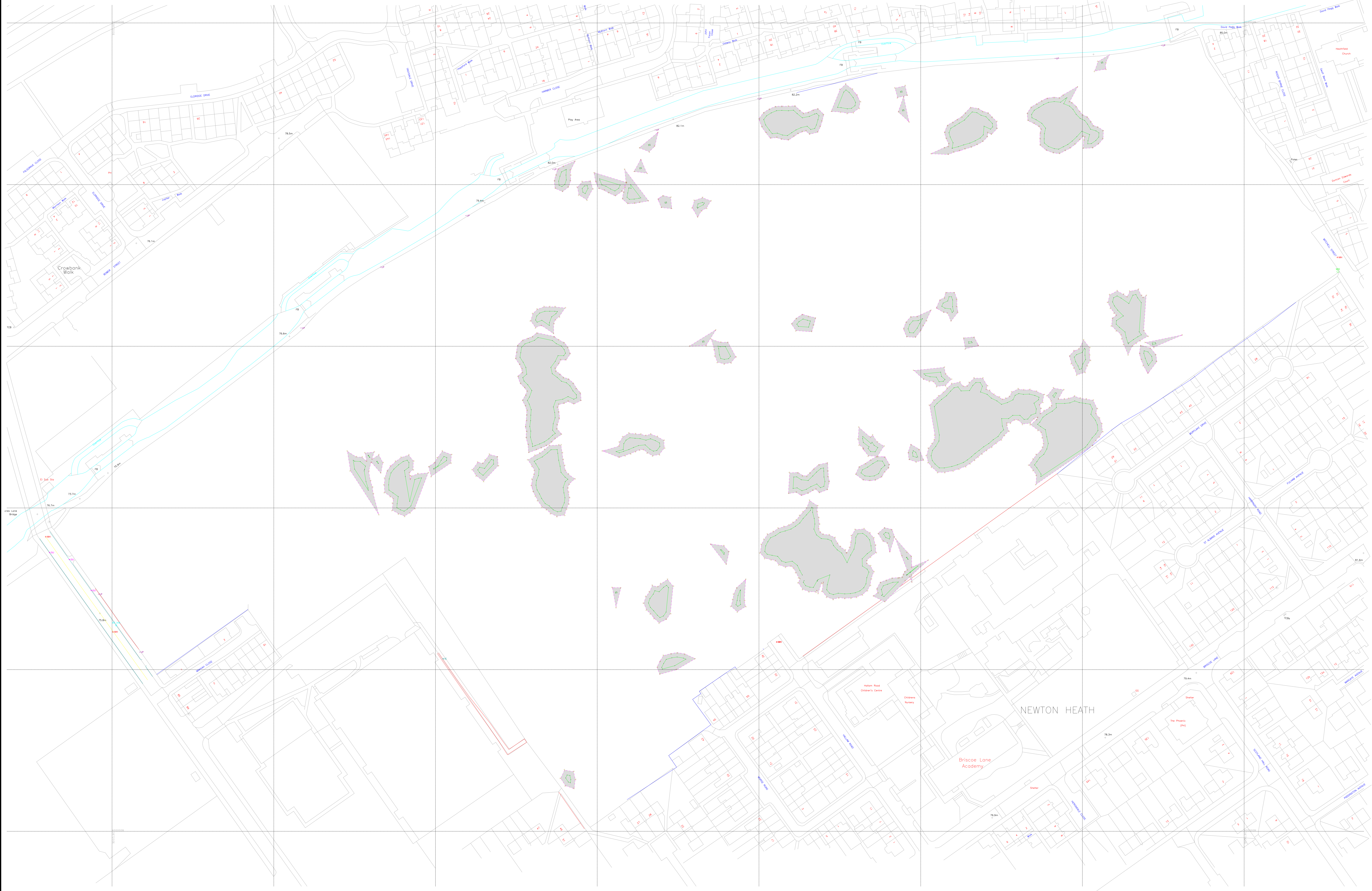
Key

Bottom of Bank

Top of Bank

Japanese Knotweed Locations

Volume of impacted soil to be removed: 23,920m³



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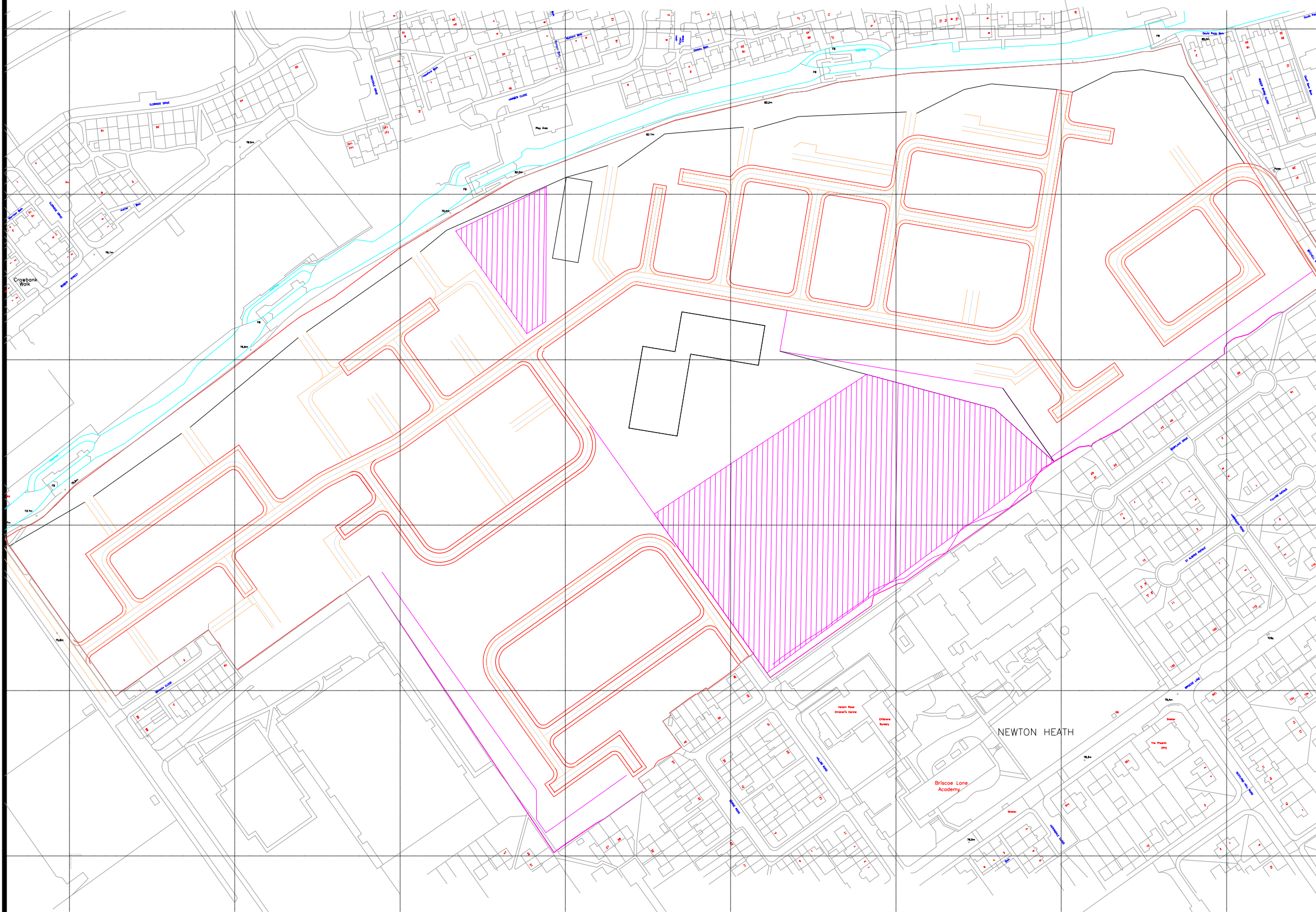
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Tel: 01246 813289
Fax: 01246 812863

Site Address: Ten Acres Lane Manchester M40 2SP		Rev.
Title: Japanese Knotweed Locations		
Client: Your Housing Group Limited		
Drawn By: JGL	Checked: TH	Approved: ML
Dwg No: D4744_02	Contract No: 193ZYCU	Scale: 1:500

Key

 Proposed Japanese Knotweed Cell Locations



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Site Address:
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Manchester
M40 2SP

Rev:

Title: Japanese Knotweed Burial Cell Location

Client: Your Housing Group Ltd

Drawn: JGL	Checked: AR	Approved: SE
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Dwg: D4744_04	Contract: 4744YOU	Scale: 1:2500
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Notes:
 HRM - High Risk Materials
 LRM - Low Risk Materials
 LRM C+D - Low Risk Materials Construction and Demolition

 Perched water/leachate will be pumped and treated wherever and whenever it is encountered (mainly HRM area)

Excavation Depths
 LRM: Excavation Depth FFL -1m (or natural, whichever is shallower)
 LRM C+D: Excavation Depth FFL -1m (or natural, whichever is shallower)
 HRM: Excavation Depth FFL -3m (or natural, whichever is shallower)
 Adoptable Roads: Excavation Depth FFL -3m (or natural, or LRM with a 2.5% CBR whichever is shallower)

A	Updates to text	JGL	22-11-2023
	FIRST ISSUE		03-07-2023
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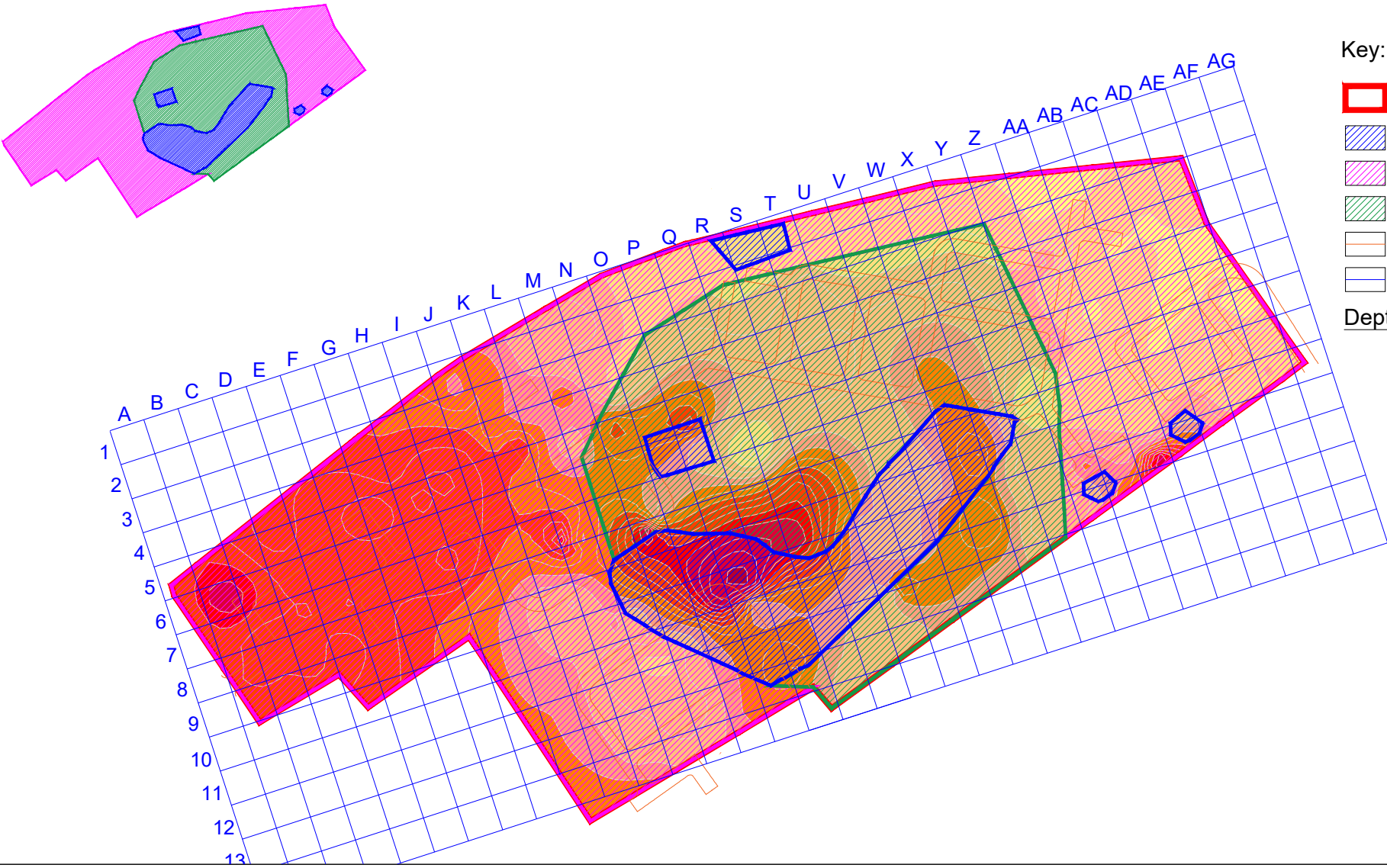
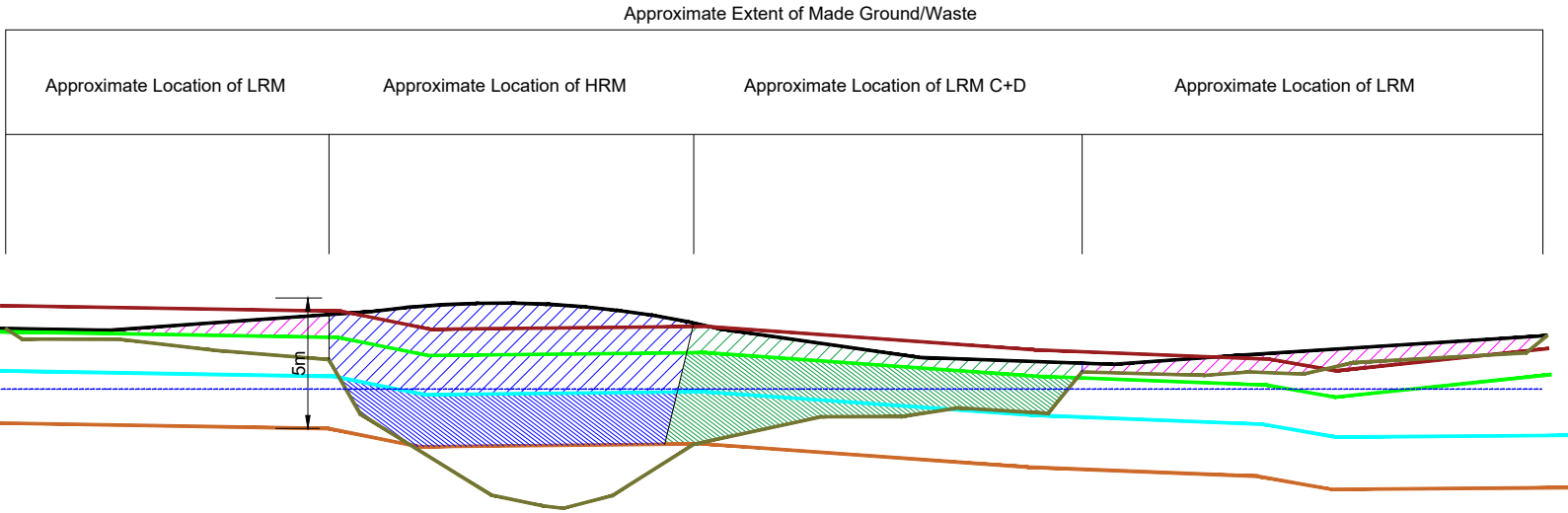
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Tel: 01246 813289
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Site Address: Ten Acres Lane Manchester M40 2SP			Rev: A
Title: Proposed Remediation Strategy			
Client: Your Housing Group Ltd			
Drawn: JGL	Checked: SE	Approved: SE	
Dwg: D4744_08	Contract: 4744YOU	Scale: NTS	



Proposed Waste Remediation Strategy
 NOT DRAWN TO SCALE FOR INFORMATION ONLY

Key

- Existing Ground Level
- Proposed Formation Level
- Top of Natural Ground
- Proposed Formation Level (-1m)
- Proposed Formation Level (-3m)
- Proposed Formation Level (-5m)
- HRM - to be processed
- HRM - subject to the dynamic strategy - deeper excavation protocol
- LRM - to be processed
- LRM C+D - to be processed
- LRM C+D - subject to the dynamic strategy - deeper excavation protocol
- Indicative GW Level

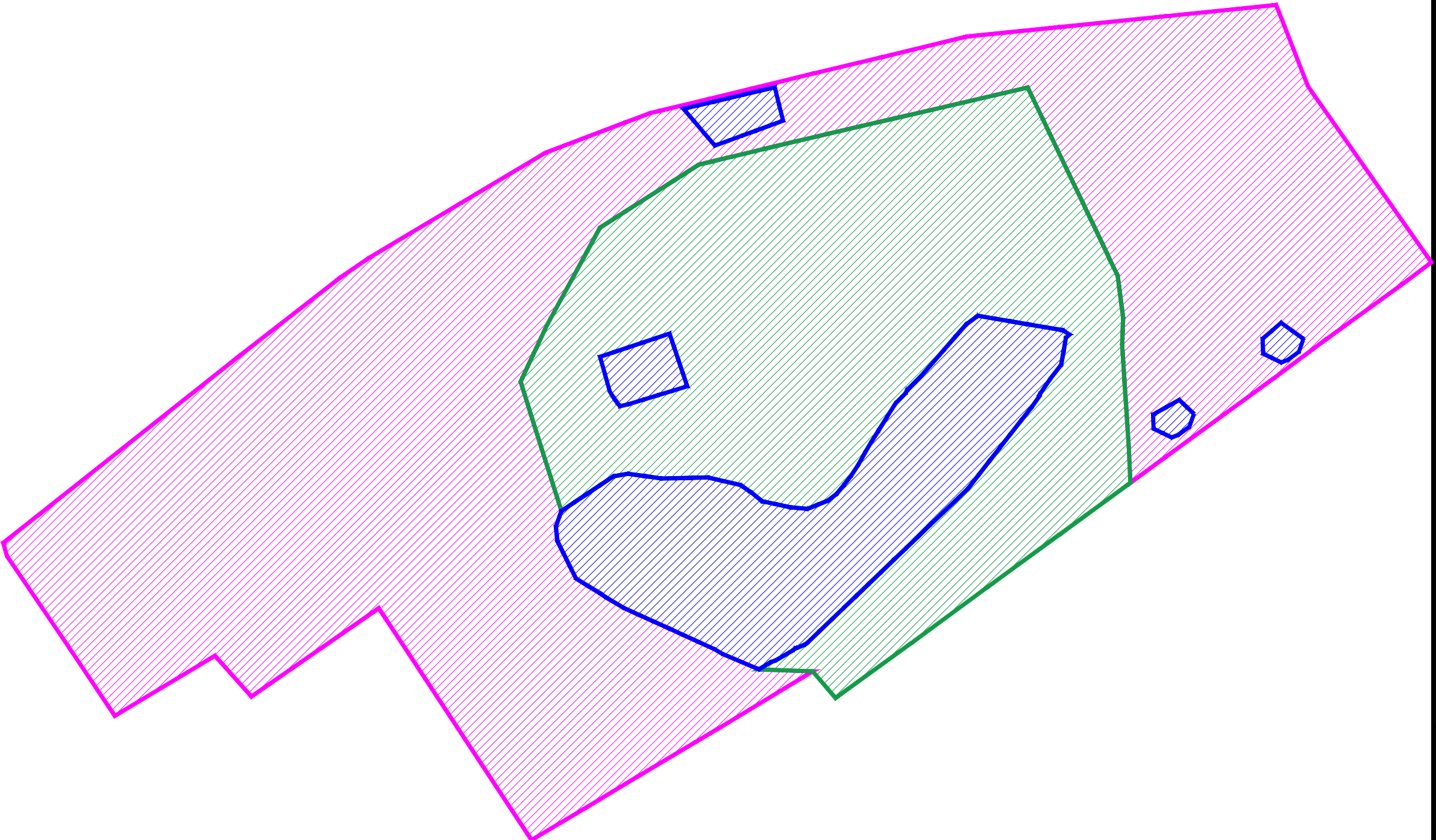
Key:

Site Boundary

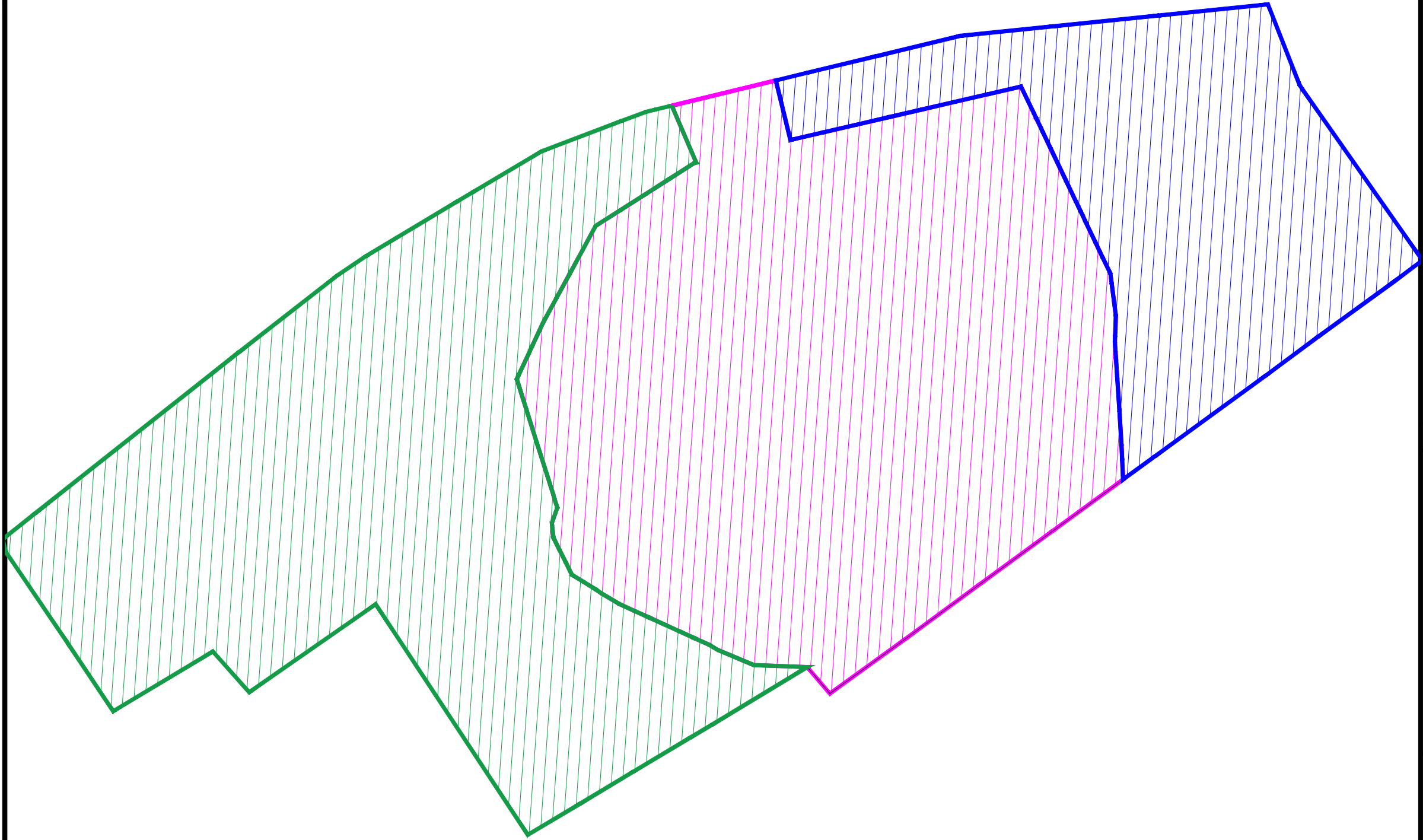
HRM

LRM

LRM C+D



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<div> <div>Site Address:</div> <div>Ten Acres Lane</div> <div>Manchester</div> <div>M40 2SP</div> </div>			Rev:
Title: Proposed Remediation Strategy v2			
Client: Your Housing Group Ltd			
Drawn: JGL	Checked: SE	Approved: ML	
Dwg: D4744_12	Contract: 4744YOU	Scale: 1:2500	



Key

-  Predominantly Coal Measures Overburden
-  Predominantly Landfill
-  Predominantly Made Ground

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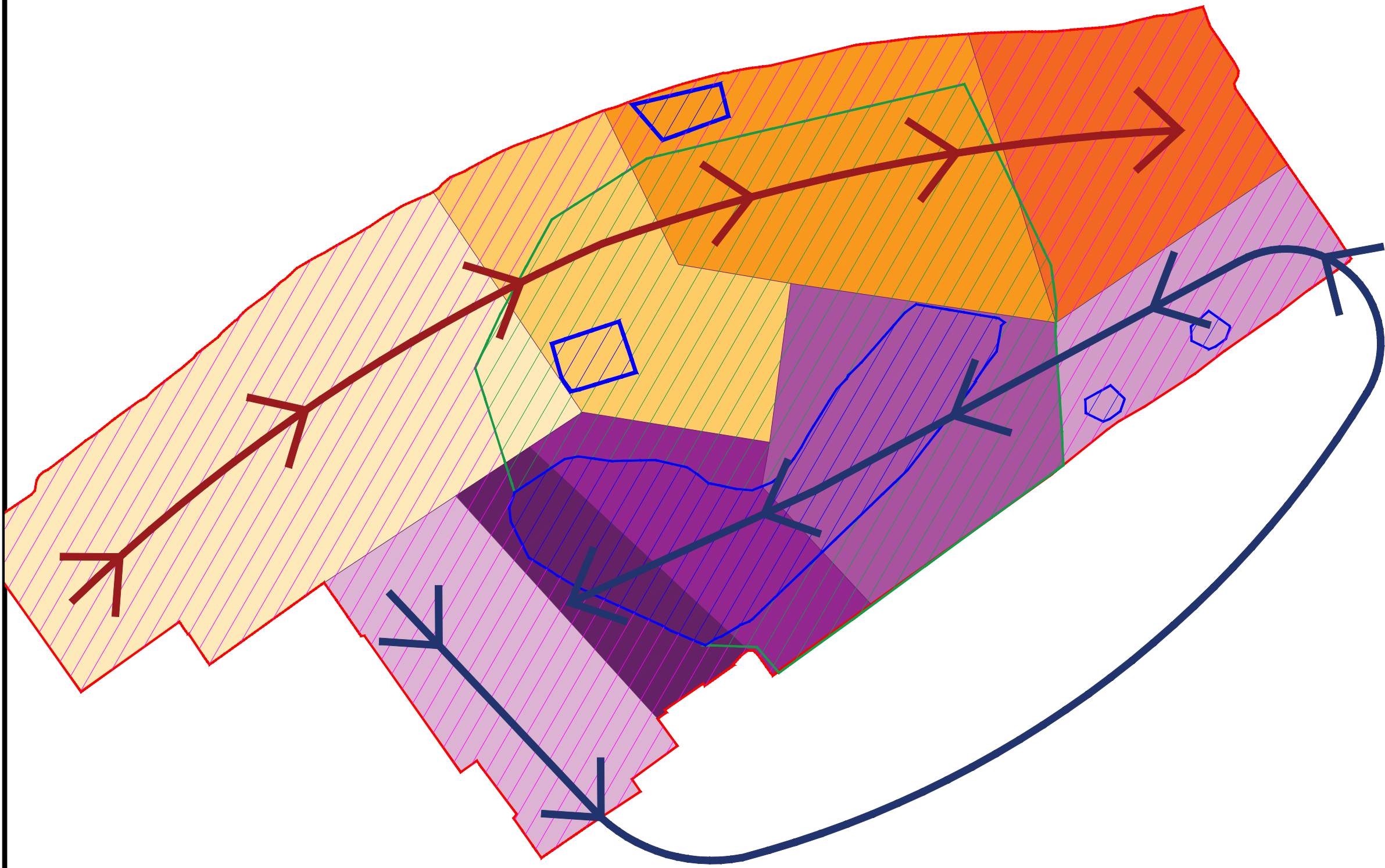
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Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: Indicative Material Types/ Filling History		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: SE	Approved: AR
Dwg: D4744_17	Contract: 4744YOU	Scale: 1:2500

Key

-  Team A - Working Direction
-  Team B - Working Direction
-  LRM
-  LRM C+D
-  HRM



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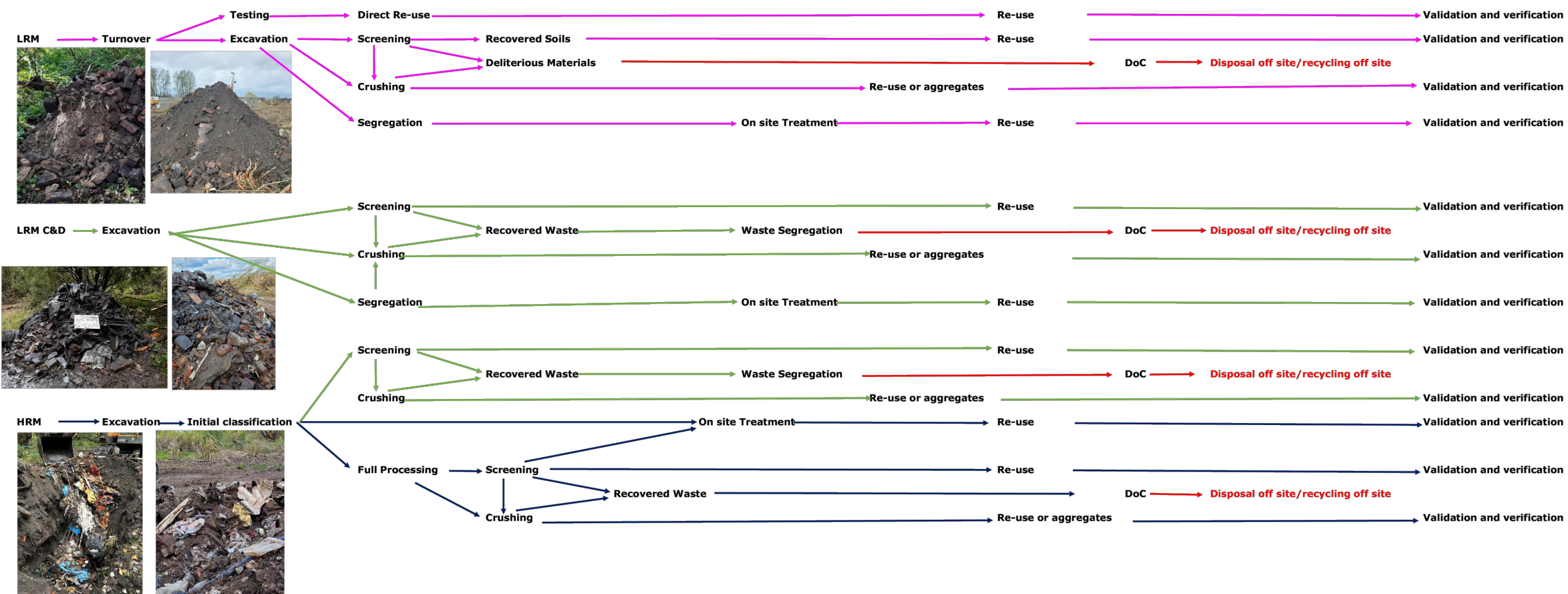
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Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: Proposed Remediation Progression and Sequencing		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: SE	Approved: SE
Dwg: D4744_18	Contract: 4744YOU	Scale: 1:2500



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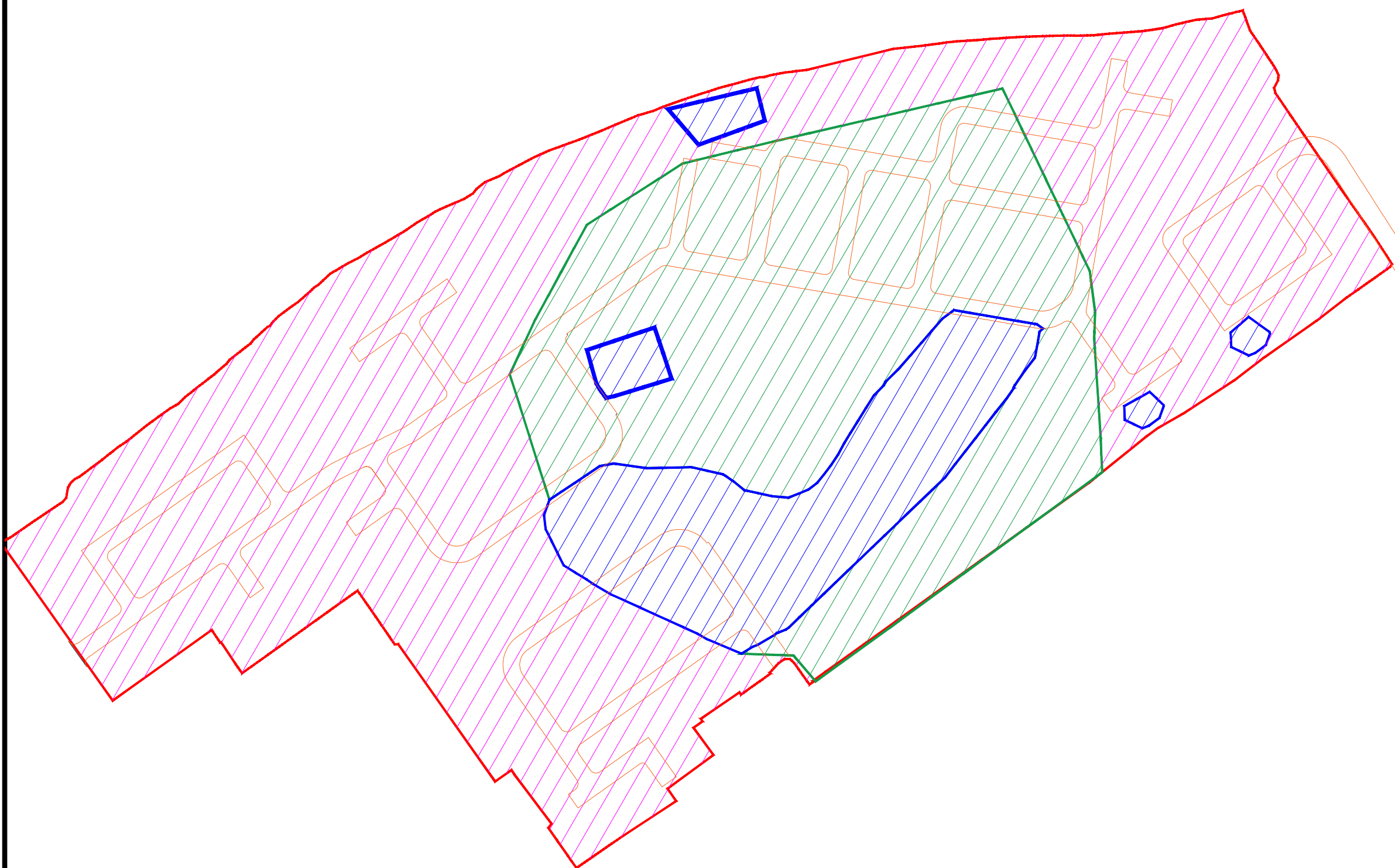
Rev:

Title: Treatment Train

Client: Your Housing Group Ltd

Drawn: JGL Checked: SE Approved: SE

Dwg: D4744_19 Contract: 4744YOU Scale: NTS



Key

- Site Boundary
- LRM: Excavation Depth FFL -1m (or natural, whichever is shallower)
- LRM C+D: Excavation Depth FFL -1m (or natural, whichever is shallower)
- HRM: Excavation Depth FFL -3m (or natural, whichever is shallower)
- Adoptable Roads: Excavation Depth FFL -3m (or natural, or LRM with a 2.5% CBR whichever is shallower)

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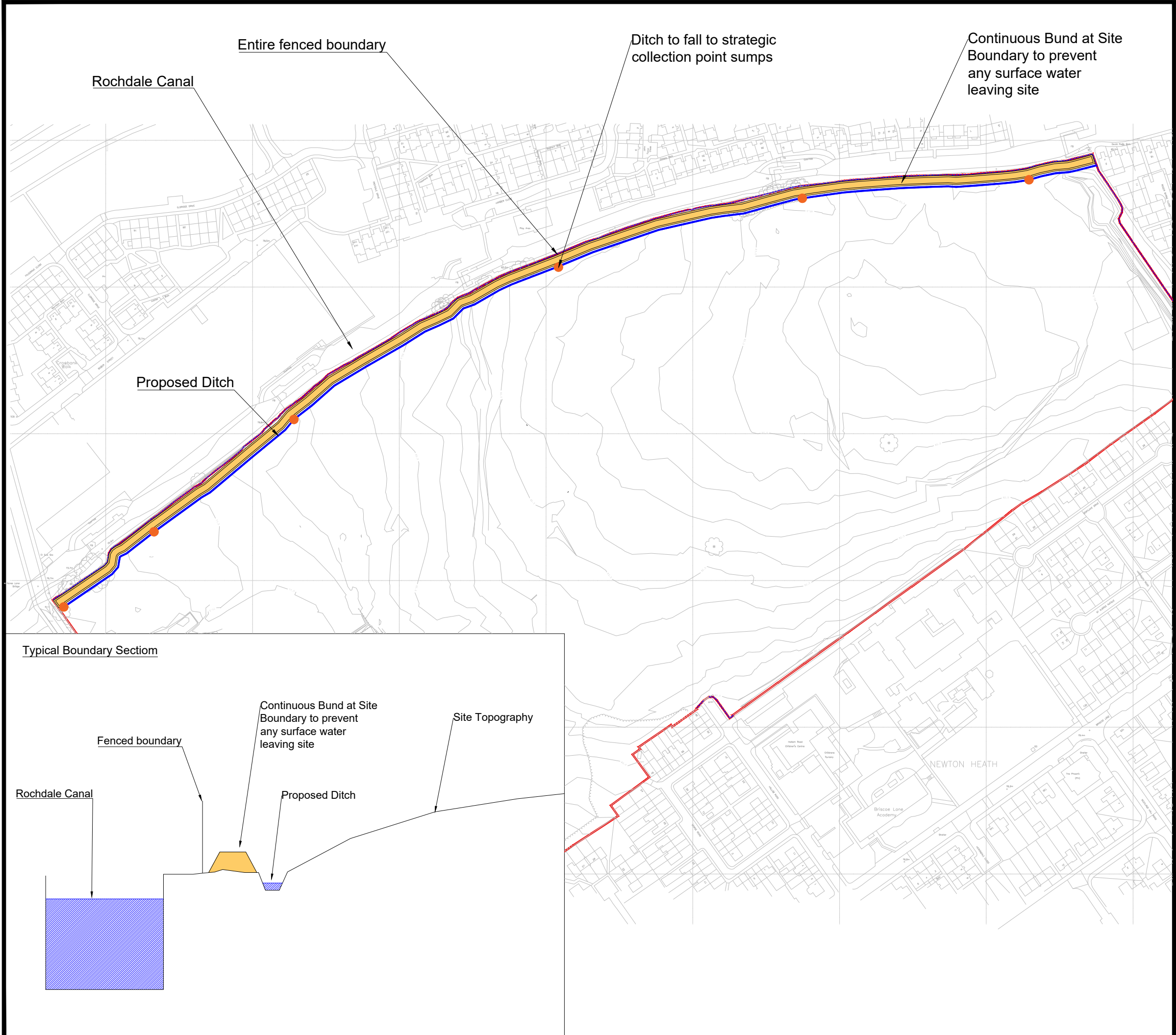
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Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: Basic Remediation Excavation Depth		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: SE	Approved: SE
Dwg: D4744_20	Contract: 4744YOU	Scale: 1:2500



Key

- Site Boundary
- Perimeter Bund
- Ditch
- Proposed Collection Point

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Site Address:

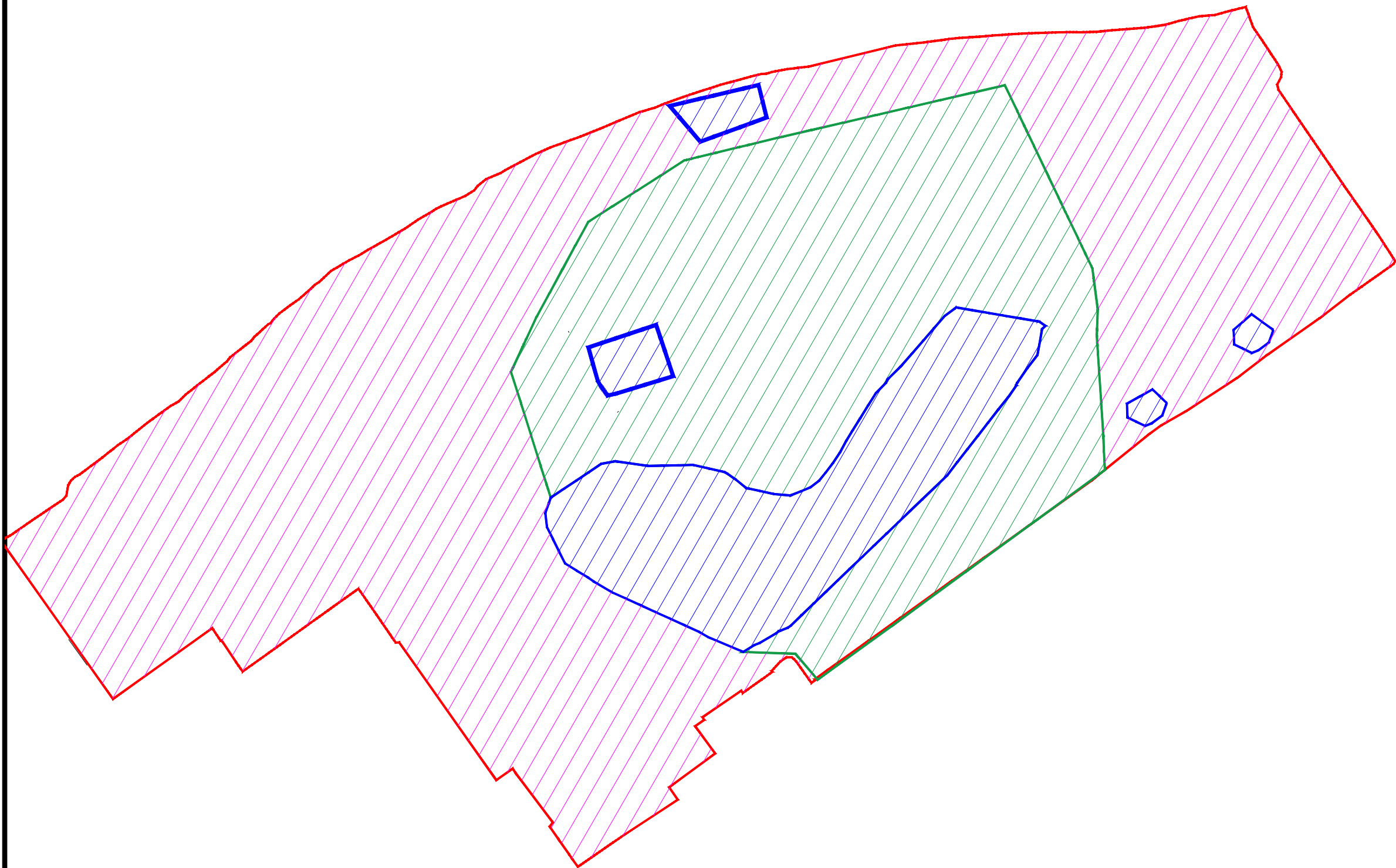
Ten Acres Lane
Manchester
M40 2SP

Rev:

Title: Canal Protection Measures

Client: Your Housing Group Ltd

Drawn: JGL	Checked: SE	Approved: SE
Dwg: D4744_21	Contract: 4744YOU	Scale: 1:2500



Key

-  Site Boundary
-  LRM: Excavation Depth FFL -1m
Areas where dynamic strategy not applicable, standard base investigation protocol only
-  LRM C+D: Excavation Depth FFL -1m
Depth at which dynamic strategy is employed for remaining HRM
-  HRM: Excavation Depth FFL -3m
Depth at which dynamic strategy is employed for remaining HRM

See also Deeper Excavation Protocol

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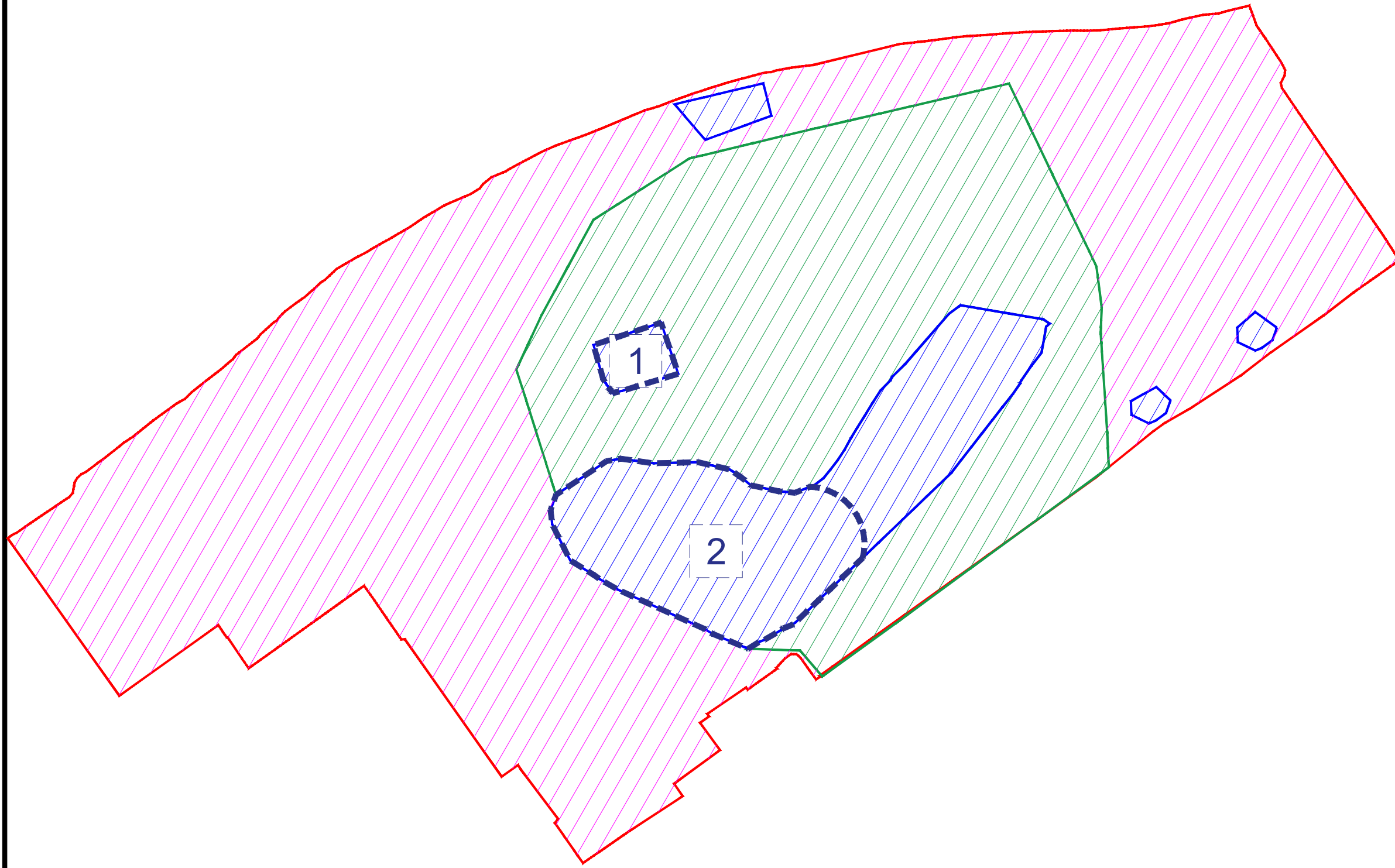
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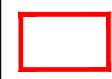
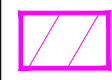
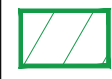
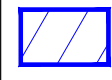
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Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: Areas for Dynamic Remediation Strategy		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: SE	Approved: SE
Dwg: D4744_22	Contract: 4744YOU	Scale: 1:2500



Key

-  Site Boundary
-  LRM
-  LRM C+D
-  HRM
-  Primary Leachate Pumping Areas

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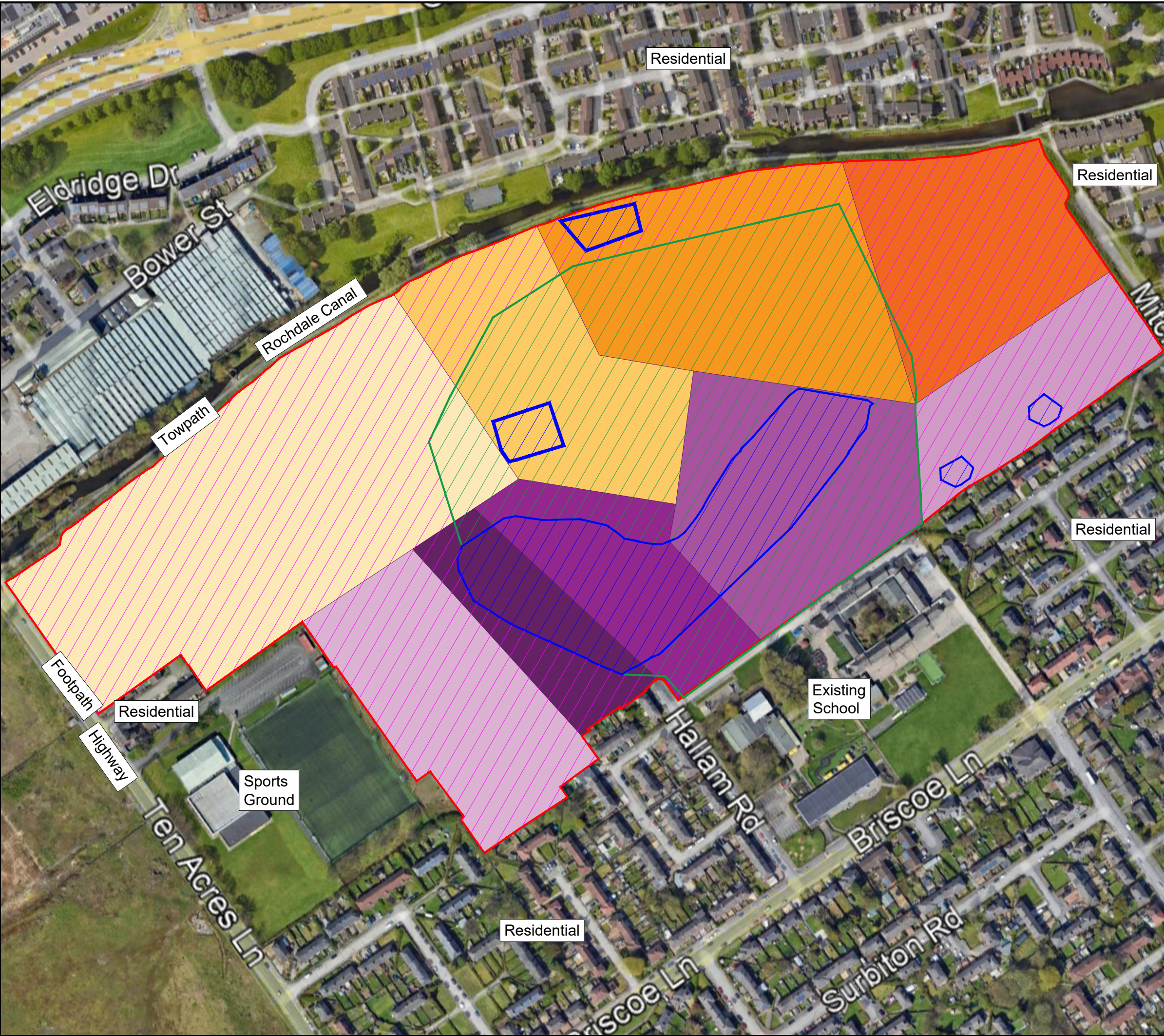
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Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: Primary Leachate Pumping Areas		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: SE	Approved: SE
Dwg: D4744_23	Contract: 4744YOU	Scale: 1:2500



Key

- Site Boundary
- LRM
- LRM C+D
- HRM

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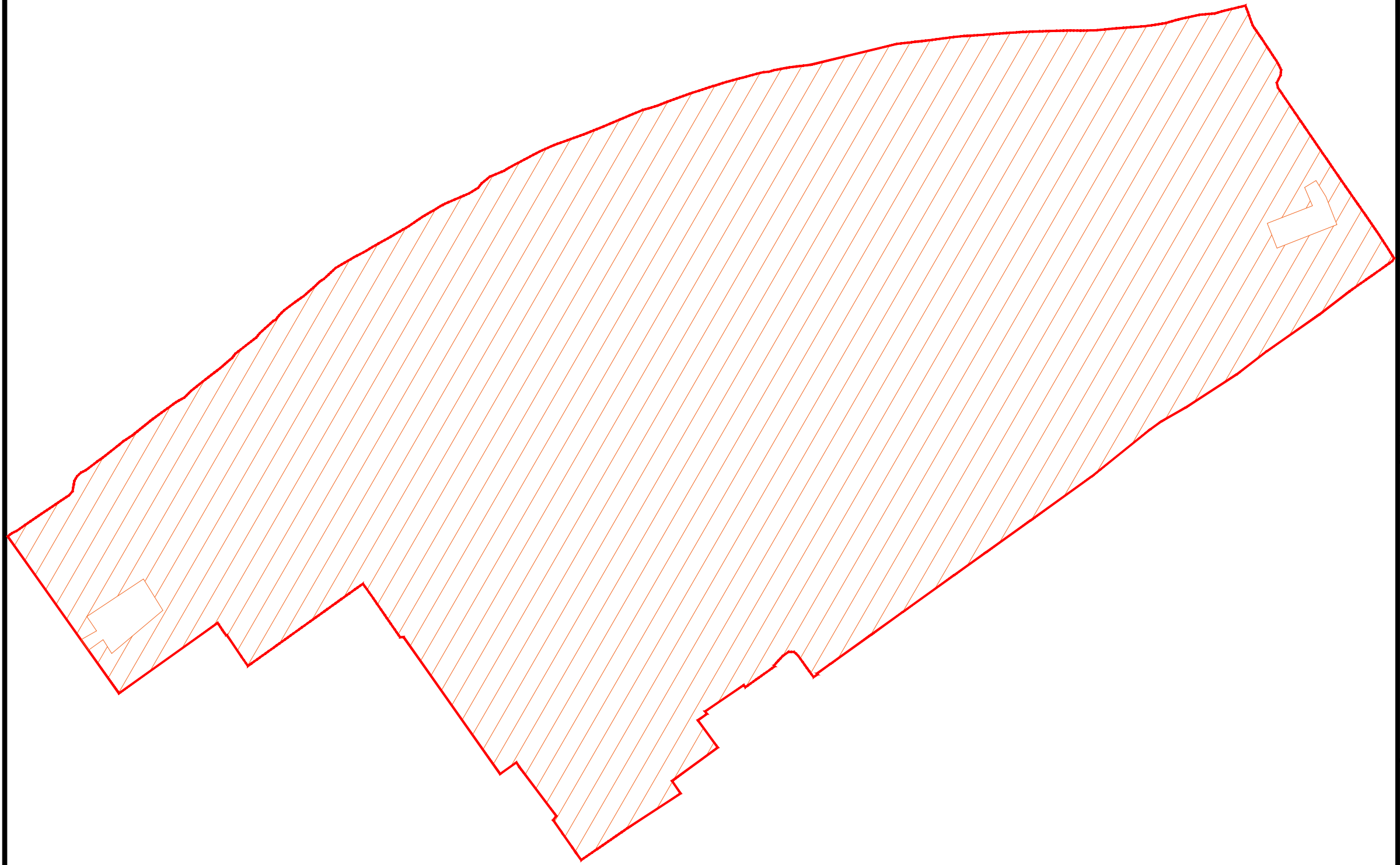
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Site Address: Ten Acres Lane Manchester M40 2SP			Rev:
Title: Surrounding Environment			
Client: Your Housing Group Ltd			
Drawn: JGL	Checked: SE	Approved: SE	
Dwg: D4744_24	Contract: 4744YOU	Scale: 1:2500	

Key

- Site Boundary
- LRM - Topsoil Surface Strip Areas



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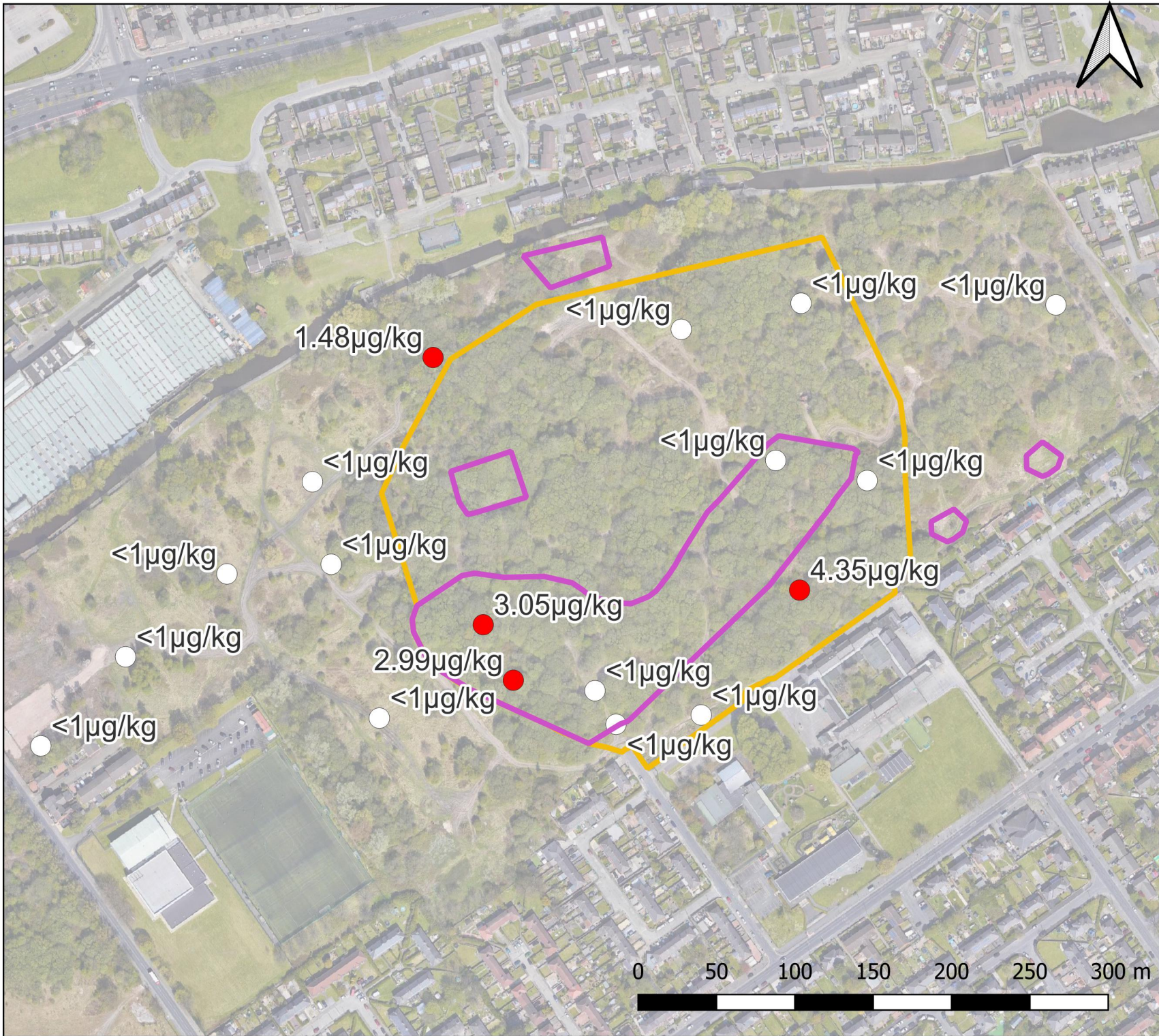
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Site Address: Ten Acres Lane Manchester M40 2SP		Rev:
Title: LRM - Topsoil		
Client: Your Housing Group Ltd		
Drawn: JGL	Checked: SE	Approved: SE
Dwg: D4744_25	Contract: 4744YOU	Scale: 1:2500



Legend

Features

— HRM

— LRM - Con&Demo

Soils

Total PFOS ug/kg

☐ ND

● Detected



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Total PFOS (ug/kg) detected in soil samples from the Ten Acres Site

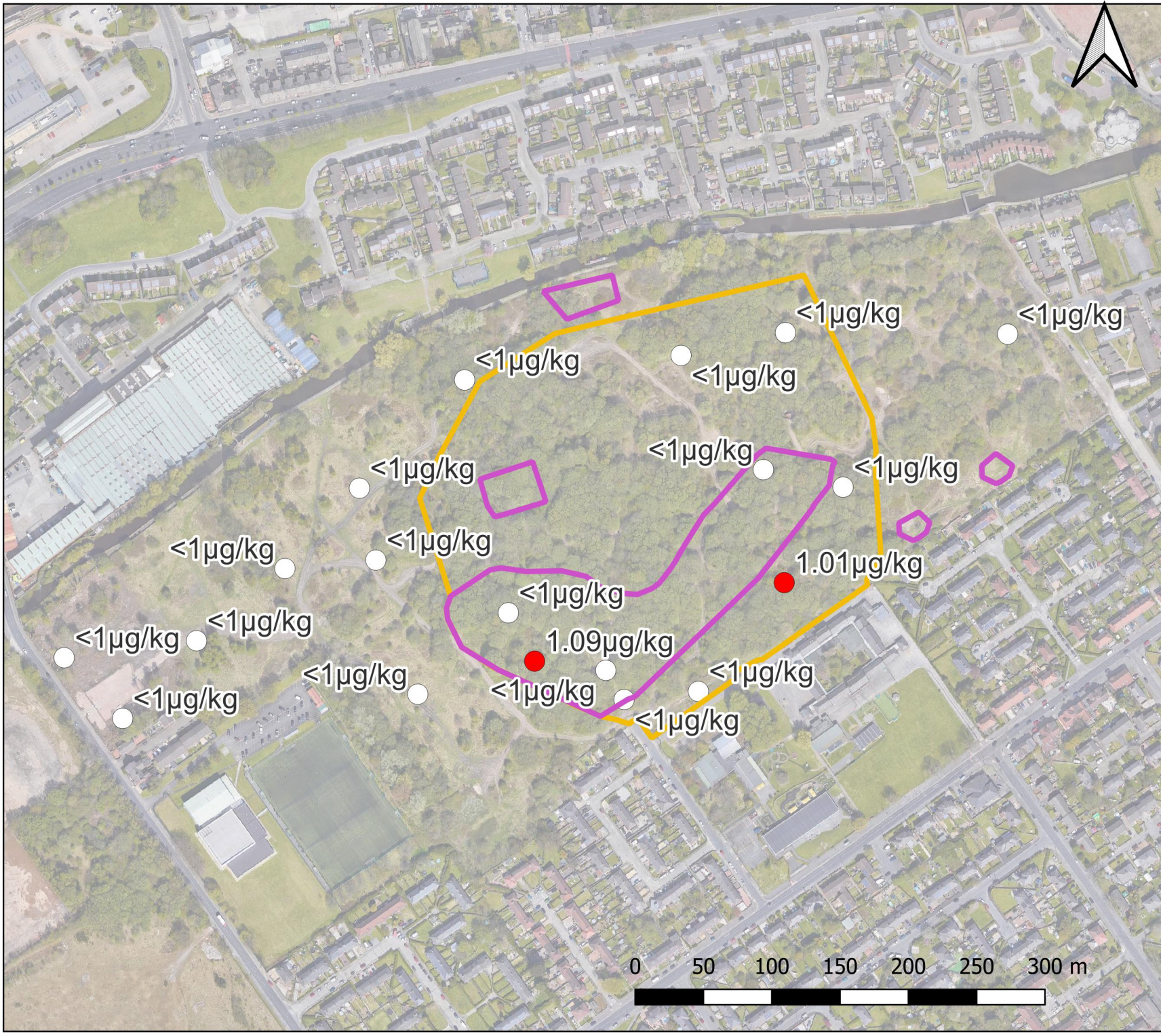
Client: Your Housing Limited

Drawn: RJW

Approved: SE

SK1967_03

Tender Submission



Legend

Features

- HRM
- LRM - Con&Demo

Soils

Total PFOA ug/kg

- ND
- Detected



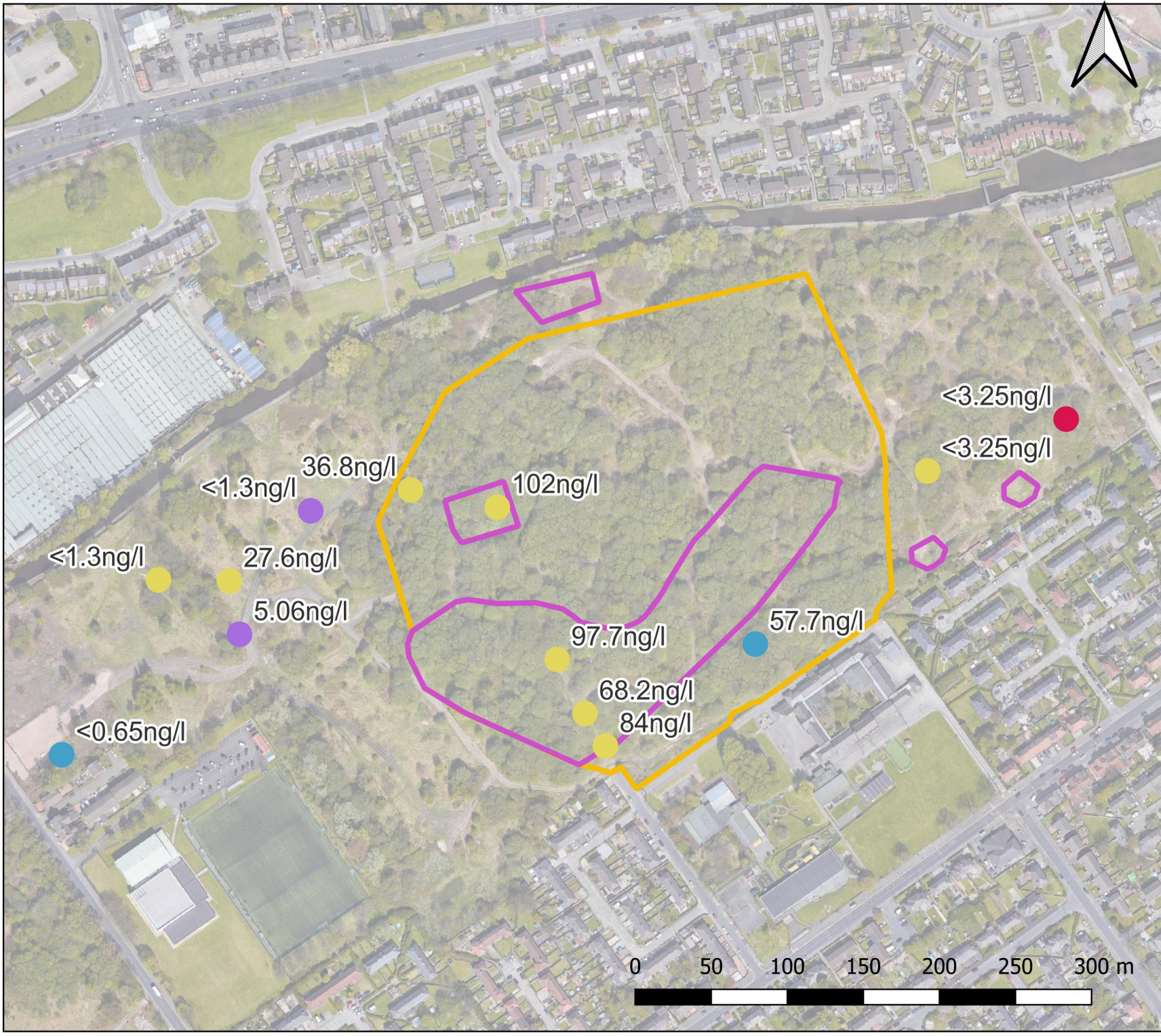
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Fax: 01275 397601
Sheffield Office: Tel: 01246 813289
Fax: 01246 812963

Total PFOA (ug/kg) detected in soil samples from the Ten Acres Site

Client: Your Housing Limited

Drawn: RJW Approved: SE

SK1932_04 Tender Submission



Legend

PFAS Groundwater Samples

- Made Ground
- Made Ground/GT
- GT
- Sandstone

Features

- HRM
- LRM - Con&Demo

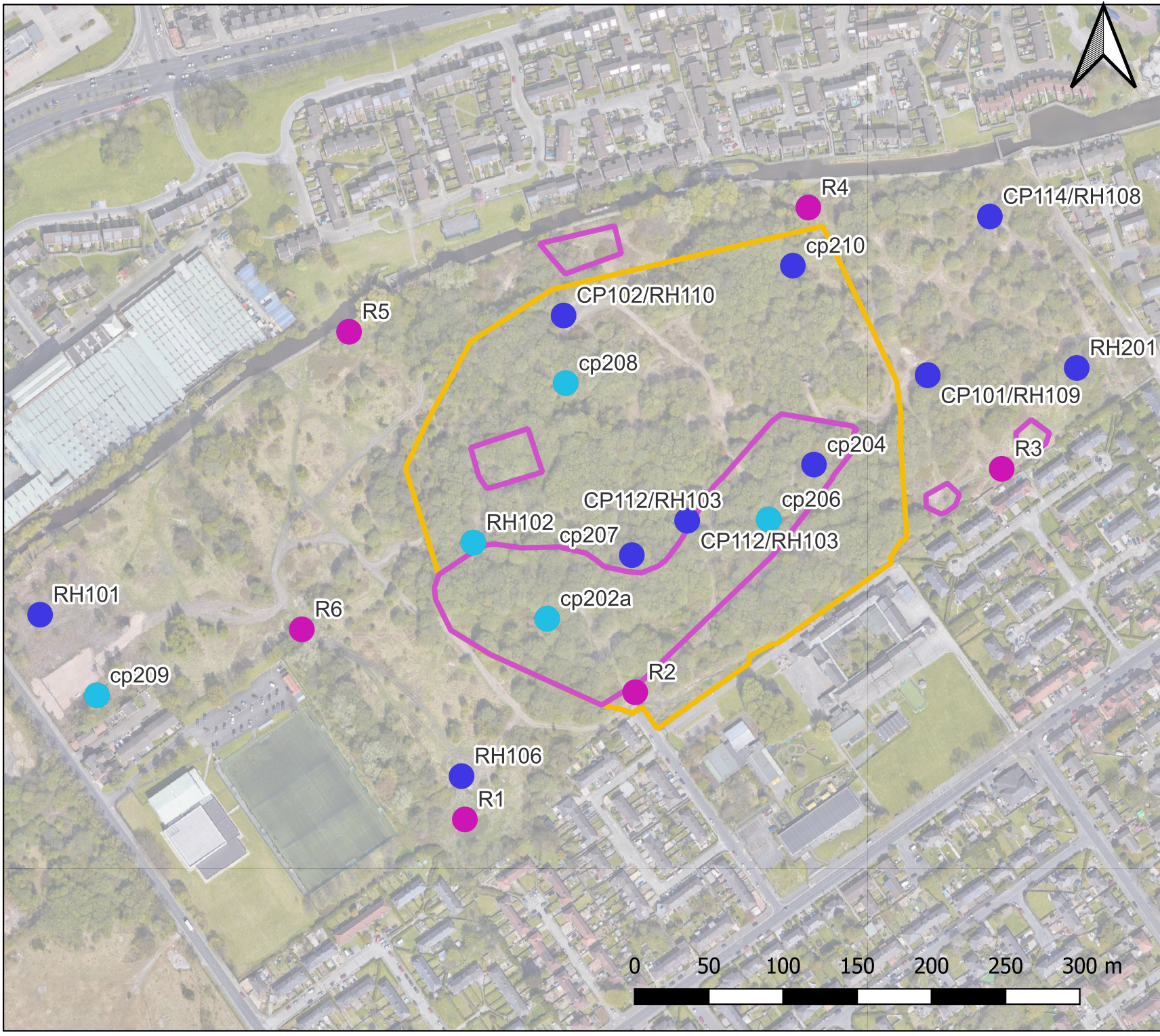


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Sheffield Office: Tel: 01246 813289
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Total PFAS detected in Groundwater Samples	
Client: Your Housing Limited	
Drawn: RJW	Approved: SE
SK1932_05	Tender Submission



Legend

Potential Sample Locations

- Deep Aquifer
- Shallow Aquifer
- Deep Aquifer - Perimeter

Features

- HRM
- LRM - Con&Demo



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Potential locations for further PFAS testing in both shallow and deep groundwater bodies.

Client: Your Housing Limited

Drawn: RJW

Approved: SE

SK1967_06

Tender Submission

Appendix F

Guidance Notes

Dynamic Strategy - Deeper Excavation Protocol

This protocol is established to guide the VertaseFLI site remediation team in the excavation of materials which may be required below the Basic Excavation Depths defined in the Remediation Strategy.

The Basic Excavation Depths defined in the Remediation Strategy are either natural ground or Final Floor Level minus 1m (FFL-1m), where the base of the excavation remains within artificial ground.

Therefore, for clarity, this deeper excavation protocol is only applicable in areas of the site where artificial ground extends greater than FFL-1m (which applies primarily to the infilled former clay pit and some areas outside of the infilled pit). This is illustrated schematically in **Figure 1**.

The protocol has been agreed in collaboration with the Environment Agency during a meeting held on 11th September 2024. It is intended to maximise the removal of 'undesirable' materials from the artificial ground prior to backfilling the excavated void with treated material within the context of the sustainability assessment presented within the Options Appraisal, which concludes that it is not sustainable to excavate all of the artificial ground.

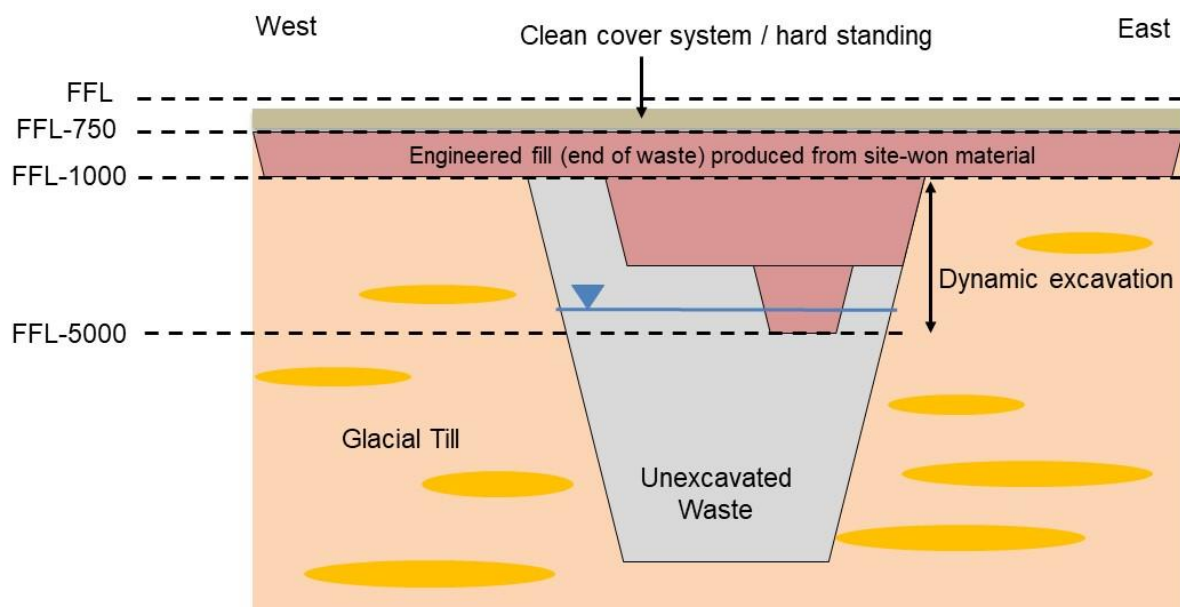


Figure 1. Schematic post-remediation cross section of the ground model illustrating the zone of dynamic excavation of artificial ground at depths >FFL-1000mm

Definitions

In accordance with discussions with the Environment Agency, materials forming the artificial ground (Made Ground / waste) are to be broadly classified as “visually hazardous” and “visually inert”. Definitions to accompany these two broad classifications are provided in **Table 1**.

It is important to note that these definitions have been developed to inform the excavation activity proposed herein and do not relate to definitions given in the Hazardous Waste Regulations.

Table 1. Definitions of materials forming the artificial ground

Visually Hazardous	Includes putrescible materials (materials that can decompose quickly), visual chemical waste (e.g. non-aqueous phase liquids or solid chemical wastes), drums, tanks, chemical containers, asbestos containing materials, tyres, waste electrical items, plastic, carpets and other textiles, metal including household items such as pans, rubber, and PVC.
Visually Inert	Includes, soils (sand, silt and clay), stones, rock, brick, concrete, ceramics, glass, asphalt, ash, clinker, other aggregate-forming materials

Protocol

At excavation depths >FFL-1m, the base of the excavation (termed ‘sub-formation’) shall be inspected by a VertaseFLI Engineer who shall provide a watching brief to the excavator operator.

Excavations shall cease where the Environmental Engineer observes and records that the proportion (by exposed area) of visually hazardous materials at the sub-formation is less than 30% (i.e., in other words the proportion of visually inert materials is greater than 70%).

The minimum “averaging area” over which the visual assessment shall be undertaken at the sub-formation shall be 625m² (assuming a 25m x 25m grid). The sub-formation shall be broadly level at the time of the assessment, however localised hummocks and depressions in the sub-formation will be acceptable given the anticipated nature of the materials.

Within each averaging area, the depth intervals at which the visual assessment is undertaken by the Environmental Engineer shall be at the discretion of the Engineer. However, the assessment shall likely be undertaken iteratively (e.g., every 0.5m level reduction in the sub-formation) until the appropriate conditions for ceasing excavation are observed.

Excavations shall cease where the sub-formation is unsafe for access and egress by plant and personnel. This shall likely be the case at depths >FFL-5m, especially if excavations penetrate the saturated zone. While de-watering of the excavations shall be undertaken to facilitate excavation progression, sub-formation stability within de-watered excavations may be poor. Safety considerations shall be iteratively assessed and will ultimately determine excavation depth.

All sub-formation coverage assessments undertaken by the Environmental Engineer to justify termination of excavation shall be photographed and recorded in the VertaVerse 3D site database.

This protocol is known as the protocol for “dynamic excavation” within the Remediation Strategy.

Example Coverage Assessment Supporting the Termination of Further Excavation below FFL-1m

Photographs illustrating the surface of stockpiles that would be supportive of ceasing excavation beyond FFL-1m, if observed at the sub-formation over the averaging area, are provided in **Figure 2** and **Figure 3**. These surfaces exhibit a proportional coverage of visually hazardous materials that is less than 30% (i.e., in other words the proportion of visually inert materials is greater than 70%).



Figure 2. Example area coverage by visually hazardous materials that would be supportive of ceasing the excavation



Figure 3. Example area coverage by visually hazardous materials that would be supportive of ceasing the excavation

Example Coverage Assessment Not Supporting the Termination of Excavation below FFL-1m

Photographs illustrating the surface of stockpiles that would not be supportive of ceasing excavation beyond FFL-1m, if observed at the sub-formation over the averaging area, are provided in **Figure 4** and **Figure 5**. These surfaces exhibit a proportional coverage of visually hazardous materials that is greater than 30% (i.e., in other words the proportion of visually inert materials is less than 70%). In this scenario, excavation would continue to a greater depth.



Figure 4. Example area coverage by visually hazardous materials that would not be supportive of ceasing the excavation



Figure 5. Example area coverage by visually hazardous materials that would not be supportive of ceasing the excavation

Appendix G

Programme of Works

Trades Contractor, Procurement Stages

Appendix H

Suitable for Use Calculations

Appendix H1

Suitable for Use Calculations – 10m Compliance



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

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

Details to be completed for each assessment

Site Name:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	19-Sep-24		
Contaminant	Aliphatic C5-C6		
Target Concentration (C _T)	15	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C5-C6

15

mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

4.70E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

8.13E+02

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.14E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.76E+02

mg/kg

(for comparison with soil analyses)

or

15

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 19-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C5-C6

15

mg/l

from Level 1

from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.53E+01 or 1.80E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 19-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C5-C6		from Level 1
Target Concentration	C _T	15	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	5.00E+02	days	
Half life for degradation of contaminant in water	1.39E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	1.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.14E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.55E+01	fraction
Decay rate used	2.12E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.04E-04	m/d
Ratio of Compliance Point to Source Concentration	7.12E-01	
Attenuation factor (C ₀ /C _{eq})	1.40E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.15E+01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	2.53E+02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	10	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	7.12E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 1.14E+01 l/kg

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

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

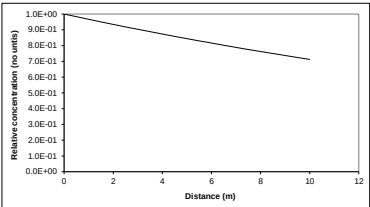
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	1.00E+00	8.30E-03 m
Transverse dispersivity	az	0.00E+00	1.00E-01 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.83E-01	0.00E+00
1.0	9.67E-01	0.00E+00
1.5	9.50E-01	0.00E+00
2.0	9.34E-01	0.00E+00
2.5	9.19E-01	0.00E+00
3.0	9.03E-01	0.00E+00
3.5	8.88E-01	0.00E+00
4.0	8.73E-01	0.00E+00
4.5	8.59E-01	0.00E+00
5.0	8.44E-01	0.00E+00
5.5	8.30E-01	0.00E+00
6.0	8.16E-01	0.00E+00
6.5	8.02E-01	0.00E+00
7.0	7.89E-01	0.00E+00
7.5	7.76E-01	0.00E+00
8.0	7.62E-01	0.00E+00
8.5	7.50E-01	0.00E+00
9.0	7.37E-01	0.00E+00
9.5	7.25E-01	0.00E+00
10.0	7.12E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C6-C8		
Target Concentration (C _T)	15	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C6-C8

15

mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

5.00E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

3.80E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

5.32E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

8.04E+02

mg/kg

(for comparison with soil analyses)

or

15

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C6-C8
15

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.53E+01 or 8.22E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C6-C8		from Level 1
Target Concentration	C _T	15	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.14E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.55E+01	fraction
Decay rate used	2.12E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.04E-04	m/d
Ratio of Compliance Point to Source Concentration	7.12E-01	
Attenuation factor (C ₀ /C _{eq})	1.40E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.15E+01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.15E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	7.12E-01	fraction Domenico - Steady state

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

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

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

Soil water partition coefficient K_d 1.14E+01 l/kg

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

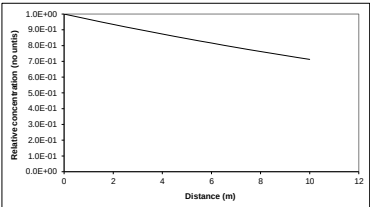
Dispersivities 10%, 1%, 0.1% of pathway length

Enter value Calc value Xu & Eckstein
Longitudinal dispersivity ax 0.00E+00 1.00E+00 8.30E-03 m
Transverse dispersivity az 0.00E+00 1.00E-01 7.62E-01 m
Vertical dispersivity ay 0.00E+00 1.00E-02 8.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.83E-01	0.00E+00
1.0	9.67E-01	0.00E+00
1.5	9.50E-01	0.00E+00
2.0	9.34E-01	0.00E+00
2.5	9.19E-01	0.00E+00
3.0	9.03E-01	0.00E+00
3.5	8.88E-01	0.00E+00
4.0	8.73E-01	0.00E+00
4.5	8.59E-01	0.00E+00
5.0	8.44E-01	0.00E+00
5.5	8.30E-01	0.00E+00
6.0	8.16E-01	0.00E+00
6.5	8.02E-01	0.00E+00
7.0	7.89E-01	0.00E+00
7.5	7.76E-01	0.00E+00
8.0	7.62E-01	0.00E+00
8.5	7.50E-01	0.00E+00
9.0	7.37E-01	0.00E+00
9.5	7.25E-01	0.00E+00
10.0	7.12E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: #####
Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C8-C10		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration C_T Aliphatic C8-C10
0.3 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	5.50E+01	dimensionless

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

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

--

Organic carbon partition coefficient K_{oc}

3.02E+04 l/kg

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

l/kg

--

Sorption coefficient for ionised species $K_{oc,i}$

l/kg

--

pH value pH

pH units

--

Acid dissociation constant pK_a

--

Fraction of organic carbon (in soil) f_{oc}

fraction

--

Soil water partition coefficient used in Level Assessment K_d 4.23E+02 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	1.27E+02	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C8-C10
0.3

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 1.30E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters

Variable	Value	Unit	Source
Contaminant	Aliphatic C8-C10		from Level 1
Target Concentration	0.3	mg/l	from Level 1
Dilution Factor	1.02E+00		from Level 2

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

Domenico - Steady state

Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Enter source concentration

Variable	Value	Unit	Source of parameter value
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	4.23E+02	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.40E+03	fraction
Decay rate used	5.78E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.65E-05	m/d
Ratio of Compliance Point to Source Concentration	7.12E-01	fraction
Attenuation factor (C ₀ /C _{eq})	1.40E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	4.30E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.82E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	7.12E-01	fraction

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 4.23E+02 l/kg

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

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

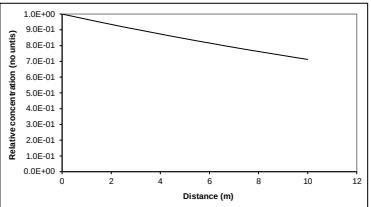
Longitudinal dispersivity	ax	1.00E+00	1.00E+00	6.30E-03	m
Transverse dispersivity	az	0.00E+00	1.00E-01	7.62E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.30E-03	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.83E-01	0.00E+00
1.0	9.67E-01	0.00E+00
1.5	9.50E-01	0.00E+00
2.0	9.34E-01	0.00E+00
2.5	9.19E-01	0.00E+00
3.0	9.03E-01	0.00E+00
3.5	8.88E-01	0.00E+00
4.0	8.73E-01	0.00E+00
4.5	8.59E-01	0.00E+00
5.0	8.44E-01	0.00E+00
5.5	8.30E-01	0.00E+00
6.0	8.16E-01	0.00E+00
6.5	8.02E-01	0.00E+00
7.0	7.89E-01	0.00E+00
7.5	7.76E-01	0.00E+00
8.0	7.62E-01	0.00E+00
8.5	7.50E-01	0.00E+00
9.0	7.37E-01	0.00E+00
9.5	7.25E-01	0.00E+00
10.0	7.12E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C10-C12		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C10-C12
0.3 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

6.00E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

2.40E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

3.36E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.01E+03

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C10-C12
0.3

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 1.03E+03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	3.36E+03	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.90E+04	fraction
Decay rate used	3.64E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.08E-06	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.64E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.22E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 3.36E+03 l/kg

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

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

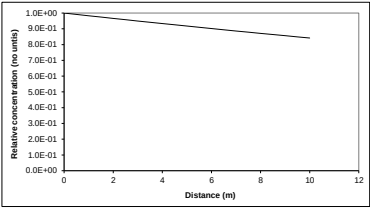
Longitudinal dispersivity	ax	1.00E+00	1.00E+00	8.42E-01	m
Transverse dispersivity	az	0.00E+00	1.00E-01	8.42E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.42E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C12-C16		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration
C_T
Aliphatic C12-C16
0.3 mg/l

Input Parameters Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	6.90E+01	dimensionless

Source of parameter value

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

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}	1.40E-02	fraction
Organic carbon partition coefficient K_{oc}	5.37E+06	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$		l/kg
Sorption coefficient for ionised species $K_{oc,i}$		l/kg
pH value pH		pH units
Acid dissociation constant pK_a		
Fraction of organic carbon (in soil) f_{oc}		fraction

Soil water partition coefficient used in Level Assessment K_d 7.52E+04 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	2.26E+04	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C12-C16
0.3

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 2.31E+04	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.52E+04	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.26E+05	fraction
Decay rate used	1.63E-09	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	9.28E-08	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.64E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.74E+04	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 7.52E+04 l/kg

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

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

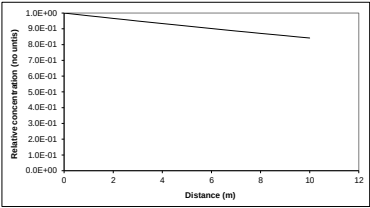
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	8.42E-01
Vertical dispersivity	ay	0.00E+00	1.00E-01	8.42E-01

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C16-C35		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C16-C35
0.3 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

8.50E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

5.75E+08

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

8.06E+06

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.42E+06

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C16-C35
0.3

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 2.47E+06	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C35		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	8.06E+06	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.57E+07	fraction
Decay rate used	1.52E-11	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	8.66E-10	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	fraction
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.64E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.94E+06	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 8.06E+06 l/kg

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

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

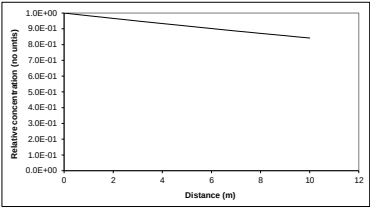
Longitudinal dispersivity	ax	1.00E+00	1.00E+00	8.42E-01	m
Transverse dispersivity	az	0.00E+00	1.00E-01	8.42E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.42E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C5-C7		
Target Concentration (C _T)	0.05	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C5-C7
0.05 mg/l

Input Parameters Standard entry

Variable Value Unit Source of parameter value

Water filled soil porosity θ_w 5.00E-01 fraction
Air filled soil porosity θ_a 3.70E-03 fraction
Bulk density of soil zone material ρ 1.90E+00 g/cm³
Henry's Law constant H 2.30E-01 dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc} 1.40E-02 fraction
Organic carbon partition coefficient K_{oc} 6.80E+01 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species K_{oc,n} l/kg
Sorption coefficient for ionised species K_{oc,i} l/kg
pH value pH pH units
Acid dissociation constant pK_a
Fraction of organic carbon (in soil) f_{oc} fraction

Soil water partition coefficient used in Level Assessment K_d 9.52E-01 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target 6.08E-02 mg/kg (for comparison with soil analyses)
or
0.05 mg/l (for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C5-C7
0.05

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		5.11E-02 or 6.21E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C5-C7		from Level 1
Target Concentration	C _T	0.05	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	5.00E+02	days	
Half life for degradation of contaminant in water	1.39E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	1.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	9.52E-01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.39E+00	fraction
Decay rate used	2.17E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.19E-03	m/d
Ratio of Compliance Point to Source Concentration	7.12E-01	
Attenuation factor (C ₀ /C _{eq})	1.40E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	7.17E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	8.72E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	7.12E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 9.52E-01 l/kg

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

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

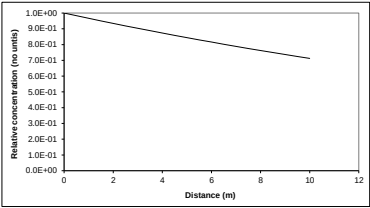
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.83E-01	0.00E+00
1.0	9.67E-01	0.00E+00
1.5	9.50E-01	0.00E+00
2.0	9.34E-01	0.00E+00
2.5	9.19E-01	0.00E+00
3.0	9.03E-01	0.00E+00
3.5	8.88E-01	0.00E+00
4.0	8.73E-01	0.00E+00
4.5	8.59E-01	0.00E+00
5.0	8.44E-01	0.00E+00
5.5	8.30E-01	0.00E+00
6.0	8.16E-01	0.00E+00
6.5	8.02E-01	0.00E+00
7.0	7.89E-01	0.00E+00
7.5	7.76E-01	0.00E+00
8.0	7.62E-01	0.00E+00
8.5	7.50E-01	0.00E+00
9.0	7.37E-01	0.00E+00
9.5	7.25E-01	0.00E+00
10.0	7.12E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C7-C8		
Target Concentration (C _T)	0.074	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C7-C8
0.074 mg/l

Input Parameters Standard entry

Variable Value Unit Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.70E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

2.04E+02

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

2.86E+00

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.31E-01

mg/kg

(for comparison with soil analyses)

or

0.074

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C7-C8
0.074

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.57E-02 or 2.36E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C7-C8		from Level 1
Target Concentration	C _T	0.074	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	5.00E+02	days	
Half life for degradation of contaminant in water	1.39E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	1.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	2.86E+00	l/kg see options
Longitudinal dispersivity	ax	1.000	m see options
Transverse dispersivity	az	0.100	m see options
Vertical dispersivity	ay	0.010	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.72E+01	fraction
Decay rate used	8.07E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.30E-03	m/d
Ratio of Compliance Point to Source Concentration	7.12E-01	fraction
Attenuation factor (C ₀ /C _{eq})	1.40E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

		Level 3 Remedial Target	1.06E-01	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration.
		Domenico - Steady state	or 3.31E-01	mg/kg	
		Distance to compliance point	10	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
		Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	7.12E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 1.40E-02 fraction

Organic carbon partition coefficient Koc 2.04E+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_{ow,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 2.86E+00 l/kg

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

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

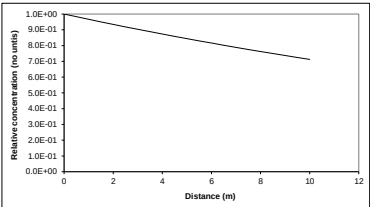
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	1.00E+00 8.30E-03 m
Transverse dispersivity	az	0.00E+00	1.00E-01 7.62E-01 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 8.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.83E-01	0.00E+00
1.0	9.67E-01	0.00E+00
1.5	9.50E-01	0.00E+00
2.0	9.34E-01	0.00E+00
2.5	9.19E-01	0.00E+00
3.0	9.03E-01	0.00E+00
3.5	8.88E-01	0.00E+00
4.0	8.73E-01	0.00E+00
4.5	8.59E-01	0.00E+00
5.0	8.44E-01	0.00E+00
5.5	8.30E-01	0.00E+00
6.0	8.16E-01	0.00E+00
6.5	8.02E-01	0.00E+00
7.0	7.89E-01	0.00E+00
7.5	7.76E-01	0.00E+00
8.0	7.62E-01	0.00E+00
8.5	7.50E-01	0.00E+00
9.0	7.37E-01	0.00E+00
9.5	7.25E-01	0.00E+00
10.0	7.12E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C8-C10		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C8-C10
0.3 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

3.90E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.59E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

2.22E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

6.74E+00

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C8-C10
0.3

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 6.89E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.22E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.27E+02	fraction
Decay rate used	1.09E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.12E-04	m/d
Ratio of Compliance Point to Source Concentration	7.12E-01	fraction
Attenuation factor (C ₀ /C _{eq})	1.40E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	4.30E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	9.67E+00	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	10	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	7.12E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 1.59E+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_{ow,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} 2.22E+01 l/kg

Soil water partition coefficient K_d 2.22E+01 l/kg

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

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

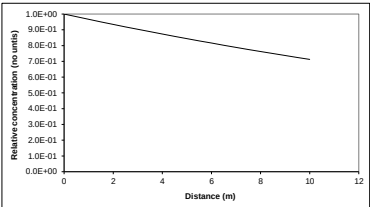
Longitudinal dispersivity	ax	0.00E+00	1.00E+00	6.30E-03	m
Transverse dispersivity	az	0.00E+00	1.00E-01	7.62E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.30E-03	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.83E-01	0.00E+00
1.0	9.67E-01	0.00E+00
1.5	9.50E-01	0.00E+00
2.0	9.34E-01	0.00E+00
2.5	9.19E-01	0.00E+00
3.0	9.03E-01	0.00E+00
3.5	8.88E-01	0.00E+00
4.0	8.73E-01	0.00E+00
4.5	8.59E-01	0.00E+00
5.0	8.44E-01	0.00E+00
5.5	8.30E-01	0.00E+00
6.0	8.16E-01	0.00E+00
6.5	8.02E-01	0.00E+00
7.0	7.89E-01	0.00E+00
7.5	7.76E-01	0.00E+00
8.0	7.62E-01	0.00E+00
8.5	7.50E-01	0.00E+00
9.0	7.37E-01	0.00E+00
9.5	7.25E-01	0.00E+00
10.0	7.12E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C10-C12		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C10-C12
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.30E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

2.51E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

3.52E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

3.19E+00

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C10-C12
0.09

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 3.26E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		from Level 1
Target Concentration	C _T	0.09	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	1.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	3.52E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.00E+02	fraction
Decay rate used	3.46E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.97E-04	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.09E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	3.87E+00	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	10	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 3.52E+01 l/kg

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

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

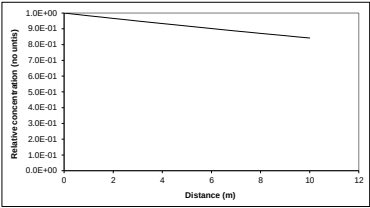
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	1.00E+00	8.42E-01 m
Transverse dispersivity	az	0.00E+00	8.42E-01 m
Vertical dispersivity	ay	0.00E+00	8.42E-01 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C12-C16		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C12-C16
0.09 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.80E-02

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

5.01E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

7.02E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

6.34E+00

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C12-C16
0.09 mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 6.48E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C16		from Level 1
Target Concentration	C _T	0.99	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.02E+01	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.99E+02	fraction
Decay rate used	1.74E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	9.92E-05	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.09E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	7.70E+00	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	10	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 7.02E+01 l/kg

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

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

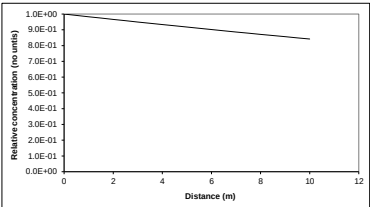
Longitudinal dispersivity	ax	1.00E+00	1.00E+00	8.42E-01	m
Transverse dispersivity	az	0.00E+00	1.00E-01	8.42E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.42E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C16-C21		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C16-C21
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.50E-03

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.41E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.98E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.78E+01

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C16-C21
0.09

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 1.82E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		from Level 1
Target Concentration	C _T	0.99	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.98E+02	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.12E+03	fraction
Decay rate used	6.18E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.53E-05	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.09E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.16E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	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 _{ow,i}	l/kg
pH value	pH	
Acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	1.98E+02 l/kg

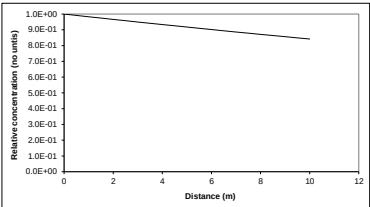
Define dispersivity (click brown cell and use pull down list)
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	0.00E+00	1.00E+00	8.42E-01	m
Transverse dispersivity	az	0.00E+00	1.00E-01	8.42E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.42E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C21-C35		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C21-C35
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.70E-05

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.26E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.76E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.59E+02

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C21-C35
0.09

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 1.62E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		from Level 1
Target Concentration	C _T	0.09	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.76E+03	l/kg see options
Longitudinal dispersivity	ax	1.000	m see options
Transverse dispersivity	az	0.100	m see options
Vertical dispersivity	ay	0.010	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	9.99E+03	fraction
Decay rate used	6.94E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.96E-06	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	AF	1.19E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	1.09E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.93E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.76E+03 l/kg

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

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

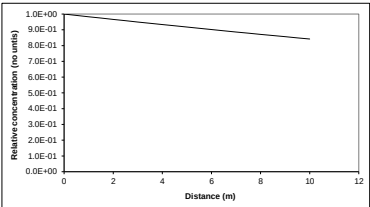
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	8.42E-01 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	8.42E-01 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant	Anthracene
Target concentration	0.0001 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.81E-04	dimensionless

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 soil)	foc	1.40E-02	fraction
Organic carbon partition coefficient	Koc	5.62E+03	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment	Kd	7.87E+01	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	7.90E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0001	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Anthracene
0.0001

mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-04 or 8.07E-03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Anthracene		from Level 1
Target Concentration	C _T	0.0001	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	7.87E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.47E+02	fraction
Decay rate used	1.55E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	8.85E-05	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C ₀₀)	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.21E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	9.59E-03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Entry if specify partition coefficient (option)		
Soil water partition coefficient	K _d	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	f _{oc}	fraction
Organic carbon partition coefficient	K _{oc}	l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	l/kg
Sorption coefficient for ionised species	K _{oc,i}	l/kg
pH value	pH	
Acid dissociation constant	pK _a	
Fraction of organic carbon in aquifer	f _{oc}	fraction
Soil water partition coefficient	K _d	7.87E+01 l/kg

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

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

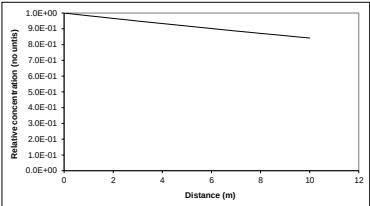
Longitudinal dispersivity	ax	0.00E+00	1.00E+00	8.42E-03	m
Transverse dispersivity	az	0.00E+00	1.00E-01	8.42E-03	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.42E-03	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Benzo(a)pyrene		
Target Concentration (C _T)	0.00027	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Benzo(a)pyrene
0.00027 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.81E-04

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.29E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.80E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

4.87E-01

mg/kg

(for comparison with soil analyses)

or

0.00027

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant	Benzo(a)pyrene	from Level 1
Target concentration	0.00027	mg/l from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.76E-04	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		4.98E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C _T	0.00027	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.80E+03	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.02E+04	fraction
Decay rate used	6.78E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.87E-06	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.28E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.92E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 1.80E+03 l/kg

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

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

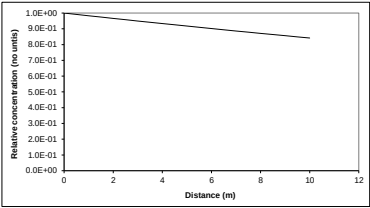
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	8.42E-01
Vertical dispersivity	ay	0.00E+00	1.00E-01	8.42E-01

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Benzo(b)fluoranthene
0.000017 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.05E-06

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.05E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.47E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.49E-02

mg/kg

(for comparison with soil analyses)

or

0.000017

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(b)fluoranthene
0.000017

mg/l
from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.74E-05 or 2.55E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(b)fluoranthene		from Level 1
Target Concentration	C _T	0.000017	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.47E+03	l/kg see options
Longitudinal dispersivity	ax	1.000	m see options
Transverse dispersivity	az	0.100	m see options
Vertical dispersivity	ay	0.010	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	8.31E+03	fraction
Decay rate used	8.34E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	4.76E-06	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C ₀₀)	AF	1.19E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	2.06E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.03E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	1.40E-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 _{ow,i}	l/kg
pH value	pH	
Acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	1.47E+03 l/kg

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

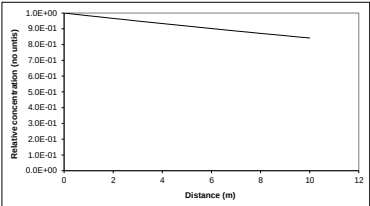
Dispersivities 10%, 1%, 0.1% of pathway length

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

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Benzo(ghi)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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Benzo(ghi)perylene
0.0000082 mg/l

Input Parameters

Standard entry

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.86E-06

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

4.17E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

5.84E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

4.79E-02

mg/kg

(for comparison with soil analyses)

or

0.0000082

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(ghi)perylene
0.0000082

mg/l
from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		8.38E-06 or 4.89E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(ghi)perylene		from Level 1
Target Concentration	C _T	0.000082	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.84E+03	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.31E+04	fraction
Decay rate used	2.10E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.20E-06	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	9.96E-06	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.81E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 5.84E+03 l/kg

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

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

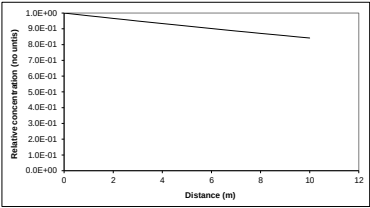
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	8.42E-01
Vertical dispersivity	ay	0.00E+00	1.00E-01	8.42E-01

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Relative

Distance concentration Concentration

(No units) mg/l

0 1.0E+00 0.00E+00

0.5 9.91E-01 0.00E+00

1.0 9.83E-01 0.00E+00

1.5 9.74E-01 0.00E+00

2.0 9.66E-01 0.00E+00

2.5 9.58E-01 0.00E+00

3.0 9.50E-01 0.00E+00

3.5 9.41E-01 0.00E+00

4.0 9.33E-01 0.00E+00

4.5 9.25E-01 0.00E+00

5.0 9.17E-01 0.00E+00

5.5 9.10E-01 0.00E+00

6.0 9.02E-01 0.00E+00

6.5 8.94E-01 0.00E+00

7.0 8.86E-01 0.00E+00

7.5 8.79E-01 0.00E+00

8.0 8.71E-01 0.00E+00

8.5 8.64E-01 0.00E+00

9.0 8.56E-01 0.00E+00

9.5 8.49E-01 0.00E+00

10.0 8.42E-01 0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant	Benzo(k)fluoranthene
Target concentration	C _T 0.000017 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.74E-06	dimensionless	

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	1.48E+05	l/kg	

Entry for ionic organic chemicals (option)

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

Soil water partition coefficient used in Level Assessment K_d 2.07E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	3.52E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.000017	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(k)fluoranthene
0.000017

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.74E-05 or 3.60E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters

Variable	Value	Unit	Source
Contaminant	Benzo(k)fluoranthene		from Level 1
Target Concentration	0.000017	mg/l	from Level 1
Dilution Factor	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.07E+03	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable		
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.17E+04	fraction
Decay rate used	5.91E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.37E-06	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C _{eq})	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.06E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	4.28E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	10	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 2.07E+03 l/kg

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

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

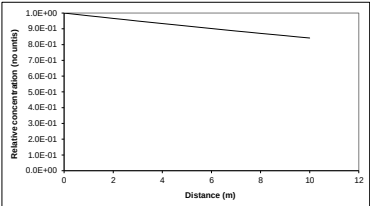
Longitudinal dispersivity	ax	0.00E+00	1.00E+00	8.42E-01	m
Transverse dispersivity	az	0.00E+00	1.00E-01	8.42E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.42E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Fluroanthene		
Target Concentration (C _T)	0.00012	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant	Fluoranthene
Target concentration	C _T 0.00012 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	6.29E-05	dimensionless	

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	1.82E+04	l/kg	

Entry for ionic organic chemicals (option)

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

Soil water partition coefficient used in Level Assessment K_d 2.55E+02 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	3.06E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.00012	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Fluoranthene
0.00012

mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.23E-04 or 3.13E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Fluoranthene		from Level 1
Target Concentration	C _T	0.00012	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.55E+02	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	R _f	1.44E+03	fraction
Decay rate used	λ	4.80E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	2.74E-05	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.42E-01	
Attenuation factor (C ₀ /C _{ED})	AF	1.19E+00	fraction
Calculated soil leachate concentration	C ₀	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.46E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.72E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 2.55E+02 l/kg

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

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

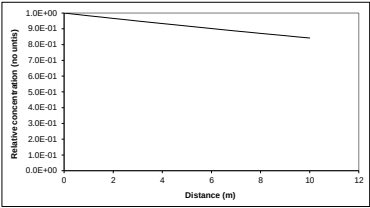
Longitudinal dispersivity	ax	0.00E+00	1.00E+00	8.42E-01	m
Transverse dispersivity	az	0.00E+00	1.00E-01	8.42E-01	m
Vertical dispersivity	ay	0.00E+00	1.00E-02	8.42E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Indeno(123-cd)perylene		
Target Concentration (C _T)	0.0001	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Indeno(123-cd)perylene
0.0001 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.05E-06

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

8.71E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.22E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.22E-01

mg/kg

(for comparison with soil analyses)

or

0.0001

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Indeno(123-cd)perylene
0.0001

mg/l
from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-04 or 1.25E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters

Variable	Value	Unit	Source
Contaminant	Indeno(123-cd)perylene		from Level 1
Target Concentration	0.0001	mg/l	from Level 1
Dilution Factor	1.02E+00		from Level 2

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

Domenico - Steady state

Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.22E+03	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.91E+03	fraction
Decay rate used	1.00E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	5.72E-06	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C ₀₀)	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.21E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.48E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	8.42E-01	fraction
			Domenico - Steady state

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.22E+03 l/kg

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

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

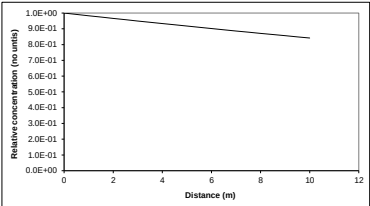
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	1.00E+00	8.42E-01 m
Transverse dispersivity	az	0.00E+00	1.00E-01 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Naphthalene		
Target Concentration (C _T)	0.13	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Naphthalene
0.13 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

6.62E-03

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

6.46E+02

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

9.04E+00

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.21E+00

mg/kg

(for comparison with soil analyses)

or

0.13

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Naphthalene
0.13

from Level 1
from Level 1
mg/l

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.33E-01 or 1.24E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Naphthalene		from Level 1
Target Concentration	C _T	0.13	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	9.04E+00	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.22E+01	fraction
Decay rate used	1.33E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	7.57E-04	m/d
Ratio of Compliance Point to Source Concentration	8.42E-01	
Attenuation factor (C ₀ /C ₀₀)	1.19E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.58E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.47E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	8.42E-01	fraction Domenico - Steady state

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

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

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	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 _{ow,i}	l/kg
pH value	pH	
Acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	9.04E+00 l/kg

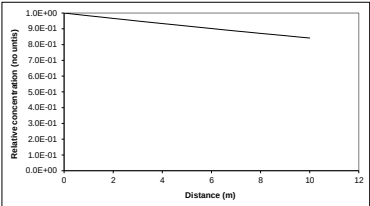
Define dispersivity (click brown cell and use pull down list)
Dispersivities 10%, 1%, 0.1% of pathway length

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

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.91E-01	0.00E+00
1.0	9.83E-01	0.00E+00
1.5	9.74E-01	0.00E+00
2.0	9.66E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.0	9.50E-01	0.00E+00
3.5	9.41E-01	0.00E+00
4.0	9.33E-01	0.00E+00
4.5	9.25E-01	0.00E+00
5.0	9.17E-01	0.00E+00
5.5	9.10E-01	0.00E+00
6.0	9.02E-01	0.00E+00
6.5	8.94E-01	0.00E+00
7.0	8.86E-01	0.00E+00
7.5	8.79E-01	0.00E+00
8.0	8.71E-01	0.00E+00
8.5	8.64E-01	0.00E+00
9.0	8.56E-01	0.00E+00
9.5	8.49E-01	0.00E+00
10.0	8.42E-01	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Phenol		
Target Concentration (C _T)	0.0077	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

User specified value for partition coefficient

Contaminant	Phenol
Target concentration	0.0077 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	0.00E+00	dimensionless	

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	4.00E-01	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 4.00E-01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	5.11E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0077	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Phenol
0.0077 mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.87E-03 or 5.22E-03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Phenol		from Level 1
Target Concentration	C _T	0.0077	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	3.00E+02	days	
Calculated decay rate	2.31E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	4.00E-01	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.27E+00	fraction
Decay rate used	7.07E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.21E-02	m/d
Ratio of Compliance Point to Source Concentration	5.75E-01	
Attenuation factor (C ₀ /C ₀₀)	1.74E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.37E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	9.08E-03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 4.00E-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_{ow,n} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 4.00E-01 l/kg

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

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

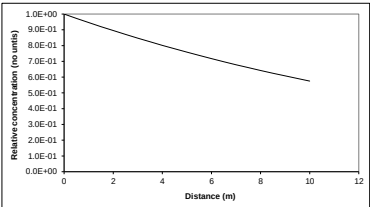
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	6.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	6.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	mg/l
0	1.0E+00	0.00E+00
0.5	9.73E-01	0.00E+00
1.0	9.46E-01	0.00E+00
1.5	9.20E-01	0.00E+00
2.0	8.95E-01	0.00E+00
2.5	8.71E-01	0.00E+00
3.0	8.47E-01	0.00E+00
3.5	8.24E-01	0.00E+00
4.0	8.01E-01	0.00E+00
4.5	7.80E-01	0.00E+00
5.0	7.58E-01	0.00E+00
5.5	7.38E-01	0.00E+00
6.0	7.17E-01	0.00E+00
6.5	6.98E-01	0.00E+00
7.0	6.79E-01	0.00E+00
7.5	6.60E-01	0.00E+00
8.0	6.42E-01	0.00E+00
8.5	6.25E-01	0.00E+00
9.0	6.08E-01	0.00E+00
9.5	5.91E-01	0.00E+00
10.0	5.75E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chloroform		
Target Concentration (C _T)	0.0025	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

User specified value for partition coefficient

Contaminant	Chloroform
Target concentration	0.0025 mg/l

Input Parameters Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	0.00E+00	dimensionless

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	7.00E-01	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 7.00E-01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.41E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0025	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chloroform
0.0025

mg/l
from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.56E-03 or 2.46E-03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chloroform		from Level 1
Target Concentration	C _T	0.0025	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	2.00E+02	days	
Half life for degradation of contaminant in water	3.47E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	1.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.00E-01	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.97E+00	fraction
Decay rate used	6.98E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	7.95E-03	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	5.75E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.54E-03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 7.00E-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 7.00E-01 l/kg

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

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

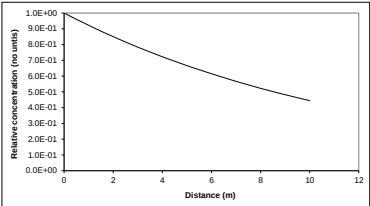
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.60E-01	0.00E+00
1.0	9.22E-01	0.00E+00
1.5	8.86E-01	0.00E+00
2.0	8.50E-01	0.00E+00
2.5	8.17E-01	0.00E+00
3.0	7.84E-01	0.00E+00
3.5	7.53E-01	0.00E+00
4.0	7.23E-01	0.00E+00
4.5	6.94E-01	0.00E+00
5.0	6.67E-01	0.00E+00
5.5	6.40E-01	0.00E+00
6.0	6.15E-01	0.00E+00
6.5	5.90E-01	0.00E+00
7.0	5.67E-01	0.00E+00
7.5	5.45E-01	0.00E+00
8.0	5.23E-01	0.00E+00
8.5	5.02E-01	0.00E+00
9.0	4.82E-01	0.00E+00
9.5	4.63E-01	0.00E+00
10.0	4.45E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Bis(2-ethylhexyl)phthalate		
Target Concentration (C _T)	0.0013	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

User specified value for partition coefficient

Contaminant
Target concentration
C_T **Bis(2-ethylhexyl)phthalate**
0.0013 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	0.00E+00	dimensionless

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

Entry if specify partition coefficient (option)

Soil water partition coefficient
K_d **2.22E+03** l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)
f_{oc} fraction
Organic carbon partition coefficient
K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species
K_{oc,n} l/kg
Sorption coefficient for ionised species
K_{oc,i} l/kg
pH value
pH pH units
Acid dissociation constant
pK_a
Fraction of organic carbon (in soil)
f_{oc} fraction

Soil water partition coefficient used in Level Assessment
K_d **2.22E+03** l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.88E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0013	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Bis(2-ethylhexyl)phthalate
0.0013

mg/l
from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.33E-03 or 2.95E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Bis(2-ethylhexyl)phthalate		from Level 1
Target Concentration	C _T	0.0013	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	3.00E+02	days	
Half life for degradation of contaminant in water	t _{1/2}	days	
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	
Effective porosity of aquifer	n	fraction	
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	m	
Distance (depth) to compliance point perpendicular to flow direction	y	m	
Time since pollutant entered groundwater	t	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	2.22E+03	l/kg see options
Longitudinal dispersivity	ax	1.000	m see options
Transverse dispersivity	az	0.100	m see options
Vertical dispersivity	ay	0.010	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	3.96E-02 m/d
Retardation factor	Rf	1.26E+04 fraction
Decay rate used	λ	1.84E-07 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00 fraction
Rate of contaminant flow due to retardation	u	3.15E-06 m/d
Ratio of Compliance Point to Source Concentration	C _{CL} /C ₀	5.75E-01 fraction
Attenuation factor (C ₀ /C _{CL})	AF	1.74E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	2.31E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.13E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{CL} /C ₀	5.75E-01	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 2.22E+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 2.22E+03 l/kg

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

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

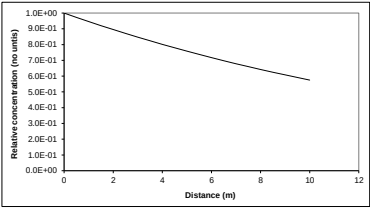
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	6.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	6.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.73E-01	0.00E+00
1.0	9.46E-01	0.00E+00
1.5	9.20E-01	0.00E+00
2.0	8.95E-01	0.00E+00
2.5	8.71E-01	0.00E+00
3.0	8.47E-01	0.00E+00
3.5	8.24E-01	0.00E+00
4.0	8.01E-01	0.00E+00
4.5	7.80E-01	0.00E+00
5.0	7.58E-01	0.00E+00
5.5	7.38E-01	0.00E+00
6.0	7.17E-01	0.00E+00
6.5	6.98E-01	0.00E+00
7.0	6.79E-01	0.00E+00
7.5	6.60E-01	0.00E+00
8.0	6.42E-01	0.00E+00
8.5	6.25E-01	0.00E+00
9.0	6.08E-01	0.00E+00
9.5	5.91E-01	0.00E+00
10.0	5.75E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	PFOS		
Target Concentration (C _T)	0.036	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

User specified value for partition coefficient

Contaminant	PFOS
Target concentration	0.036 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction		This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.
Air filled soil porosity	θ_a	3.70E-03	fraction		
Bulk density of soil zone material	ρ	1.90E+00	g/cm³		
Henry's Law constant	H	0.00E+00	dimensionless		
<i>Entry if specify partition coefficient (option)</i>					
Soil water partition coefficient	Kd	1.40E+01	l/kg		
<i>Entry for non-polar organic chemicals (option)</i>					
Fraction of organic carbon (in soil)	foc		fraction		
Organic carbon partition coefficient	Koc		l/kg		
<i>Entry for ionic organic chemicals (option)</i>					
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg		
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg		
pH value	pH		pH units		
Acid dissociation constant	pKa				
Fraction of organic carbon (in soil)	foc		fraction		

Soil water partition coefficient used in Level Assessment Kd 1.40E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	5.13E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.036	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

PFOS
0.036

mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.68E-02 or 5.25E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		PFOS		from Level 1
Target Concentration	C _T	0.036	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.50E+04	days	
Calculated decay rate	4.63E-05	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.40E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	8.03E+01	fraction
Decay rate used	5.77E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	4.92E-04	m/d
Ratio of Compliance Point to Source Concentration	9.88E-01	fraction
Attenuation factor (C ₀ /C ₀₀)	1.01E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.72E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.31E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	9.88E-01	fraction Domenico - Steady state

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

Enter method of defining partition co-efficient (using pull down list)
User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.40E+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 1.40E+01 l/kg

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

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

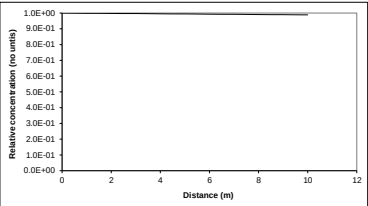
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	1.00E+00 6.30E-03 m
Transverse dispersivity	az	0.00E+00	1.00E-01 6.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 6.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	9.99E-01	0.00E+00
1.0	9.98E-01	0.00E+00
1.5	9.98E-01	0.00E+00
2.0	9.98E-01	0.00E+00
2.5	9.97E-01	0.00E+00
3.0	9.96E-01	0.00E+00
3.5	9.96E-01	0.00E+00
4.0	9.95E-01	0.00E+00
4.5	9.95E-01	0.00E+00
5.0	9.94E-01	0.00E+00
5.5	9.94E-01	0.00E+00
6.0	9.93E-01	0.00E+00
6.5	9.92E-01	0.00E+00
7.0	9.92E-01	0.00E+00
7.5	9.91E-01	0.00E+00
8.0	9.91E-01	0.00E+00
8.5	9.90E-01	0.00E+00
9.0	9.90E-01	0.00E+00
9.5	9.89E-01	0.00E+00
10.0	9.88E-01	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Arsenic		
Target Concentration (C _T)	0.01	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

User specified value for partition coefficient

Contaminant	Arsenic	
Target concentration	C _T	0.01 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

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

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d 5.00E+02 l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

--

Organic carbon partition coefficient

K_{oc}

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

--

Sorption coefficient for ionised species

K_{oc,i}

--

pH value

pH

--

Acid dissociation constant

pK_a

--

Fraction of organic carbon (in soil)

f_{oc}

--

Soil water partition coefficient used in Level Assessment

K_d 5.00E+02 l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target	5.00E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.01	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant	Arsenic	from Level 1
Target concentration	0.01	mg/l from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		5.11E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Arsenic		from Level 1
Target Concentration	C _T	0.01	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.00E+02	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.02E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.11E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

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

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

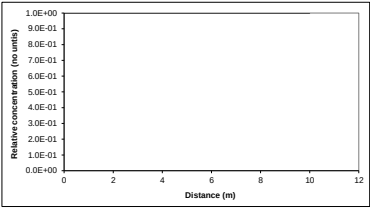
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	1.00E+00 8.30E-03 m
Transverse dispersivity	az	0.00E+00	1.00E-01 8.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 8.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Boron		
Target Concentration (C _T)	2	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

User specified value for partition coefficient

Contaminant	Boron
Target concentration	2 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+01	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.05E+01	mg/kg	(for comparison with soil analyses)
	or		
	2	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C _T	Boron	from Level 1
	2	mg/l from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.04E+00	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.10E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Boron		from Level 1
Target Concentration	C _T	2	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.00E+01	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.77E+01	fraction
Decay rate used	1.21E-102	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.86E-04	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.04E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.10E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+01 l/kg

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

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

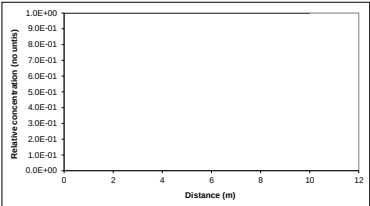
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m
		0.00E+00	1.00E-02	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Cadmium		
Target Concentration (C _T)	0.00025	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

User specified value for partition coefficient

Contaminant	Cadmium
Target concentration	0.00025 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+02	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment	Kd	1.00E+02	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	2.51E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.00025	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant	Cadmium	from Level 1
Target concentration	0.00025	mg/l from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.56E-04	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.56E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Cadmium		from Level 1
Target Concentration	C _T	0.00025	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.00E+02	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.68E+02	fraction
Decay rate used	1.23E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.97E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.56E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or	2.56E-02	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	10	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+02 l/kg

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

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

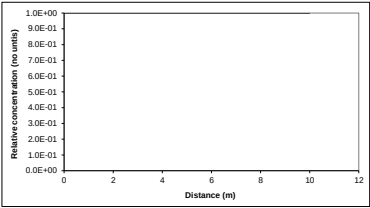
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	6.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	6.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chromium VI		
Target Concentration (C _T)	0.0034	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

User specified value for partition coefficient

Contaminant	Chromium VI
Target concentration	0.0034 mg/l

Input Parameters Variable Value Unit Source of parameter value

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.80E+01	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 1.80E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	6.21E-02 mg/kg	(for comparison with soil analyses)
	or	
	0.0034 mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chromium VI
0.0034

mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.48E-03 or 6.35E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chromium VI		from Level 1
Target Concentration	C _T	0.0034	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.80E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	R _f	1.03E+02	fraction
Decay rate used	λ	6.80E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	3.84E-04	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.00E+00	fraction
Calculated soil leachate concentration	C ₀	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.48E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	6.35E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	10	m	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d 1.80E+01 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 1.80E+01 l/kg

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

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

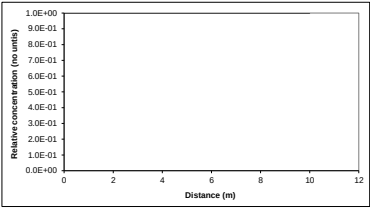
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

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

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

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chromium		
Target Concentration (C _T)	0.0047	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

User specified value for partition coefficient

Contaminant	Chromium
Target concentration	C _T 0.0047 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

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

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d 4.80E+03 l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

--

Organic carbon partition coefficient

K_{oc}

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

--

Sorption coefficient for ionised species

K_{oc,i}

--

pH value

pH

--

Acid dissociation constant

pK_a

--

Fraction of organic carbon (in soil)

f_{oc}

--

Soil water partition coefficient used in Level Assessment

K_d 4.80E+03 l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.26E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.0047	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chromium
0.0047

mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		4.80E-03 or 2.31E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chromium		from Level 1
Target Concentration	C _T	0.0047	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	4.80E+03	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.72E+04	fraction
Decay rate used	2.57E-105	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.45E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	4.80E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.31E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

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

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

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 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,n} 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

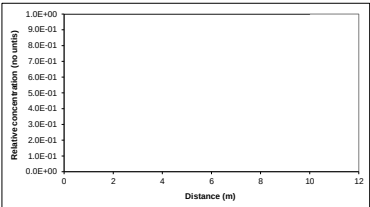
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	1.00E+00 8.30E-03 m
Transverse dispersivity	az	0.00E+00	1.00E-01 8.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 8.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Copper		
Target Concentration (C _T)	0.02146	mg/l	Origin of C _T : PNEC

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

User specified value for partition coefficient

Contaminant	Copper
Target concentration	0.02146 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+02	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.15E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.02146	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Copper
0.02146

mg/l

from Level 1
from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.19E-02 or 2.20E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Copper		from Level 1
Target Concentration	C _T	0.02146	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+02	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.68E+02	fraction
Decay rate used	1.23E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.97E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.19E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.20E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

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

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

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+02 l/kg

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

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

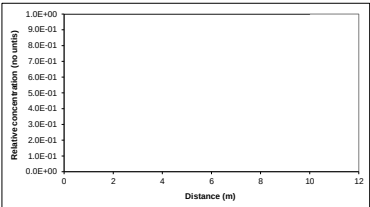
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	1.00E+00 6.30E-03 m
Transverse dispersivity	az	0.00E+00	1.00E-01 6.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 6.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Iron		
Target Concentration (C _T)	1	mg/l	Origin of C _T : EQS

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

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

User specified value for partition coefficient

Contaminant	Iron
Target concentration	C _T 1 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

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

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	1.60E+03	l/kg	
----------------------------------	----------------	----------	------	--

Entry for non-polar organic chemicals (option)

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

Entry for ionic organic chemicals (option)

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

Soil water partition coefficient used in Level Assessment K_d 1.60E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.60E+03	mg/kg	(for comparison with soil analyses)
	or		
	1	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Iron
1 mg/l

from Level 1

from Level 1

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

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

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E+00 or 1.64E+03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

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

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Iron		from Level 1
Target Concentration	C _T	1	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.60E+03	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	Rf	9.07E+03	fraction
Decay rate used	λ	7.72E-105	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	4.36E-06	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.00E+00	fraction
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.02E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.64E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	10	m	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction Domenico - Steady state

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.60E+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 1.60E+03 l/kg

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

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

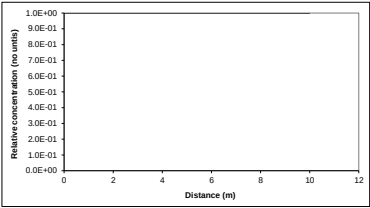
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E+03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E+03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

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



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

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

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

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

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

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Lead		
Target Concentration (C _T)	0.014	mg/l	Origin of C _T : PNEC

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

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

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

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

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

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

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

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



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

User specified value for partition coefficient

Contaminant	Lead
Target concentration	0.014 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+03	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 1.00E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.40E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.014	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Lead
0.014

from Level 1
from Level 1

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

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

Standard entry

Input Parameters

Variable

Value

Unit

Source of parameter value

Infiltration

Inf

4.55E-04

m/d

Area of contaminant source

A

6.25E+05

m²

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow

L

2.50E+02

m

Saturated aquifer thickness

da

9.80E+00

m

Hydraulic Conductivity of aquifer in which dilution occurs

K

8.64E-03

m/d

Hydraulic gradient of water table

i

3.00E-02

fraction

Width of contaminant source perpendicular to groundwater flow

w

3.00E+02

m

Not used in calculation

Background concentration of contaminant in groundwater beneath site

Cu

0.00E+00

mg/l

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

Specify

Enter mixing zone thickness

Mz

9.80E+00

m

Calculated mixing zone thickness

Mz

m

Calculated Parameters

Dilution Factor

DF

1.02E+00

Level 2 Remedial Target

1.43E-02

mg/l

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

For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)

Cc

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Lead		from Level 1
Target Concentration	C _T	0.014	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

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

Domenico - Steady state Equations in HRA publication

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+03	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.67E+03	fraction
Decay rate used	1.24E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.98E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.43E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.43E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

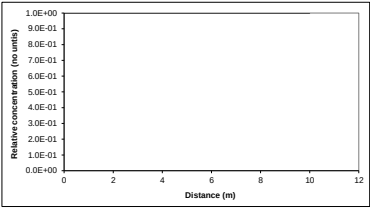
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	1.00E+00	6.30E-03 m
Transverse dispersivity	az	0.00E+00	1.00E-01 m
Vertical dispersivity	ay	0.00E+00	1.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Manganese		
Target Concentration (C _T)	0.123	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Manganese
Target concentration	0.123 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+03	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.23E+02	mg/kg	(for comparison with soil analyses)
	or		
	0.123	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Manganese
0.123

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.26E-01 or 1.26E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Manganese		from Level 1
Target Concentration	C _T	0.123	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+03	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.67E+03	fraction
Decay rate used	1.24E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.98E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.26E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.26E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

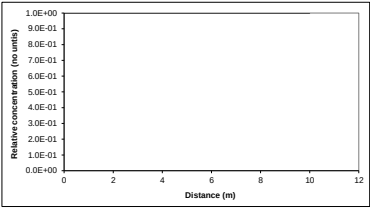
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	6.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	6.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Mercury		
Target Concentration (C _T)	0.00007	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

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The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Mercury
Target concentration	0.00007 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	5.00E+02	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 5.00E+02 l/kg Specified value

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	3.50E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.00007	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Mercury
0.00007

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.16E-05 or 3.58E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Mercury		from Level 1
Target Concentration	C _T	0.00007	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.00E+02	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	7.16E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.58E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

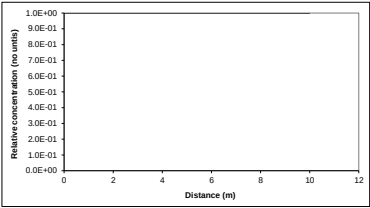
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Nickel		
Target Concentration (C _T)	0.034	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Nickel
Target concentration	0.034 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	5.00E+02	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 5.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.70E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.034	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Nickel
0.034 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.48E-02 or 1.74E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Nickel		from Level 1
Target Concentration	C _T	0.034	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.00E+02	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.48E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.74E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kgSorption 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 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

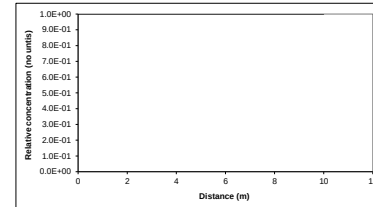
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Vanadium		
Target Concentration (C _T)	0.02	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Vanadium
Target concentration	0.02 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction		This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.
Air filled soil porosity	θ_a	3.70E-03	fraction		
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³		
Henry's Law constant	H	1.00E+00	dimensionless		

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.26E+01	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.26E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.57E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.02	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Vanadium
0.02

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.04E-02 or 2.63E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Vanadium		from Level 1
Target Concentration	C _T	0.02	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.26E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	R _f	7.24E+01	fraction
Decay rate used	λ	9.67E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	5.46E-04	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.00E+00	fraction
Calculated soil leachate concentration	C ₀	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.04E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.63E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	10	m	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d 1.26E+01 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc}

Organic carbon partition coefficient K_{oc}

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n}

Sorption coefficient for ionised species K_{oc,n}

pH value pH

Acid dissociation constant pK_a

Fraction of organic carbon in aquifer f_{oc}

Soil water partition coefficient K_d 1.26E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

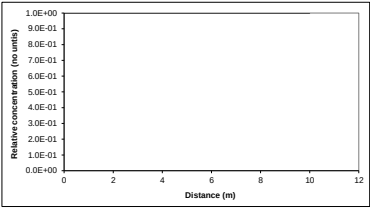
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Zinc		
Target Concentration (C _T)	0.0302	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Zinc
Target concentration	0.0302 mg/l

Input Parameters
Standard entry

Variable	Value	Unit	Source of parameter value
Water filled soil porosity θ_w	5.00E-01	fraction	
Air filled soil porosity θ_a	3.70E-03	fraction	
Bulk density of soil zone material ρ	1.90E+00	g/cm ³	
Henry's Law constant H	1.00E+00	dimensionless	

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	3.80E+01	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 3.80E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.16E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0302	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Zinc
0.0302

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.09E-02 or 1.18E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Zinc		from Level 1
Target Concentration	C _T	0.0302	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	3.80E+01	l/kg	see options
Longitudinal dispersivity	1.000	m	see options
Transverse dispersivity	0.100	m	see options
Vertical dispersivity	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.16E+02	fraction
Decay rate used	3.24E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.83E-04	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.09E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.18E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	10	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 3.80E+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 3.80E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

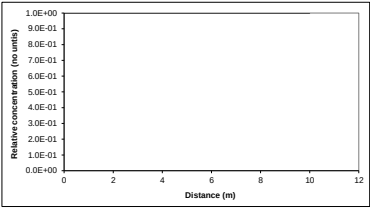
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	1.00E+00	0.00E+00
1.0	1.00E+00	0.00E+00
1.5	1.00E+00	0.00E+00
2.0	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.0	1.00E+00	0.00E+00
3.5	1.00E+00	0.00E+00
4.0	1.00E+00	0.00E+00
4.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
5.5	1.00E+00	0.00E+00
6.0	1.00E+00	0.00E+00
6.5	1.00E+00	0.00E+00
7.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.0	1.00E+00	0.00E+00
8.5	1.00E+00	0.00E+00
9.0	1.00E+00	0.00E+00
9.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Cyanide		
Target Concentration (C _T)	0.005	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Cyanide
Target concentration	0.005 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	5.00E+00	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 5.00E+00 l/kg Specified value

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	2.63E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.005	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Cyanide
0.005

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		5.11E-03 or 2.69E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Cyanide		from Level 1
Target Concentration	C _T	0.005	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	2.40E+01	days	
Calculated decay rate	2.89E-02	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	1.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.00E+00	l/kg	see options
Longitudinal dispersivity	ax	1.000	m	see options
Transverse dispersivity	az	0.100	m	see options
Vertical dispersivity	ay	0.010	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.93E+01	fraction
Decay rate used	9.85E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.35E-03	m/d
Ratio of Compliance Point to Source Concentration	7.44E-03	
Attenuation factor (C ₀ /C _{co})	1.34E+03	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.87E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.62E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	10	m	
Ratio of Compliance Point to Source Concentration	C _{co} /C ₀	7.44E-03	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+00 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 5.00E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

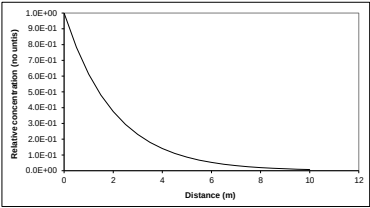
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	1.00E+00	0.30E-03 m
Vertical dispersivity	ay	0.00E+00	1.00E-01	0.30E-03 m
		0.00E+00	1.00E-02	0.30E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Relative

Distance concentration Concentration

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
0.5	7.83E-01	0.00E+00
1.0	6.13E-01	0.00E+00
1.5	4.79E-01	0.00E+00
2.0	3.75E-01	0.00E+00
2.5	2.94E-01	0.00E+00
3.0	2.30E-01	0.00E+00
3.5	1.80E-01	0.00E+00
4.0	1.41E-01	0.00E+00
4.5	1.10E-01	0.00E+00
5.0	8.63E-02	0.00E+00
5.5	6.75E-02	0.00E+00
6.0	5.29E-02	0.00E+00
6.5	4.14E-02	0.00E+00
7.0	3.24E-02	0.00E+00
7.5	2.53E-02	0.00E+00
8.0	1.98E-02	0.00E+00
8.5	1.55E-02	0.00E+00
9.0	1.22E-02	0.00E+00
9.5	9.51E-03	0.00E+00
10.0	7.44E-03	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

<u>Details to be completed for each assessment</u>			
Site Name:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly		
Date:	20-Sep-24	Version:	1
Contaminant	PCBs		
Target Concentration (C_T)	0.001	mg/l	Origin of C_T : LOD

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

PCBs
0.001 mg/l

Input Parameters

Standard entry

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.00E+00

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.66E+06

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

2.32E+04

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.32E+01

mg/kg

(for comparison with soil analyses)

or

0.001

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Appendix H2

Suitable for Use Calculations – 25m Compliance



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	19-Sep-24		
Contaminant	Aliphatic C5-C6		
Target Concentration (C _T)	15	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C5-C6

15

mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

4.70E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

8.13E+02

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.14E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.76E+02

mg/kg

(for comparison with soil analyses)

or

15

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 19-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C5-C6
15

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.53E+01 or 1.80E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 19-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C5-C6		from Level 1
Target Concentration	C _T	15	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.14E+01	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.55E+01	fraction
Decay rate used	2.12E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.04E-04	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.45E+01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	4.05E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	25	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 8.13E+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 f_{oc} fraction

Soil water partition coefficient Kd 1.14E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

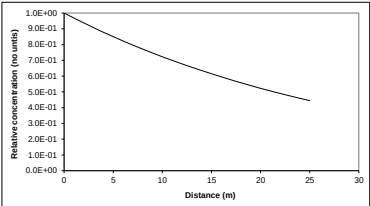
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.88E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.60E-01	0.00E+00
2.5	9.22E-01	0.00E+00
3.8	8.86E-01	0.00E+00
5.0	8.50E-01	0.00E+00
6.3	8.17E-01	0.00E+00
7.5	7.84E-01	0.00E+00
8.8	7.53E-01	0.00E+00
10.0	7.23E-01	0.00E+00
11.3	6.94E-01	0.00E+00
12.5	6.67E-01	0.00E+00
13.8	6.40E-01	0.00E+00
15.0	6.15E-01	0.00E+00
16.3	5.90E-01	0.00E+00
17.5	5.67E-01	0.00E+00
18.8	5.45E-01	0.00E+00
20.0	5.23E-01	0.00E+00
21.3	5.02E-01	0.00E+00
22.5	4.82E-01	0.00E+00
23.8	4.63E-01	0.00E+00
25.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C6-C8		
Target Concentration (C _T)	15 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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C6-C8

15

mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

5.00E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

3.80E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

5.32E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

8.04E+02

mg/kg

(for comparison with soil analyses)

or

15

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C6-C8
15

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.53E+01 or 8.22E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C6-C8		from Level 1
Target Concentration	C _T	15	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.14E+01	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.55E+01	fraction
Decay rate used	2.12E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.04E-04	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.45E+01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.85E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 8.13E+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 f_{oc} fraction

Soil water partition coefficient Kd 1.14E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

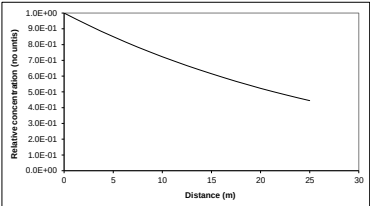
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.86E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.86E-01 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.60E-01	0.00E+00
2.5	9.22E-01	0.00E+00
3.8	8.86E-01	0.00E+00
5.0	8.50E-01	0.00E+00
6.3	8.17E-01	0.00E+00
7.5	7.84E-01	0.00E+00
8.8	7.53E-01	0.00E+00
10.0	7.23E-01	0.00E+00
11.3	6.94E-01	0.00E+00
12.5	6.67E-01	0.00E+00
13.8	6.40E-01	0.00E+00
15.0	6.15E-01	0.00E+00
16.3	5.90E-01	0.00E+00
17.5	5.67E-01	0.00E+00
18.8	5.45E-01	0.00E+00
20.0	5.23E-01	0.00E+00
21.3	5.02E-01	0.00E+00
22.5	4.82E-01	0.00E+00
23.8	4.63E-01	0.00E+00
25.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C8-C10		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C8-C10
0.3 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

5.50E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

3.02E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

4.23E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.27E+02

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C8-C10
0.3

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 1.30E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	4.23E+02	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.40E+03	fraction
Decay rate used	5.78E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.65E-05	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.90E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.5	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 3.02E+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 f_{oc} fraction

Soil water partition coefficient Kd 4.23E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

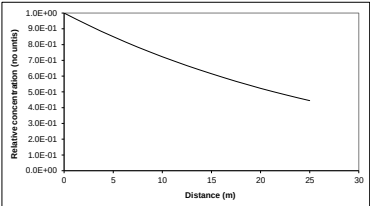
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.88E-01
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.88E-01

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.60E-01	0.00E+00
2.5	9.22E-01	0.00E+00
3.8	8.86E-01	0.00E+00
5.0	8.50E-01	0.00E+00
6.3	8.17E-01	0.00E+00
7.5	7.84E-01	0.00E+00
8.8	7.53E-01	0.00E+00
10.0	7.23E-01	0.00E+00
11.3	6.94E-01	0.00E+00
12.5	6.67E-01	0.00E+00
13.8	6.40E-01	0.00E+00
15.0	6.15E-01	0.00E+00
16.3	5.90E-01	0.00E+00
17.5	5.67E-01	0.00E+00
18.8	5.45E-01	0.00E+00
20.0	5.23E-01	0.00E+00
21.3	5.02E-01	0.00E+00
22.5	4.82E-01	0.00E+00
23.8	4.63E-01	0.00E+00
25.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C10-C12		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration C_T Aliphatic C10-C12
0.3 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	6.00E+01	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

--

Organic carbon partition coefficient K_{oc}

2.40E+05 l/kg

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

l/kg

--

Sorption coefficient for ionised species $K_{oc,i}$

l/kg

--

pH value pH

pH units

--

Acid dissociation constant pK_a

--

Fraction of organic carbon (in soil) f_{oc}

fraction

--

Soil water partition coefficient used in Level Assessment K_d 3.36E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	1.01E+03	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C10-C12
0.3

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 1.03E+03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.36E+03	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.90E+04	fraction
Decay rate used	3.64E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.08E-06	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	4.67E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.57E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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 f_{oc} fraction

Soil water partition coefficient Kd 3.36E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

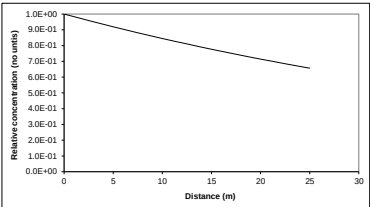
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.98E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.86E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.86E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C12-C16		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Aliphatic C12-C16
Target concentration	C _T 0.3 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	6.90E+01	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	5.37E+06	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment K_d 7.52E+04 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	2.26E+04	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C12-C16
0.3

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 2.31E+04	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	7.52E+04	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.26E+05	fraction
Decay rate used	1.63E-09	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	9.28E-08	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C ₀₀)	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	4.67E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.51E+04	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 7.52E+04 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

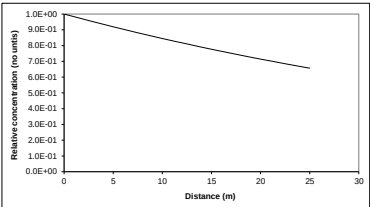
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	2.50E+00	1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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Site Name:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C16-C35		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration C_T Aliphatic C16-C35
0.3 mg/l

Input Parameters
Standard entry

Water filled soil porosity θ_w 5.00E-01 fraction
Air filled soil porosity θ_a 3.70E-03 fraction
Bulk density of soil zone material ρ 1.90E+00 g/cm³
Henry's Law constant H 8.50E+01 dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 5.75E+08 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$ l/kg

Sorption coefficient for ionised species $K_{oc,i}$ l/kg

pH value pH pH units

Acid dissociation constant pK_a

Fraction of organic carbon (in soil) f_{oc} fraction

Soil water partition coefficient used in Level Assessment K_d 8.06E+06 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	2.42E+06	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C16-C35
0.3

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 2.47E+06	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C35		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	8.06E+06	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.57E+07	fraction
Decay rate used	1.52E-11	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	8.66E-10	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	4.67E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.76E+06	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 8.06E+06 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

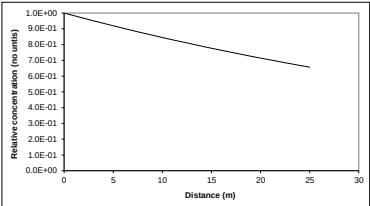
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E-01	1.86E-01
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.86E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C5-C7		
Target Concentration (C _T)	0.05	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C5-C7
0.05 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.30E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

6.80E+01

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

9.52E-01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

6.08E-02

mg/kg

(for comparison with soil analyses)

or

0.05

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C5-C7
0.05

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		5.11E-02 or 6.21E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C5-C7		from Level 1
Target Concentration	C _T	0.05	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	9.52E-01	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.39E+00	fraction
Decay rate used	1.37E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.19E-03	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.15E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.40E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 9.52E-01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

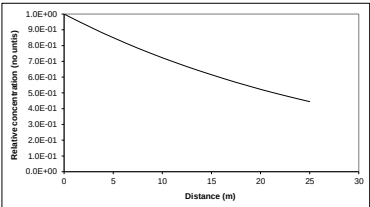
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.88E-01 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.60E-01	0.00E+00
2.5	9.22E-01	0.00E+00
3.8	8.86E-01	0.00E+00
5.0	8.50E-01	0.00E+00
6.3	8.17E-01	0.00E+00
7.5	7.84E-01	0.00E+00
8.8	7.53E-01	0.00E+00
10.0	7.23E-01	0.00E+00
11.3	6.94E-01	0.00E+00
12.5	6.67E-01	0.00E+00
13.8	6.40E-01	0.00E+00
15.0	6.15E-01	0.00E+00
16.3	5.90E-01	0.00E+00
17.5	5.67E-01	0.00E+00
18.8	5.45E-01	0.00E+00
20.0	5.23E-01	0.00E+00
21.3	5.02E-01	0.00E+00
22.5	4.82E-01	0.00E+00
23.8	4.63E-01	0.00E+00
25.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C7-C8		
Target Concentration (C _T)	0.074	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Aromatic C7-C8
Target concentration	C _T 0.074 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	2.70E-01	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	2.04E+02	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment K_d 2.86E+00 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	2.31E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.074	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C7-C8
0.074

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.57E-02 or 2.36E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C7-C8		from Level 1
Target Concentration	C _T	0.074	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	2.86E+00	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.72E+01	fraction
Decay rate used	8.07E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.30E-03	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.70E-01	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration.
Domenico - Steady state	or 5.31E-01	mg/kg	
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	
		fraction	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 2.86E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

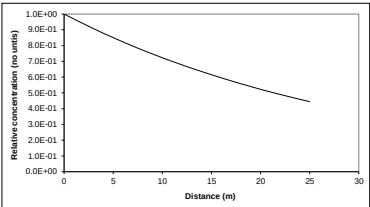
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	2.50E+00	1.98E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.60E-01	0.00E+00
2.5	9.22E-01	0.00E+00
3.8	8.86E-01	0.00E+00
5.0	8.50E-01	0.00E+00
6.3	8.17E-01	0.00E+00
7.5	7.84E-01	0.00E+00
8.8	7.53E-01	0.00E+00
10.0	7.23E-01	0.00E+00
11.3	6.94E-01	0.00E+00
12.5	6.67E-01	0.00E+00
13.8	6.40E-01	0.00E+00
15.0	6.15E-01	0.00E+00
16.3	5.90E-01	0.00E+00
17.5	5.67E-01	0.00E+00
18.8	5.45E-01	0.00E+00
20.0	5.23E-01	0.00E+00
21.3	5.02E-01	0.00E+00
22.5	4.82E-01	0.00E+00
23.8	4.63E-01	0.00E+00
25.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C8-C10		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration
C_T

Aromatic C8-C10
0.3 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	3.90E-01	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

Organic carbon partition coefficient K_{oc}

1.59E+03 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

Sorption coefficient for ionised species $K_{oc,i}$

pH value pH

Acid dissociation constant pK_a

Fraction of organic carbon (in soil) f_{oc}

Soil water partition coefficient used in Level Assessment K_d 2.22E+01 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	6.74E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C8-C10
0.3

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 6.89E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.22E+01	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.27E+02	fraction
Decay rate used	1.09E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.12E-04	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.90E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.55E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction
			Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 1.59E+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 pK_a

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 2.22E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

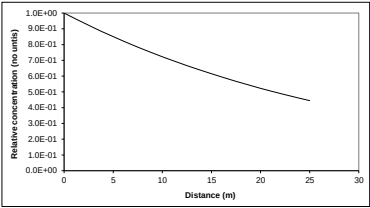
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	2.50E+00	1.98E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Relative

Distance concentration Concentration

(No units) mg/l

0 1.0E+00 0.00E+00

1.3 9.60E-01 0.00E+00

2.5 9.22E-01 0.00E+00

3.8 8.86E-01 0.00E+00

5.0 8.50E-01 0.00E+00

6.3 8.17E-01 0.00E+00

7.5 7.84E-01 0.00E+00

8.8 7.53E-01 0.00E+00

10.0 7.23E-01 0.00E+00

11.3 6.94E-01 0.00E+00

12.5 6.67E-01 0.00E+00

13.8 6.40E-01 0.00E+00

15.0 6.15E-01 0.00E+00

16.3 5.90E-01 0.00E+00

17.5 5.67E-01 0.00E+00

18.8 5.45E-01 0.00E+00

20.0 5.23E-01 0.00E+00

21.3 5.02E-01 0.00E+00

22.5 4.82E-01 0.00E+00

23.8 4.63E-01 0.00E+00

25.0 4.45E-01 0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment

Site Name:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C10-C12		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

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It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C10-C12
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.30E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

2.51E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

3.52E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

3.19E+00

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C10-C12
0.09

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 3.26E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		from Level 1
Target Concentration	C _T	0.09	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.52E+01	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.00E+02	fraction
Decay rate used	3.46E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.97E-04	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Remedial Targets	Level 3 Remedial Target	1.40E-01	mg/l	For comparison with measured pore water concentration.
	Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	Distance to compliance point	4.96E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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 f_{oc} fraction

Soil water partition coefficient Kd 3.52E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

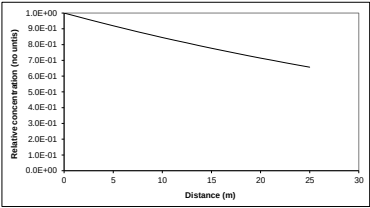
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.96E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.96E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.96E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C12-C16		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Aromatic C12-C16
Target concentration	C _T 0.09 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	2.80E-02	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	5.01E+03	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment	K _d	7.02E+01	l/kg	Calculated value
---	----------------	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	6.34E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.09	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C12-C16
0.09

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 6.48E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C16		from Level 1
Target Concentration	C _T	0.99	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	7.02E+01	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.99E+02	fraction
Decay rate used	1.74E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	9.92E-05	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C ₀₀)	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.40E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	9.87E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 7.02E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

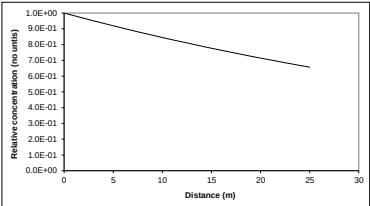
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	2.50E+00	1.98E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C16-C21		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C16-C21
0.09 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.50E-03

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.41E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.98E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.78E+01

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C16-C21

0.09

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		1.82E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		from Level 1
Target Concentration	C _T	0.99	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.98E+02	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.12E+03	fraction
Decay rate used	6.18E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.53E-05	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Remedial Targets	Level 3 Remedial Target	1.40E-01	mg/l	For comparison with measured pore water concentration.
	Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	Distance to compliance point	2.77E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} 1.98E+02 l/kg

Soil water partition coefficient K_d 1.98E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

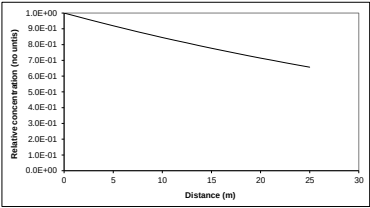
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.98E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.98E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.98E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C21-C35		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration
 C_T

Aromatic C21-C35
0.09 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	1.70E-05	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

--

Organic carbon partition coefficient K_{oc}

1.26E+05 l/kg

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

l/kg

--

Sorption coefficient for ionised species $K_{oc,i}$

l/kg

--

pH value pH

pH units

--

Acid dissociation constant pK_a

--

Fraction of organic carbon (in soil) f_{oc}

fraction

--

Soil water partition coefficient used in Level Assessment K_d 1.76E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	1.59E+02	mg/kg	(for comparison with soil analyses)
	or		
	0.09	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C21-C35
0.09

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 1.62E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		from Level 1
Target Concentration	C _T	0.09	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.76E+03	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	Rf	9.99E+03	fraction
Decay rate used	λ	6.94E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	3.96E-06	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	6.57E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.52E+00	fraction
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.40E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 1.40E-02 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 1.76E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

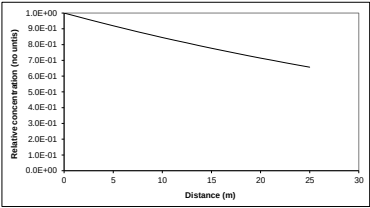
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.86E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.86E-01 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Anthracene
Target concentration	0.0001 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.81E-04	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	
----------------------------------	----	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	1.40E-02	fraction	
Organic carbon partition coefficient	Koc	5.62E+03	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 7.87E+01 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	7.90E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0001	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Anthracene
0.0001

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-04 or 8.07E-03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Anthracene		from Level 1
Target Concentration	C _T	0.0001	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	7.87E+01	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.47E+02	fraction
Decay rate used	1.55E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	8.85E-05	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{Co})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.56E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	1.23E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{Co} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 7.87E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

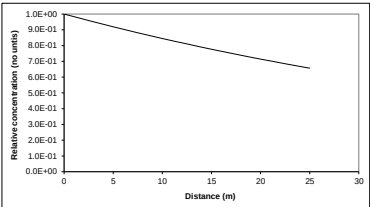
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	2.50E+00	1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Benzo(a)pyrene		
Target Concentration (C _T)	0.00027	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

Benzo(a)pyrene
0.00027 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	1.81E-04	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

Organic carbon partition coefficient K_{oc}

1.29E+05 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

Sorption coefficient for ionised species $K_{oc,i}$

pH value pH

Acid dissociation constant pK_a

Fraction of organic carbon (in soil) f_{oc}

Soil water partition coefficient used in Level Assessment K_d 1.80E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target 4.87E-01 mg/kg (for comparison with soil analyses)

or 0.00027 mg/l (for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(a)pyrene
0.00027

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.76E-04 or 4.98E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C _T	0.00027	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.80E+03	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.02E+04	fraction
Decay rate used	6.78E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.87E-06	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Remedial Targets	Level 3 Remedial Target	4.20E-04	mg/l	For comparison with measured pore water concentration.
	Domenico - Steady state	7.58E-01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
	Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} 1.80E+03 l/kg

Soil water partition coefficient K_d 1.80E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

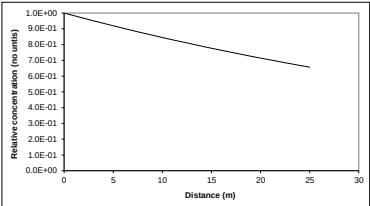
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.80E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.80E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.80E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative (No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Benzo(b)fluoranthene
0.000017 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.05E-06

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.05E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.47E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.49E-02

mg/kg

(for comparison with soil analyses)

or

0.000017

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(b)fluoranthene
0.000017

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.74E-05 or 2.55E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters

Variable	Value	Unit	Source
Contaminant	Benzo(b)fluoranthene		from Level 1
Target Concentration	0.000017	mg/l	from Level 1
Dilution Factor	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.47E+03	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	8.31E+03	fraction
Decay rate used	8.34E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	4.76E-06	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C ₀₀)	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.65E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.88E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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,n} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 1.47E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

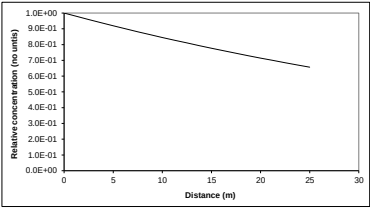
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.88E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Benzo(ghi)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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Benzo(ghi)perylene
Target concentration	C _T 0.0000082 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	2.86E-06	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	4.17E+05	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment K_d 5.84E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	4.79E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.0000082	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(ghi)perylene
0.0000082

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		8.38E-06 or 4.89E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(ghi)perylene		from Level 1
Target Concentration	C _T	0.000082	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.84E+03	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.31E+04	fraction
Decay rate used	2.10E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.20E-06	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	fraction
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.28E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	7.45E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} 5.84E+03 l/kg

Soil water partition coefficient K_d 5.84E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

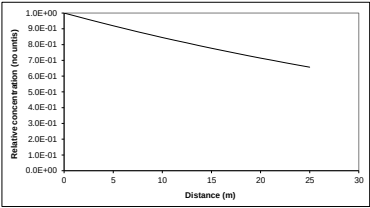
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.88E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Benzo(k)fluoranthene
Target concentration	C _T 0.000017 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.74E-06	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	1.48E+05	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment K_d 2.07E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	3.52E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.000017	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(k)fluoranthene
0.000017

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.74E-05 or 3.60E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters

Variable	Value	Unit	Source
Contaminant	Benzo(k)fluoranthene		from Level 1
Target Concentration	0.000017	mg/l	from Level 1
Dilution Factor	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.07E+03	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable		
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.17E+04	fraction
Decay rate used	5.91E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.37E-06	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C ₀₀)	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.65E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	5.48E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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 pK_a fraction

Fraction of organic carbon in aquifer f_{oc} 2.07E+03 l/kg

Soil water partition coefficient Kd 2.07E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity ax

Transverse dispersivity az

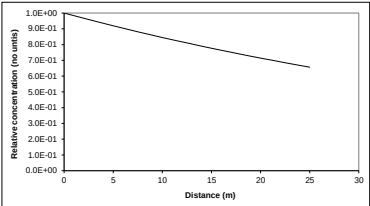
Vertical dispersivity ay

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Fluroanthene		
Target Concentration (C _T)	0.00012	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Fluoranthene
0.00012 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

6.29E-05

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.82E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

2.55E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

3.06E-02

mg/kg

(for comparison with soil analyses)

or

0.00012

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Fluoranthene
0.00012

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.23E-04 or 3.13E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Fluoranthene		from Level 1
Target Concentration	C _T	0.00012	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.55E+02	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.44E+03	fraction
Decay rate used	4.80E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.74E-05	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.87E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	4.76E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 2.55E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

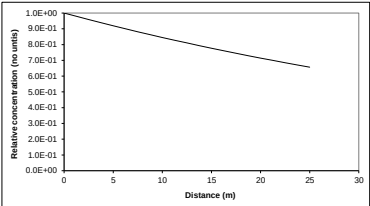
Longitudinal dispersivity	ax	2.50E+00	2.50E+00	1.86E-01	m
Transverse dispersivity	az	0.00E+00	2.50E-01	1.86E-01	m
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.86E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative (No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Indeno(123-cd)perylene		
Target Concentration (C _T)	0.0001	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration
C_T

Indeno(123-cd)perylene
0.0001 mg/l

Input Parameters

Standard entry

Water filled soil porosity θ_w 5.00E-01 fraction
Air filled soil porosity θ_a 3.70E-03 fraction
Bulk density of soil zone material ρ 1.90E+00 g/cm³
Henry's Law constant H 2.05E-06 dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc} 1.40E-02 fraction
Organic carbon partition coefficient K_{oc} 8.71E+04 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species K_{oc,n} l/kg
Sorption coefficient for ionised species K_{oc,i} l/kg
pH value pH pH units
Acid dissociation constant pK_a
Fraction of organic carbon (in soil) f_{oc} fraction

Soil water partition coefficient used in Level Assessment K_d 1.22E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	1.22E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.0001	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Indeno(123-cd)perylene
0.0001

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-04 or 1.25E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Indeno(123-cd)perylene		from Level 1
Target Concentration	C _T	0.0001	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.22E+03	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.91E+03	fraction
Decay rate used	1.00E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	5.72E-06	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.56E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.22E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

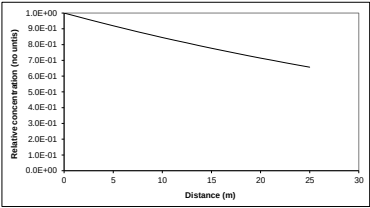
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.88E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	mg/l
	(No units)	
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Naphthalene		
Target Concentration (C _T)	0.13	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Naphthalene
0.13 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

6.62E-03

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

6.46E+02

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

9.04E+00

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.21E+00

mg/kg

(for comparison with soil analyses)

or

0.13

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Naphthalene
0.13

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.33E-01 or 1.24E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Naphthalene		from Level 1
Target Concentration	C _T	0.13	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	9.04E+00	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.22E+01	fraction
Decay rate used	1.33E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	7.57E-04	m/d
Ratio of Compliance Point to Source Concentration	6.57E-01	
Attenuation factor (C ₀ /C _{eq})	1.52E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.02E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.88E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	6.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 9.04E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

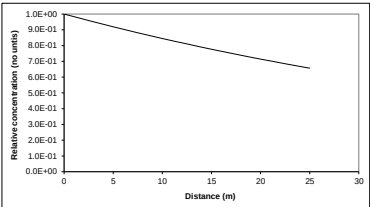
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	2.50E+00	1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.79E-01	0.00E+00
2.5	9.58E-01	0.00E+00
3.8	9.39E-01	0.00E+00
5.0	9.19E-01	0.00E+00
6.3	9.00E-01	0.00E+00
7.5	8.82E-01	0.00E+00
8.8	8.63E-01	0.00E+00
10.0	8.45E-01	0.00E+00
11.3	8.28E-01	0.00E+00
12.5	8.10E-01	0.00E+00
13.8	7.94E-01	0.00E+00
15.0	7.77E-01	0.00E+00
16.3	7.61E-01	0.00E+00
17.5	7.45E-01	0.00E+00
18.8	7.30E-01	0.00E+00
20.0	7.14E-01	0.00E+00
21.3	7.00E-01	0.00E+00
22.5	6.85E-01	0.00E+00
23.8	6.71E-01	0.00E+00
25.0	6.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Phenol		
Target Concentration (C _T)	0.0077	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Phenol
0.0077 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

0.00E+00

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

4.00E-01

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

4.00E-01

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

5.11E-03

mg/kg

(for comparison with soil analyses)

or

0.0077

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Phenol
0.0077

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.87E-03 or 5.22E-03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Phenol		from Level 1
Target Concentration	C _T	0.0077	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	3.00E+02	days	
Calculated decay rate	2.31E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	4.00E-01	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.27E+00	fraction
Decay rate used	7.07E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.21E-02	m/d
Ratio of Compliance Point to Source Concentration	2.74E-01	fraction
Attenuation factor (C ₀ /C ₀₀)	3.64E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.87E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.90E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	2.74E-01	fraction	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 4.00E-01 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 4.00E-01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

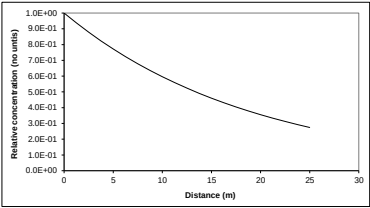
Longitudinal dispersivity	ax	2.50E+00	2.50E+00	1.90E-01	m
Transverse dispersivity	az	0.00E+00	2.50E-01	1.86E-01	m
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.86E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Relative concentration	Concentration
	(No units)		mg/l
0	1.0E+00		0.00E+00
1.3	9.37E-01		0.00E+00
2.5	8.79E-01		0.00E+00
3.8	8.24E-01		0.00E+00
5.0	7.72E-01		0.00E+00
6.3	7.24E-01		0.00E+00
7.5	6.78E-01		0.00E+00
8.8	6.36E-01		0.00E+00
10.0	5.96E-01		0.00E+00
11.3	5.59E-01		0.00E+00
12.5	5.24E-01		0.00E+00
13.8	4.91E-01		0.00E+00
15.0	4.60E-01		0.00E+00
16.3	4.31E-01		0.00E+00
17.5	4.04E-01		0.00E+00
18.8	3.79E-01		0.00E+00
20.0	3.55E-01		0.00E+00
21.3	3.33E-01		0.00E+00
22.5	3.12E-01		0.00E+00
23.8	2.93E-01		0.00E+00
25.0	2.74E-01		0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chloroform		
Target Concentration (C _T)	0.0025	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chloroform
Target concentration	0.0025 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	0.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	7.00E-01	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 7.00E-01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.41E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0025	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chloroform
0.0025

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.56E-03	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.46E-03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chloroform		from Level 1
Target Concentration	C _T	0.0025	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	2.00E+02	days	
Half life for degradation of contaminant in water	3.47E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.00E-01	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.97E+00	fraction
Decay rate used	6.98E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	7.96E-03	m/d
Ratio of Compliance Point to Source Concentration	1.57E-01	fraction
Attenuation factor (C ₀ /C ₀₀)	6.35E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.62E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	1.56E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	1.57E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 7.00E-01 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 7.00E-01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

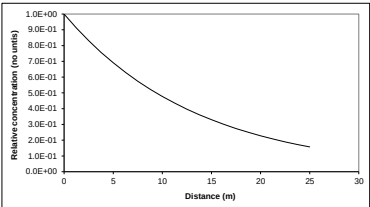
Longitudinal dispersivity	ax	2.50E+00	2.50E+00	1.88E-01	m
Transverse dispersivity	az	0.00E+00	2.50E-01	1.88E-01	m
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.88E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative (No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.12E-01	0.00E+00
2.5	8.31E-01	0.00E+00
3.8	7.58E-01	0.00E+00
5.0	6.91E-01	0.00E+00
6.3	6.30E-01	0.00E+00
7.5	5.74E-01	0.00E+00
8.8	5.24E-01	0.00E+00
10.0	4.77E-01	0.00E+00
11.3	4.35E-01	0.00E+00
12.5	3.97E-01	0.00E+00
13.8	3.62E-01	0.00E+00
15.0	3.30E-01	0.00E+00
16.3	3.01E-01	0.00E+00
17.5	2.74E-01	0.00E+00
18.8	2.50E-01	0.00E+00
20.0	2.28E-01	0.00E+00
21.3	2.08E-01	0.00E+00
22.5	1.89E-01	0.00E+00
23.8	1.73E-01	0.00E+00
25.0	1.57E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Bis(2-ethylhexyl)phthalate		
Target Concentration (C _T)	0.0013	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration
C_T **Bis(2-ethylhexyl)phthalate**
0.0013 mg/l

Input Parameters Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	0.00E+00	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d 2.22E+03 l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}
Organic carbon partition coefficient K_{oc}

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$
Sorption coefficient for ionised species $K_{oc,i}$
pH value pH
Acid dissociation constant pK_a
Fraction of organic carbon (in soil) f_{oc}

Soil water partition coefficient used in Level Assessment K_d 2.22E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.88E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0013	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Bis(2-ethylhexyl)phthalate
0.0013

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.33E-03 or 2.95E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Bis(2-ethylhexyl)phthalate		from Level 1
Target Concentration	C _T	0.0013	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	3.00E+02	days	
Half life for degradation of contaminant in water	2.31E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.22E+03	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.26E+04	fraction
Decay rate used	1.84E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.15E-06	m/d
Ratio of Compliance Point to Source Concentration	2.74E-01	fraction
Attenuation factor (C ₀ /C _{eq})	3.64E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	4.84E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	1.07E+01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	2.74E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 2.22E+03 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 2.22E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

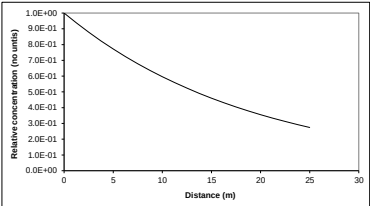
Longitudinal dispersivity	ax	2.50E+00	2.50E+00	1.84E-01	m
Transverse dispersivity	az	0.00E+00	2.50E-01	1.84E-01	m
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.84E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.37E-01	0.00E+00
2.5	8.79E-01	0.00E+00
3.8	8.24E-01	0.00E+00
5.0	7.72E-01	0.00E+00
6.3	7.24E-01	0.00E+00
7.5	6.78E-01	0.00E+00
8.8	6.36E-01	0.00E+00
10.0	5.96E-01	0.00E+00
11.3	5.59E-01	0.00E+00
12.5	5.24E-01	0.00E+00
13.8	4.91E-01	0.00E+00
15.0	4.60E-01	0.00E+00
16.3	4.31E-01	0.00E+00
17.5	4.04E-01	0.00E+00
18.8	3.79E-01	0.00E+00
20.0	3.55E-01	0.00E+00
21.3	3.33E-01	0.00E+00
22.5	3.12E-01	0.00E+00
23.8	2.93E-01	0.00E+00
25.0	2.74E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	PFOS		
Target Concentration (C _T)	0.036	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	PFOS
Target concentration	0.036 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	0.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.40E+01	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment	Kd	1.40E+01	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	5.13E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.036	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

PFOS
0.036 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.68E-02 or 5.25E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant	PFOS			from Level 1
Target Concentration	C _T	0.036	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.50E+04	days	
Half life for degradation of contaminant in water	4.63E-05	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.40E+01	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	8.03E+01	fraction
Decay rate used	5.77E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	4.92E-04	m/d
Ratio of Compliance Point to Source Concentration	9.71E-01	
Attenuation factor (C ₀ /C ₀₀)	AF	1.03E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	3.79E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.40E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	9.71E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.40E+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 1.40E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

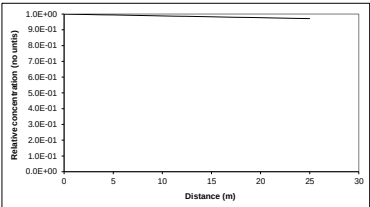
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	2.50E+00 1.88E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 1.88E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	9.99E-01	0.00E+00
2.5	9.97E-01	0.00E+00
3.8	9.96E-01	0.00E+00
5.0	9.94E-01	0.00E+00
6.3	9.93E-01	0.00E+00
7.5	9.91E-01	0.00E+00
8.8	9.90E-01	0.00E+00
10.0	9.88E-01	0.00E+00
11.3	9.87E-01	0.00E+00
12.5	9.86E-01	0.00E+00
13.8	9.84E-01	0.00E+00
15.0	9.83E-01	0.00E+00
16.3	9.81E-01	0.00E+00
17.5	9.80E-01	0.00E+00
18.8	9.78E-01	0.00E+00
20.0	9.77E-01	0.00E+00
21.3	9.75E-01	0.00E+00
22.5	9.74E-01	0.00E+00
23.8	9.73E-01	0.00E+00
25.0	9.71E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Arsenic		
Target Concentration (C _T)	0.01	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Arsenic
0.01 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.00E+00

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

5.00E+02

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

5.00E+02

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

5.00E+00

mg/kg

(for comparison with soil analyses)

or

0.01

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Arsenic
0.01

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-02 or 5.11E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Arsenic		from Level 1
Target Concentration	C _T	0.01	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.00E+02	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Remedial Targets	Level 3 Remedial Target	1.02E-02	mg/l	For comparison with measured pore water concentration.
	Domenico - Steady state	or	5.11E+00	This assumes Level 1 Remedial Target is based on Target Concentration.
	Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

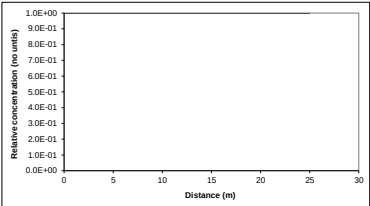
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	0.00E+00	2.50E+00	1.00E+00 m
Transverse dispersivity az	0.00E+00	2.50E-01	1.00E-01 m
Vertical dispersivity ay	0.00E+00	2.50E-02	1.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Boron		
Target Concentration (C _T)	2	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Boron
Target concentration	2 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+01	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.05E+01	mg/kg	(for comparison with soil analyses)
	or		
	2	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Boron
2

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.04E+00 or 2.10E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Boron		from Level 1
Target Concentration	C _T	2	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+01	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.77E+01	fraction
Decay rate used	1.21E-102	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.86E-04	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.04E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.10E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

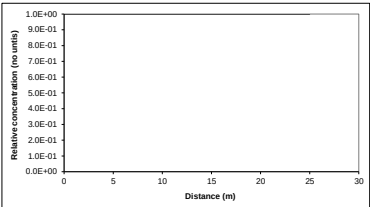
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.86E-01
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.86E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Cadmium		
Target Concentration (C _T)	0.00025	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Cadmium
Target concentration	0.00025 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction		This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.
Air filled soil porosity	θ_a	3.70E-03	fraction		
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³		
Henry's Law constant	H	1.00E+00	dimensionless		

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+02	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.51E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.00025	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Cadmium
0.00025

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.56E-04 or 2.56E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Cadmium		from Level 1
Target Concentration	C _T	0.00025	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.00E+02	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.68E+02	fraction
Decay rate used	1.23E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.97E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.56E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.56E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

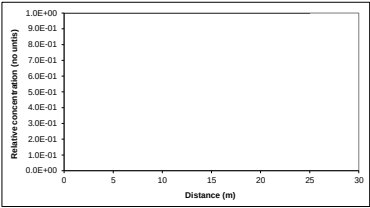
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.88E-01
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.88E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chromium VI		
Target Concentration (C _T)	0.0034	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chromium VI
Target concentration	C _T 0.0034 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d 1.80E+01 l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

--

Organic carbon partition coefficient

K_{oc}

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

--

Sorption coefficient for ionised species

K_{oc,i}

--

pH value

pH

--

Acid dissociation constant

pK_a

--

Fraction of organic carbon (in soil)

f_{oc}

--

Soil water partition coefficient used in Level Assessment

K_d 1.80E+01 l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target	6.21E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.0034	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chromium VI
0.0034

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.48E-03 or 6.35E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chromium VI		from Level 1
Target Concentration	C _T	0.0034	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.80E+01	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.03E+02	fraction
Decay rate used	6.80E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.84E-04	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.48E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	6.35E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	25	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.80E+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 1.80E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

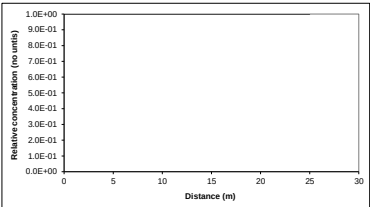
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.80E-01
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.80E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chromium		
Target Concentration (C _T)	0.0047	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chromium
Target concentration	0.0047 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction		This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.
Air filled soil porosity	θ_a	3.70E-03	fraction		
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³		
Henry's Law constant	H	1.00E+00	dimensionless		

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 soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 4.80E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.26E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.0047	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chromium
0.0047

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		4.80E-03 or 2.31E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chromium		from Level 1
Target Concentration	C _T	0.0047	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	9.90E+99	days	
Half life for degradation of contaminant in water	t _{1/2}	days	
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	
Effective porosity of aquifer	n	fraction	
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	m	
Distance (depth) to compliance point perpendicular to flow direction	v	m	
Time since pollutant entered groundwater	t	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	4.80E+03	l/kg see options
Longitudinal dispersivity	ax	2.500	m see options
Transverse dispersivity	az	0.250	m see options
Vertical dispersivity	ay	0.025	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	3.96E-02 m/d
Retardation factor	Rf	2.72E+04 fraction
Decay rate used	λ	2.57E-105 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00 fraction
Rate of contaminant flow due to retardation	u	1.45E-06 m/d
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00
Attenuation factor (C ₀ /C _{EQ})	AF	1.00E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	4.80E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

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 fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 4.80E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

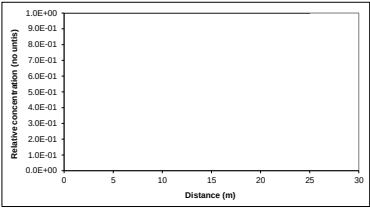
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E-01	1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.88E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Copper		
Target Concentration (C _T)	0.02146	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Copper
Target concentration	0.02146 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+02	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.15E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.02146	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Copper
0.02146 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.19E-02 or 2.20E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Copper		from Level 1
Target Concentration	C _T	0.02146	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+02	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.68E+02	fraction
Decay rate used	1.23E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.97E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.19E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	2.20E+00	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

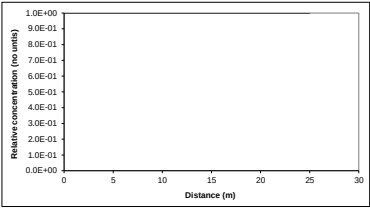
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.00E+00
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.00E-01
		0.00E+00	2.50E-02	1.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Iron		
Target Concentration (C _T)	1	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Iron
Target concentration	1 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.60E+03	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.60E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.60E+03	mg/kg	(for comparison with soil analyses)
	or		
	1	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Iron
1 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E+00 or 1.64E+03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Iron		from Level 1
Target Concentration	C _T	1	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.60E+03	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	9.07E+03	fraction
Decay rate used	7.72E-105	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	4.36E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.02E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.64E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	25	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.60E+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 1.60E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

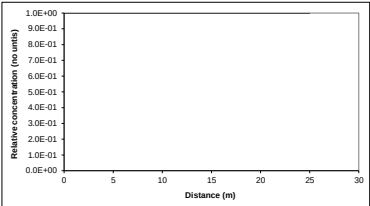
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	2.50E+00	1.98E-01 m
Transverse dispersivity	az	0.00E+00	2.50E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Lead		
Target Concentration (C _T)	0.014	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Lead
Target concentration	0.014 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+03	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 1.00E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.40E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.014	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Lead
0.014

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.43E-02 or 1.43E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Lead		from Level 1
Target Concentration	C _T	0.014	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+03	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.67E+03	fraction
Decay rate used	1.24E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.98E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.43E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.43E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	25	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

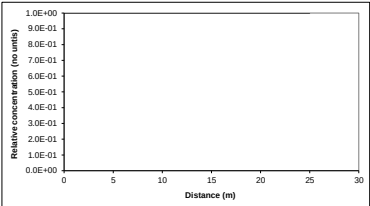
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.00E+00
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.00E-01
		0.00E+00	2.50E-02	1.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Manganese		
Target Concentration (C _T)	0.123	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Manganese
Target concentration	0.123 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+03	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 1.00E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.23E+02	mg/kg	(for comparison with soil analyses)
	or		
	0.123	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Manganese
0.123

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.26E-01 or 1.26E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Manganese		from Level 1
Target Concentration	C _T	0.123	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+03	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.67E+03	fraction
Decay rate used	1.24E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.98E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.26E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.26E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	25	m	
C _{eq} /C ₀	1.00E+00	fraction	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

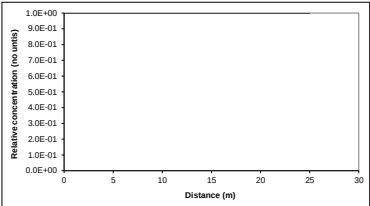
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.00E+00
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.00E-01
		0.00E+00	2.50E-02	1.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Mercury		
Target Concentration (C _T)	0.00007	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Mercury
Target concentration	0.00007 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	5.00E+02	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment	Kd	5.00E+02	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	3.50E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.00007	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Mercury
0.00007 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.16E-05 or 3.58E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Mercury		from Level 1
Target Concentration	C _T	0.00007	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.00E+02	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	7.16E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.58E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

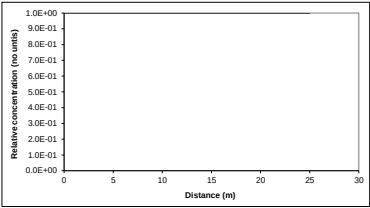
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.00E-01
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.00E-01

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Nickel		
Target Concentration (C _T)	0.034	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Nickel
Target concentration	0.034 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	5.00E+02	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 5.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.70E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.034	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Nickel
0.034

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.48E-02 or 1.74E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Nickel		from Level 1
Target Concentration	C _T	0.034	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.00E+02	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.48E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.74E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	25	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

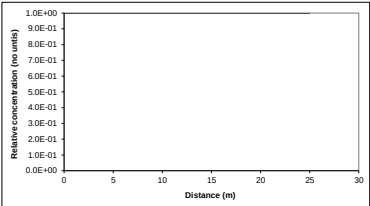
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.00E+00
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.00E-01
		0.00E+00	2.50E-02	1.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Vanadium		
Target Concentration (C _T)	0.02	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

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The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Vanadium
Target concentration	0.02 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.26E+01	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 1.26E+01 l/kg Specified value

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	2.57E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.02	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Vanadium
0.02

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.04E-02 or 2.63E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Vanadium		from Level 1
Target Concentration	C _T	0.02	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	2.50E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.26E+01	l/kg	see options
Longitudinal dispersivity	2.500	m	see options
Transverse dispersivity	0.250	m	see options
Vertical dispersivity	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	7.24E+01	fraction
Decay rate used	9.67E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	5.46E-04	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.04E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.63E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.26E+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 1.26E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

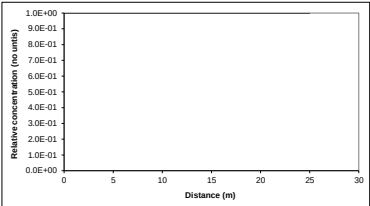
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E-01	1.86E-01
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.86E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Zinc		
Target Concentration (C _T)	0.0302	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Zinc
Target concentration	0.0302 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	3.80E+01	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 3.80E+01 l/kg Specified value

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	1.16E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0302	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Zinc
0.0302 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.09E-02 or 1.18E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Zinc		from Level 1
Target Concentration	C _T	0.0302	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	9.90E+99	days	
Half life for degradation of contaminant in water	t _{1/2}	days	
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	
Effective porosity of aquifer	n	fraction	
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	m	
Distance (depth) to compliance point perpendicular to flow direction	y	m	
Time since pollutant entered groundwater	t	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	l/kg	see options
Longitudinal dispersivity	ax	m	see options
Transverse dispersivity	az	m	see options
Vertical dispersivity	ay	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	3.96E-02 m/d
Retardation factor	Rf	2.16E+02 fraction
Decay rate used	λ	3.24E-103 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00 fraction
Rate of contaminant flow due to retardation	u	1.93E-04 m/d
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00
Attenuation factor (C ₀ /C _{EQ})	AF	1.00E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	3.09E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	25	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 3.80E+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 3.80E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

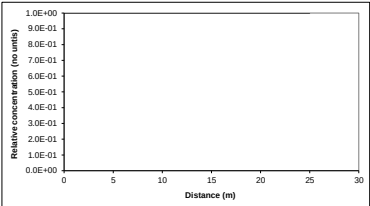
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E+00	1.98E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-01	1.86E-01 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	1.00E+00	0.00E+00
2.5	1.00E+00	0.00E+00
3.8	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
6.3	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
8.8	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
11.3	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
13.8	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
16.3	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
18.8	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
21.3	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
23.8	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Cyanide		
Target Concentration (C _T)	0.005	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Cyanide
Target concentration	0.005 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	5.00E+00	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 5.00E+00 l/kg Specified value

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	2.63E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.005	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Cyanide
0.005

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		5.11E-03 or 2.69E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Cyanide		from Level 1
Target Concentration	C _T	0.005	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	2.40E+01	days	
Half life for degradation of contaminant in water	2.89E-02	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	2.50E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.00E+00	l/kg	see options
Longitudinal dispersivity	ax	2.500	m	see options
Transverse dispersivity	az	0.250	m	see options
Vertical dispersivity	ay	0.025	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.93E+01	fraction
Decay rate used	9.85E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.35E-03	m/d
Ratio of Compliance Point to Source Concentration	8.22E-05	fraction
Attenuation factor (C ₀ /C _{eq})	1.22E+04	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.22E+01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.27E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	8.22E-05	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+00 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 5.00E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

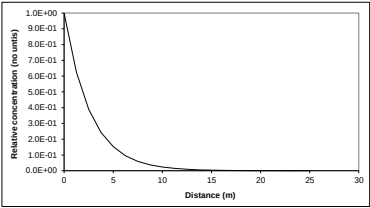
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	2.50E-01	1.88E-01 m
Vertical dispersivity	ay	0.00E+00	2.50E-02	1.88E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
1.3	6.25E-01	0.00E+00
2.5	3.90E-01	0.00E+00
3.8	2.44E-01	0.00E+00
5.0	1.52E-01	0.00E+00
6.3	9.52E-02	0.00E+00
7.5	5.95E-02	0.00E+00
8.8	3.72E-02	0.00E+00
10.0	2.32E-02	0.00E+00
11.3	1.45E-02	0.00E+00
12.5	9.07E-03	0.00E+00
13.8	5.67E-03	0.00E+00
15.0	3.54E-03	0.00E+00
16.3	2.21E-03	0.00E+00
17.5	1.38E-03	0.00E+00
18.8	8.63E-04	0.00E+00
20.0	5.39E-04	0.00E+00
21.3	3.37E-04	0.00E+00
22.5	2.11E-04	0.00E+00
23.8	1.32E-04	0.00E+00
25.0	8.22E-05	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1

Appendix H3

Suitable for Use Calculations – 50m Compliance



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	19-Sep-24		
Contaminant	Aliphatic C5-C6		
Target Concentration (C _T)	15	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C5-C6

15

mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

4.70E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

8.13E+02

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.14E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.76E+02

mg/kg

(for comparison with soil analyses)

or

15

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 19-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C5-C6
15

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.53E+01 or 1.80E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	19-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C5-C6		from Level 1
Target Concentration	C _T	15	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.14E+01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.55E+01	fraction
Decay rate used	2.12E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.04E-04	m/d
Ratio of Compliance Point to Source Concentration	2.18E-01	fraction
Attenuation factor (C ₀ /C ₅₀)	4.58E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	7.02E+01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	8.24E+02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀ /C ₅₀	2.18E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)		
Soil water partition coefficient	K _d	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	f _{oc}	fraction
Organic carbon partition coefficient	K _{oc}	l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	l/kg
Sorption coefficient for ionised species	K _{oc,i}	l/kg
pH value	pH	
Acid dissociation constant	pK _a	
Fraction of organic carbon in aquifer	f _{oc}	fraction

Soil water partition coefficient K_d 1.14E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

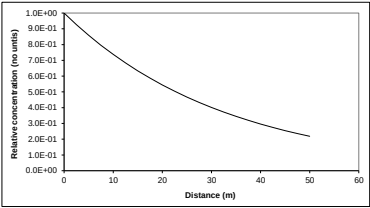
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Relative concentration	Concentration
		(No units)	mg/l
0		1.0E+00	0.00E+00
2.5		9.27E-01	0.00E+00
5.0		8.50E-01	0.00E+00
7.5		7.96E-01	0.00E+00
10.0		7.38E-01	0.00E+00
12.5		6.84E-01	0.00E+00
15.0		6.34E-01	0.00E+00
17.5		5.87E-01	0.00E+00
20.0		5.44E-01	0.00E+00
22.5		5.04E-01	0.00E+00
25.0		4.67E-01	0.00E+00
27.5		4.33E-01	0.00E+00
30.0		4.01E-01	0.00E+00
32.5		3.72E-01	0.00E+00
35.0		3.45E-01	0.00E+00
37.5		3.20E-01	0.00E+00
40.0		2.96E-01	0.00E+00
42.5		2.74E-01	0.00E+00
45.0		2.54E-01	0.00E+00
47.5		2.36E-01	0.00E+00
50.0		2.18E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C6-C8		
Target Concentration (C _T)	15	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration
C_T

Aliphatic C6-C8
15 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	5.00E+01	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

Organic carbon partition coefficient K_{oc}

3.80E+03 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

Sorption coefficient for ionised species $K_{oc,i}$

pH value pH

Acid dissociation constant pK_a

Fraction of organic carbon (in soil) f_{oc}

Soil water partition coefficient used in Level Assessment K_d 5.32E+01 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	8.04E+02	mg/kg	(for comparison with soil analyses)
	or		
	15	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C6-C8
15

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.53E+01 or 8.22E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C6-C8		from Level 1
Target Concentration	C _T	15	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.14E+01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.55E+01	fraction
Decay rate used	2.12E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.04E-04	m/d
Ratio of Compliance Point to Source Concentration	2.18E-01	fraction
Attenuation factor (C ₀ /C ₀₀)	4.58E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	7.02E+01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.76E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀₀ /C ₀	2.18E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Soil water partition coefficient	K _d		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	f _{oc}	1.40E-02	fraction
Organic carbon partition coefficient	K _{oc}	8.13E+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,n}		l/kg
pH value	pH		
Acid dissociation constant	pK _a		
Fraction of organic carbon in aquifer	f _{oc}		fraction

Soil water partition coefficient K_d 1.14E+01 l/kg

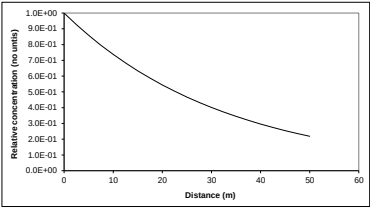
Define dispersivity (click brown cell and use pull down list)
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Relative concentration	Concentration
		(No units)	mg/l
0		1.0E+00	0.00E+00
2.5		9.27E-01	0.00E+00
5.0		8.50E-01	0.00E+00
7.5		7.96E-01	0.00E+00
10.0		7.38E-01	0.00E+00
12.5		6.84E-01	0.00E+00
15.0		6.34E-01	0.00E+00
17.5		5.87E-01	0.00E+00
20.0		5.44E-01	0.00E+00
22.5		5.04E-01	0.00E+00
25.0		4.67E-01	0.00E+00
27.5		4.33E-01	0.00E+00
30.0		4.01E-01	0.00E+00
32.5		3.72E-01	0.00E+00
35.0		3.45E-01	0.00E+00
37.5		3.20E-01	0.00E+00
40.0		2.96E-01	0.00E+00
42.5		2.74E-01	0.00E+00
45.0		2.54E-01	0.00E+00
47.5		2.36E-01	0.00E+00
50.0		2.18E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C8-C10		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C8-C10
0.3 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

5.50E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

3.02E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

4.23E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.27E+02

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C8-C10
0.3

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 1.30E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	4.23E+02	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.40E+03	fraction
Decay rate used	5.78E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.65E-05	m/d
Ratio of Compliance Point to Source Concentration	2.18E-01	fraction
Attenuation factor (C ₀ /C _{eq})	4.58E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.40E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.94E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	2.18E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 3.02E+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 f_{oc} fraction

Soil water partition coefficient Kd 4.23E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

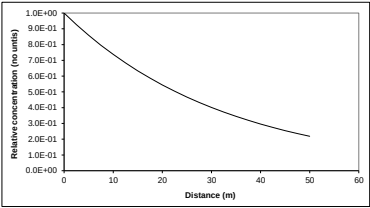
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.98E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.98E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.27E-01	0.00E+00
5.0	8.50E-01	0.00E+00
7.5	7.96E-01	0.00E+00
10.0	7.38E-01	0.00E+00
12.5	6.84E-01	0.00E+00
15.0	6.34E-01	0.00E+00
17.5	5.87E-01	0.00E+00
20.0	5.44E-01	0.00E+00
22.5	5.04E-01	0.00E+00
25.0	4.67E-01	0.00E+00
27.5	4.33E-01	0.00E+00
30.0	4.01E-01	0.00E+00
32.5	3.72E-01	0.00E+00
35.0	3.45E-01	0.00E+00
37.5	3.20E-01	0.00E+00
40.0	2.96E-01	0.00E+00
42.5	2.74E-01	0.00E+00
45.0	2.54E-01	0.00E+00
47.5	2.36E-01	0.00E+00
50.0	2.18E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C10-C12		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C10-C12
0.3 mg/l

Input Parameters Standard entry

Variable Value Unit Source of parameter value

Water filled soil porosity θ_w 5.00E-01 fraction
Air filled soil porosity θ_a 3.70E-03 fraction
Bulk density of soil zone material ρ 1.90E+00 g/cm³
Henry's Law constant H 6.00E+01 dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc} 1.40E-02 fraction
Organic carbon partition coefficient K_{oc} 2.40E+05 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species K_{oc,n} l/kg
Sorption coefficient for ionised species K_{oc,i} l/kg
pH value pH pH units
Acid dissociation constant pK_a
Fraction of organic carbon (in soil) f_{oc} fraction

Soil water partition coefficient used in Level Assessment K_d 3.36E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target 1.01E+03 mg/kg (for comparison with soil analyses)
or
0.3 mg/l (for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C10-C12

0.3

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 1.03E+03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	3.36E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.90E+04	fraction
Decay rate used	3.64E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.08E-06	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.90E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	2.32E+03	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 3.36E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

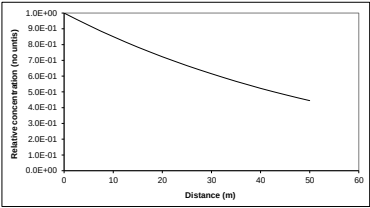
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C12-C16		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aliphatic C12-C16
0.3 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

6.90E+01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

5.37E+06

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

7.52E+04

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.26E+04

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aliphatic C12-C16

0.3

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 2.31E+04	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.52E+04	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.26E+05	fraction
Decay rate used	1.63E-09	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	9.28E-08	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.90E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.19E+04	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 7.52E+04 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

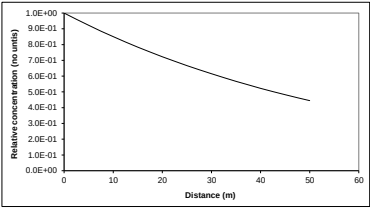
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.00E-01

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aliphatic C16-C35		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Aliphatic C16-C35
Target concentration	C _T 0.3 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	8.50E+01	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
----------------------------------	----------------	--	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	5.75E+08	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment K_d 8.06E+06 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	2.42E+06	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant Target concentration C_T **Aliphatic C16-C35** from Level 1
0.3 mg/l from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 2.47E+06	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C35		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	8.06E+06	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.57E+07	fraction
Decay rate used	1.52E-11	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	8.66E-10	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.90E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.56E+06	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 8.06E+06 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

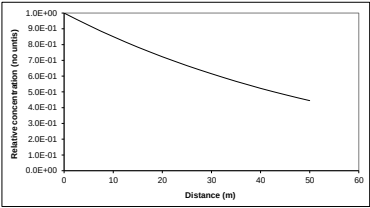
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C5-C7		
Target Concentration (C _T)	0.05	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C5-C7
0.05 mg/l

Input Parameters Standard entry

Variable Value Unit Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.30E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

6.80E+01

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

9.52E-01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

6.08E-02

mg/kg

(for comparison with soil analyses)

or

0.05

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C5-C7
0.05

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		5.11E-02 or 6.21E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C5-C7		from Level 1
Target Concentration	C _T	0.05	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	9.52E-01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.39E+00	fraction
Decay rate used	2.17E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.19E-03	m/d
Ratio of Compliance Point to Source Concentration	2.18E-01	fraction
Attenuation factor (C ₀ /C ₅₀)	4.58E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.34E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.84E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀ /C ₅₀	2.18E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)		
Soil water partition coefficient	K _d	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	f _{oc}	fraction
Organic carbon partition coefficient	K _{oc}	l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	l/kg
Sorption coefficient for ionised species	K _{ow,n}	l/kg
pH value	pH	
Acid dissociation constant	pK _a	
Fraction of organic carbon in aquifer	f _{oc}	fraction
Soil water partition coefficient	K _d	9.52E-01 l/kg

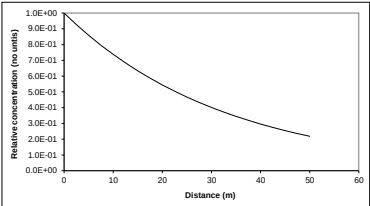
Define dispersivity (click brown cell and use pull down list)
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.27E-01	0.00E+00
5.0	8.50E-01	0.00E+00
7.5	7.96E-01	0.00E+00
10.0	7.38E-01	0.00E+00
12.5	6.84E-01	0.00E+00
15.0	6.34E-01	0.00E+00
17.5	5.87E-01	0.00E+00
20.0	5.44E-01	0.00E+00
22.5	5.04E-01	0.00E+00
25.0	4.67E-01	0.00E+00
27.5	4.33E-01	0.00E+00
30.0	4.01E-01	0.00E+00
32.5	3.72E-01	0.00E+00
35.0	3.45E-01	0.00E+00
37.5	3.20E-01	0.00E+00
40.0	2.96E-01	0.00E+00
42.5	2.74E-01	0.00E+00
45.0	2.54E-01	0.00E+00
47.5	2.36E-01	0.00E+00
50.0	2.18E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C7-C8		
Target Concentration (C _T)	0.074	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C7-C8
0.074 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.70E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

2.04E+02

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

2.86E+00

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.31E-01

mg/kg

(for comparison with soil analyses)

or

0.074

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C7-C8
0.074

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.57E-02 or 2.36E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C7-C8		from Level 1
Target Concentration	C _T	0.074	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	5.00E+02	days	
Half life for degradation of contaminant in water	1.39E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance (lateral) to compliance point		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.86E+00	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.72E+01	fraction
Decay rate used	8.07E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.30E-03	m/d
Ratio of Compliance Point to Source Concentration	2.18E-01	fraction
Attenuation factor (C ₀ /C _{eq})	4.58E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.46E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.08E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	2.18E-01	fraction

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 2.04E+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 f_{oc} fraction

Soil water partition coefficient Kd 2.86E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

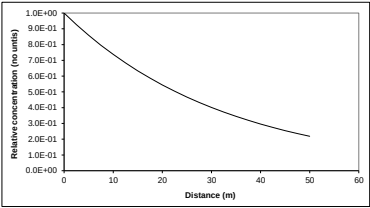
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Relative concentration	Concentration
		(No units)	mg/l
0		1.0E+00	0.00E+00
2.5		9.27E-01	0.00E+00
5.0		8.50E-01	0.00E+00
7.5		7.96E-01	0.00E+00
10.0		7.38E-01	0.00E+00
12.5		6.84E-01	0.00E+00
15.0		6.34E-01	0.00E+00
17.5		5.87E-01	0.00E+00
20.0		5.44E-01	0.00E+00
22.5		5.04E-01	0.00E+00
25.0		4.67E-01	0.00E+00
27.5		4.33E-01	0.00E+00
30.0		4.01E-01	0.00E+00
32.5		3.72E-01	0.00E+00
35.0		3.45E-01	0.00E+00
37.5		3.20E-01	0.00E+00
40.0		2.96E-01	0.00E+00
42.5		2.74E-01	0.00E+00
45.0		2.54E-01	0.00E+00
47.5		2.36E-01	0.00E+00
50.0		2.18E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C8-C10		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration
C_T

Aromatic C8-C10
0.3 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	3.90E-01	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

Organic carbon partition coefficient K_{oc}

1.59E+03 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

Sorption coefficient for ionised species $K_{oc,i}$

pH value pH

Acid dissociation constant pK_a

Fraction of organic carbon (in soil) f_{oc}

Soil water partition coefficient used in Level Assessment K_d

2.22E+01 l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	6.74E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C8-C10
0.3

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.07E-01 or 6.89E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	5.00E+02	days	
Calculated decay rate	1.39E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.22E+01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.27E+02	fraction
Decay rate used	1.09E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.12E-04	m/d
Ratio of Compliance Point to Source Concentration	2.18E-01	fraction
Attenuation factor (C ₀ /C ₅₀)	4.58E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.40E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.15E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	50	m	
C ₀ /C ₅₀	2.18E-01	fraction	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Soil water partition coefficient	K _d		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	f _{oc}	1.40E-02	fraction
Organic carbon partition coefficient	K _{oc}	1.59E+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 _{ow,n}		l/kg
pH value	pH		
Acid dissociation constant	pK _a		
Fraction of organic carbon in aquifer	f _{oc}		fraction

Soil water partition coefficient K_d 2.22E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

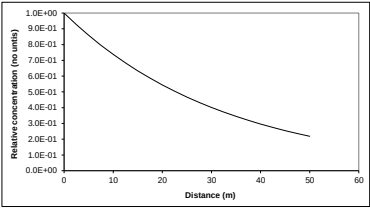
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.27E-01	0.00E+00
5.0	8.50E-01	0.00E+00
7.5	7.96E-01	0.00E+00
10.0	7.38E-01	0.00E+00
12.5	6.84E-01	0.00E+00
15.0	6.34E-01	0.00E+00
17.5	5.87E-01	0.00E+00
20.0	5.44E-01	0.00E+00
22.5	5.04E-01	0.00E+00
25.0	4.67E-01	0.00E+00
27.5	4.33E-01	0.00E+00
30.0	4.01E-01	0.00E+00
32.5	3.72E-01	0.00E+00
35.0	3.45E-01	0.00E+00
37.5	3.20E-01	0.00E+00
40.0	2.96E-01	0.00E+00
42.5	2.74E-01	0.00E+00
45.0	2.54E-01	0.00E+00
47.5	2.36E-01	0.00E+00
50.0	2.18E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C10-C12		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C10-C12
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.30E-01

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

2.51E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

3.52E+01

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

3.19E+00

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C10-C12
0.09

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 3.26E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		from Level 1
Target Concentration	C _T	0.09	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	3.52E+01	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.00E+02	fraction
Decay rate used	3.46E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.97E-04	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.07E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	7.33E+00	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 3.52E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

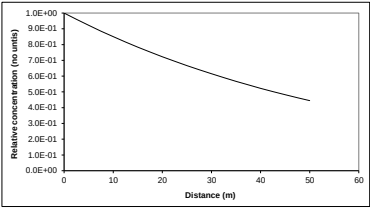
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C12-C16		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration
C_T

Aromatic C12-C16
0.09 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	2.80E-02	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

--

Organic carbon partition coefficient K_{oc}

5.01E+03 l/kg

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

l/kg

--

Sorption coefficient for ionised species $K_{oc,i}$

l/kg

--

pH value pH

pH units

--

Acid dissociation constant pK_a

--

Fraction of organic carbon (in soil) f_{oc}

fraction

--

Soil water partition coefficient used in Level Assessment K_d 7.02E+01 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	6.34E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.09	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C12-C16
0.09

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 6.48E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C16		from Level 1
Target Concentration	C _T	0.99	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter soil concentration	0	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.02E+01	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	Rf	3.99E+02	fraction
Decay rate used	λ	1.74E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	9.92E-05	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	4.45E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	2.25E+00	fraction
Calculated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.07E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 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 7.02E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

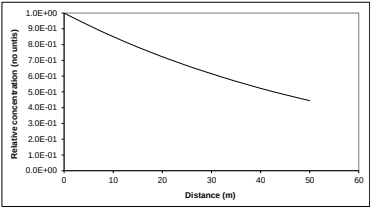
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.98E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.98E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C16-C21		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C16-C21
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.50E-03

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.41E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.98E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.78E+01

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C16-C21
0.09

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 1.82E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		from Level 1
Target Concentration	C _T	0.99	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.98E+02	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.12E+03	fraction
Decay rate used	6.18E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.53E-05	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.07E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	4.10E+01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.98E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

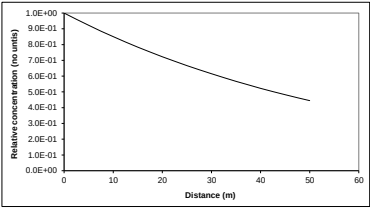
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.98E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.98E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Aromatic C21-C35		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Aromatic C21-C35
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.70E-05

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.26E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.76E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.59E+02

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Aromatic C21-C35
0.09

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		9.20E-02 or 1.62E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		from Level 1
Target Concentration	C _T	0.99	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.76E+03	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	9.99E+03	fraction
Decay rate used	6.94E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.96E-06	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.07E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.65E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.76E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

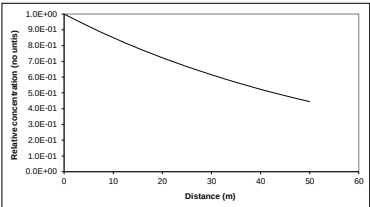
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.98E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.98E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Anthracene
Target concentration	0.0001 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.81E-04	dimensionless

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 soil)	foc	1.40E-02	fraction
Organic carbon partition coefficient	Koc	5.62E+03	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment	Kd	7.87E+01	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	7.90E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0001	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Anthracene
0.0001

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Standard entry

Input Parameters

Variable

Value

Unit

Source of parameter value

Infiltration

Inf

4.55E-04

m/d

Area of contaminant source

A

6.25E+05

m²

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow

L

2.50E+02

m

Saturated aquifer thickness

da

9.80E+00

m

Hydraulic Conductivity of aquifer in which dilution occurs

K

8.64E-03

m/d

Hydraulic gradient of water table

i

3.00E-02

fraction

Width of contaminant source perpendicular to groundwater flow

w

3.00E+02

m

Not used in calculation

Background concentration of contaminant in groundwater beneath site

Cu

0.00E+00

mg/l

Define mixing zone depth by specifying or calculating depth (using pull down list)

Specify

Enter mixing zone thickness

Mz

9.80E+00

m

Calculated mixing zone thickness

Mz

m

Calculated Parameters

Dilution Factor

DF

1.02E+00

Level 2 Remedial Target

1.02E-04

mg/l

For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration

or

8.07E-03

mg/kg

For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)

Cc

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Anthracene		from Level 1
Target Concentration	C _T	0.0001	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	7.87E+01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.47E+02	fraction
Decay rate used	1.55E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	8.85E-05	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.30E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	1.82E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 7.87E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

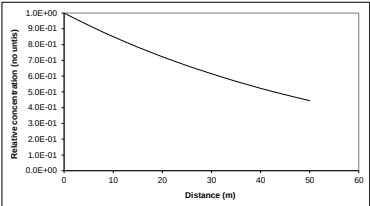
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	5.00E+00	5.00E+00 m
Transverse dispersivity	az	0.00E+00	5.00E-01 m
Vertical dispersivity	ay	0.00E+00	5.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Benzo(a)pyrene		
Target Concentration (C _T)	0.00027	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

Benzo(a)pyrene
0.00027 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	1.81E-04	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

1.40E-02 fraction

Organic carbon partition coefficient K_{oc}

1.29E+05 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

Sorption coefficient for ionised species $K_{oc,i}$

pH value pH

Acid dissociation constant pK_a

Fraction of organic carbon (in soil) f_{oc}

Soil water partition coefficient used in Level Assessment K_d

1.80E+03 l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	4.87E-01	mg/kg
	or	
	0.00027	mg/l

(for comparison with soil analyses)

(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(a)pyrene
0.00027

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.76E-04 or 4.98E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C _T	0.00027	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.80E+03	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.02E+04	fraction
Decay rate used	6.78E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.87E-06	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C ₅₀)	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.21E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or	1.12E+00	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₀ /C ₅₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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 pK_a fraction

Fraction of organic carbon in aquifer f_{oc} 1.80E+03 l/kg

Soil water partition coefficient Kd 1.80E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

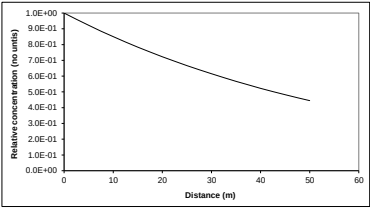
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Benzo(b)fluoranthene
0.000017 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

2.05E-06

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.05E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.47E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.49E-02

mg/kg

(for comparison with soil analyses)

or

0.000017

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(b)fluoranthene
0.000017

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.74E-05 or 2.55E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(b)fluoranthene		from Level 1
Target Concentration	C _T	0.000017	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.47E+03	l/kg see options
Longitudinal dispersivity	ax	5.000	m see options
Transverse dispersivity	az	0.500	m see options
Vertical dispersivity	ay	0.050	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	8.31E+03	fraction
Decay rate used	8.34E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	4.76E-06	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	4.45E-01
Attenuation factor (C ₀ /C _{ED})	AF	2.25E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Remedial Targets	Level 3 Remedial Target	3.91E-05	mg/l	For comparison with measured pore water concentration.
	Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	Distance to compliance point	5.73E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	1.40E-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 _{ow,i}	l/kg
pH value	pH	
Acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction

Soil water partition coefficient Kd 1.47E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

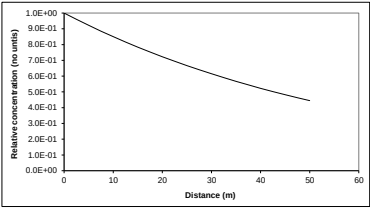
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Benzo(ghi)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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Benzo(ghi)perylene
Target concentration	C _T 0.0000082 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	2.86E-06	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient

K_{oc} 4.17E+05 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

Sorption coefficient for ionised species

K_{oc,i}

pH value

pH

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

Soil water partition coefficient used in Level Assessment

K_d 5.84E+03 l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	4.79E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.0000082	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(ghi)perylene
0.0000082

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		8.38E-06 or 4.89E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(ghi)perylene		from Level 1
Target Concentration	C _T	0.000082	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.84E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.31E+04	fraction
Decay rate used	2.10E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.20E-06	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.89E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.10E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 5.84E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

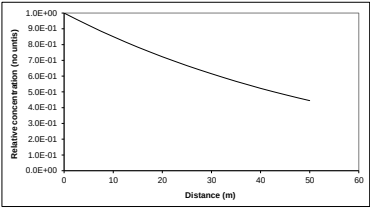
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	5.00E+00	5.00E+00 m
Transverse dispersivity	az	0.00E+00	5.00E-01 m
Vertical dispersivity	ay	0.00E+00	5.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration C_T Benzo(k)fluoranthene
0.000017 mg/l

Input Parameters

Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	1.74E-06	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}

--

Organic carbon partition coefficient K_{oc}

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species $K_{oc,n}$

--

Sorption coefficient for ionised species $K_{oc,i}$

--

pH value pH

--

Acid dissociation constant pK_a

--

Fraction of organic carbon (in soil) f_{oc}

--

Soil water partition coefficient used in Level Assessment K_d 2.07E+03 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	3.52E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.000017	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(k)fluoranthene
0.000017

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.74E-05 or 3.60E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters

Variable	Value	Unit	Source
Contaminant	Benzo(k)fluoranthene		from Level 1
Target Concentration	0.000017	mg/l	from Level 1
Dilution Factor	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.07E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.17E+04	fraction
Decay rate used	5.91E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.37E-06	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.91E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	8.10E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 2.07E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

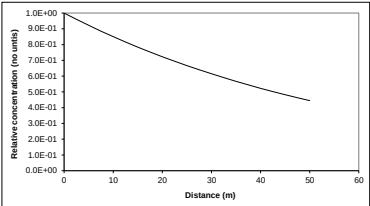
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	5.00E+00	5.00E+00 m
Transverse dispersivity	az	0.00E+00	5.00E-01 m
Vertical dispersivity	ay	0.00E+00	5.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Fluroanthene		
Target Concentration (C _T)	0.00012	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Fluoranthene
0.00012 mg/l

Input Parameters
Standard entry

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

6.29E-05

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

1.40E-02

fraction

Organic carbon partition coefficient

K_{oc}

1.82E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

2.55E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

3.06E-02

mg/kg

(for comparison with soil analyses)

or

0.00012

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Fluoranthene
0.00012

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.23E-04 or 3.13E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Fluoranthene		from Level 1
Target Concentration	C _T	0.00012	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+03	days	
Half life for degradation of contaminant in water	6.93E-04	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.55E+02	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.44E+03	fraction
Decay rate used	4.80E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	2.74E-05	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.76E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	7.04E-02	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 2.55E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

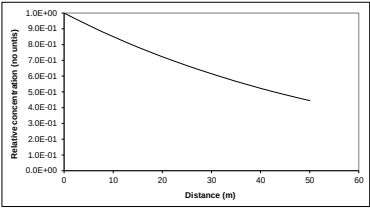
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Indeno(123-cd)perylene		
Target Concentration (C _T)	0.0001	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Indeno(123-cd)perylene
Target concentration	C _T 0.0001 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	2.05E-06	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d		l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}	1.40E-02	fraction	
Organic carbon partition coefficient	K _{oc}	8.71E+04	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment	K _d	1.22E+03	l/kg	Calculated value
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Level 1 Remedial Target

Level 1 Remedial Target	1.22E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.0001	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Indeno(123-cd)perylene
0.0001 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-04 or 1.25E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Indeno(123-cd)perylene		from Level 1
Target Concentration	C _T	0.0001	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance (lateral) to compliance point	5.00E+01	m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.22E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	6.91E+03	fraction
Decay rate used	1.00E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	5.72E-06	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Remedial Targets	Level 3 Remedial Target	2.30E-04	mg/l	For comparison with measured pore water concentration.
	Domenico - Steady state	2.80E-01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
	Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	4.45E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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 f_{oc} fraction

Soil water partition coefficient Kd 1.22E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

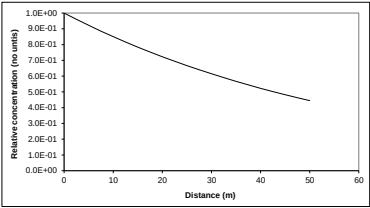
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	5.00E+00	5.00E+00 m
Transverse dispersivity	az	0.00E+00	5.00E-01 m
Vertical dispersivity	ay	0.00E+00	5.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Naphthalene		
Target Concentration (C _T)	0.13	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Naphthalene
Target concentration	0.13 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	6.62E-03	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	1.40E-02	fraction	
Organic carbon partition coefficient	Koc	6.46E+02	l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	9.04E+00	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	1.21E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.13	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Naphthalene
0.13

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.33E-01 or 1.24E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Naphthalene		from Level 1
Target Concentration	C _T	0.13	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+03	days	
Calculated decay rate	6.93E-04	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	9.04E+00	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.22E+01	fraction
Decay rate used	1.33E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	7.57E-04	m/d
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction
Attenuation factor (C ₀ /C _{eq})	2.25E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.99E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.78E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	4.45E-01	fraction	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 1.40E-02 fraction

Organic carbon partition coefficient K_{oc} 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 pK_a fraction

Fraction of organic carbon in aquifer f_{oc} 9.04E+00 l/kg

Soil water partition coefficient Kd

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

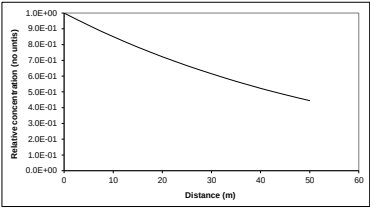
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.00E-01

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	9.60E-01	0.00E+00
5.0	9.22E-01	0.00E+00
7.5	8.86E-01	0.00E+00
10.0	8.50E-01	0.00E+00
12.5	8.17E-01	0.00E+00
15.0	7.84E-01	0.00E+00
17.5	7.53E-01	0.00E+00
20.0	7.23E-01	0.00E+00
22.5	6.94E-01	0.00E+00
25.0	6.67E-01	0.00E+00
27.5	6.40E-01	0.00E+00
30.0	6.15E-01	0.00E+00
32.5	5.90E-01	0.00E+00
35.0	5.67E-01	0.00E+00
37.5	5.45E-01	0.00E+00
40.0	5.23E-01	0.00E+00
42.5	5.02E-01	0.00E+00
45.0	4.82E-01	0.00E+00
47.5	4.63E-01	0.00E+00
50.0	4.45E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	PFOS		
Target Concentration (C _T)	0.036	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	PFOS
Target concentration	0.036 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	0.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.40E+01	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.40E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	5.13E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.036	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

PFOS
0.036

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.68E-02 or 5.25E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		PFOS		from Level 1
Target Concentration	C _T	0.036	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.50E+04	days	
Calculated decay rate	4.63E-05	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.40E+01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	R _f	8.03E+01	fraction
Decay rate used	λ	5.77E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	4.92E-04	m/d
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	9.43E-01	fraction
Attenuation factor (C ₀ /C _{EQ})	AF	1.06E+00	fraction
Calculated soil leachate concentration	C ₀	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.90E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.56E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	9.43E-01	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d 1.40E+01 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,n} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 1.40E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

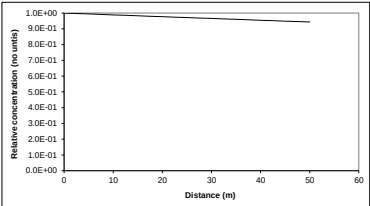
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein	m
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00	m
Vertical dispersivity	ay	0.00E+00	5.00E-01	9.98E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Relative concentration	Concentration
		(No units)	mg/l
0		1.0E+00	0.00E+00
2.5		9.97E-01	0.00E+00
5.0		9.94E-01	0.00E+00
7.5		9.91E-01	0.00E+00
10.0		9.88E-01	0.00E+00
12.5		9.86E-01	0.00E+00
15.0		9.83E-01	0.00E+00
17.5		9.80E-01	0.00E+00
20.0		9.77E-01	0.00E+00
22.5		9.74E-01	0.00E+00
25.0		9.71E-01	0.00E+00
27.5		9.68E-01	0.00E+00
30.0		9.66E-01	0.00E+00
32.5		9.63E-01	0.00E+00
35.0		9.60E-01	0.00E+00
37.5		9.57E-01	0.00E+00
40.0		9.54E-01	0.00E+00
42.5		9.52E-01	0.00E+00
45.0		9.49E-01	0.00E+00
47.5		9.46E-01	0.00E+00
50.0		9.43E-01	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Phenol		
Target Concentration (C _T)	0.0077	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Phenol
Target concentration	0.0077 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	0.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	4.00E-01	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 4.00E-01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	5.11E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0077	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Phenol
0.0077

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.87E-03 or 5.22E-03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Phenol		from Level 1
Target Concentration	C _T	0.0077	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	3.00E+02	days	
Calculated decay rate	2.31E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	4.00E-01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	3.27E+00	fraction
Decay rate used	7.07E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.21E-02	m/d
Ratio of Compliance Point to Source Concentration	9.42E-02	fraction
Attenuation factor (C ₀ /C _{eq})	1.06E+01	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	8.36E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.54E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	9.42E-02	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 4.00E-01 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 4.00E-01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

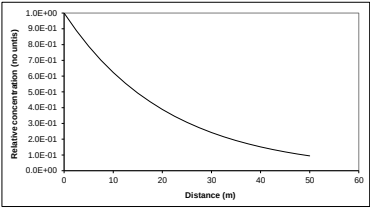
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	5.00E+00	5.00E+00 m
Transverse dispersivity	az	0.00E+00	0.00E+00 m
Vertical dispersivity	ay	0.00E+00	0.00E+00 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	mg/l
	(No units)	
0	1.0E+00	0.00E+00
2.5	8.89E-01	0.00E+00
5.0	7.90E-01	0.00E+00
7.5	7.02E-01	0.00E+00
10.0	6.23E-01	0.00E+00
12.5	5.54E-01	0.00E+00
15.0	4.92E-01	0.00E+00
17.5	4.37E-01	0.00E+00
20.0	3.89E-01	0.00E+00
22.5	3.45E-01	0.00E+00
25.0	3.07E-01	0.00E+00
27.5	2.73E-01	0.00E+00
30.0	2.42E-01	0.00E+00
32.5	2.15E-01	0.00E+00
35.0	1.91E-01	0.00E+00
37.5	1.70E-01	0.00E+00
40.0	1.51E-01	0.00E+00
42.5	1.34E-01	0.00E+00
45.0	1.19E-01	0.00E+00
47.5	1.06E-01	0.00E+00
50.0	9.42E-02	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chloroform		
Target Concentration (C _T)	0.0025	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chloroform
Target concentration	0.0025 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	0.00E+00	dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	7.00E-01	l/kg
----------------------------------	----	----------	------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment	Kd	7.00E-01	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	2.41E-03	mg/kg	(for comparison with soil analyses)
	or		
	0.0025	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chloroform
0.0025

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.56E-03 or 2.46E-03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chloroform		from Level 1
Target Concentration	C _T	0.0025	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	2.00E+02	days	
Half life for degradation of contaminant in water	3.47E-03	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	7.00E-01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	4.97E+00	fraction
Decay rate used	6.98E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	7.96E-03	m/d
Ratio of Compliance Point to Source Concentration	3.71E-02	fraction
Attenuation factor (C ₀ /C _{eq})	2.70E+01	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	6.90E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	6.64E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
50		m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	3.71E-02	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 7.00E-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 7.00E-01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

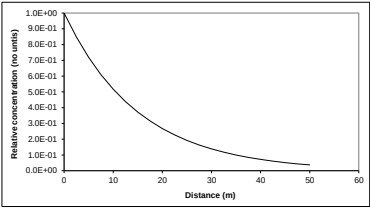
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	5.00E+00	5.00E-01
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Relative

Distance concentration Concentration

0 (No units) mg/l

2.5 1.0E+00 0.00E+00

5.0 8.48E-01 0.00E+00

7.5 7.19E-01 0.00E+00

10.0 6.10E-01 0.00E+00

12.5 5.17E-01 0.00E+00

15.0 4.39E-01 0.00E+00

17.5 3.72E-01 0.00E+00

20.0 3.16E-01 0.00E+00

22.5 2.68E-01 0.00E+00

25.0 2.27E-01 0.00E+00

27.5 1.93E-01 0.00E+00

30.0 1.63E-01 0.00E+00

32.5 1.38E-01 0.00E+00

35.0 1.17E-01 0.00E+00

37.5 9.96E-02 0.00E+00

40.0 8.45E-02 0.00E+00

42.5 7.16E-02 0.00E+00

45.0 6.08E-02 0.00E+00

47.5 5.15E-02 0.00E+00

50.0 4.37E-02 0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Bis(2-ethylhexyl)phthalate		
Target Concentration (C _T)	0.0013	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration
C_T

Bis(2-ethylhexyl)phthalate
0.0013 mg/l

Input Parameters Standard entry

Variable Value Unit Source of parameter value

Water filled soil porosity θ_w 5.00E-01 fraction
Air filled soil porosity θ_a 3.70E-03 fraction
Bulk density of soil zone material ρ 1.90E+00 g/cm³
Henry's Law constant H 0.00E+00 dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d 2.22E+03 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) f_{oc}
Organic carbon partition coefficient K_{oc}

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species K_{oc,n}
Sorption coefficient for ionised species K_{oc,i}
pH value pH
Acid dissociation constant pK_a
Fraction of organic carbon (in soil) f_{oc}

Soil water partition coefficient used in Level Assessment K_d 2.22E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.88E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0013	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Bis(2-ethylhexyl)phthalate
0.0013

from Level 1
from Level 1
mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.33E-03 or 2.95E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Bis(2-ethylhexyl)phthalate		from Level 1
Target Concentration	C _T	0.0013	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	3.00E+02	days	
Calculated decay rate	2.31E-03	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	2.22E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.26E+04	fraction
Decay rate used	1.84E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.15E-06	m/d
Ratio of Compliance Point to Source Concentration	9.42E-02	fraction
Attenuation factor (C ₀ /C _{eq})	1.06E+01	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.41E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	3.13E+01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	50	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	9.42E-02	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 2.22E+03 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient Kd 2.22E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity ax

Transverse dispersivity az

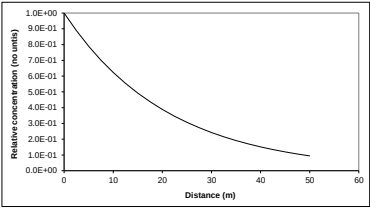
Vertical dispersivity ay

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	mg/l
0	1.0E+00	0.00E+00
2.5	8.89E-01	0.00E+00
5.0	7.90E-01	0.00E+00
7.5	7.02E-01	0.00E+00
10.0	6.23E-01	0.00E+00
12.5	5.54E-01	0.00E+00
15.0	4.92E-01	0.00E+00
17.5	4.37E-01	0.00E+00
20.0	3.89E-01	0.00E+00
22.5	3.45E-01	0.00E+00
25.0	3.07E-01	0.00E+00
27.5	2.73E-01	0.00E+00
30.0	2.42E-01	0.00E+00
32.5	2.15E-01	0.00E+00
35.0	1.91E-01	0.00E+00
37.5	1.70E-01	0.00E+00
40.0	1.51E-01	0.00E+00
42.5	1.34E-01	0.00E+00
45.0	1.19E-01	0.00E+00
47.5	1.06E-01	0.00E+00
50.0	9.42E-02	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: #####
Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Arsenic		
Target Concentration (C _T)	0.01	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Arsenic	
Target concentration	C _T	0.01 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d 5.00E+02 l/kg

--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

--

Organic carbon partition coefficient

K_{oc}

--

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

--

Sorption coefficient for ionised species

K_{oc,i}

--

pH value

pH

--

Acid dissociation constant

pK_a

--

Fraction of organic carbon (in soil)

f_{oc}

--

Soil water partition coefficient used in Level Assessment

K_d 5.00E+02 l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target	5.00E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.01	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Arsenic
0.01

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E-02 or 5.11E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Arsenic		from Level 1
Target Concentration	C _T	0.01	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.00E+02	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.02E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	5.11E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

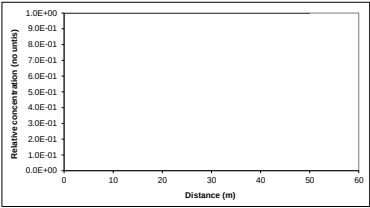
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	5.00E+00	2.98E-01
Vertical dispersivity	ay	0.00E+00	5.00E-01	2.98E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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Details to be completed for each assessment

Site Name:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Boron		
Target Concentration (C _T)	2	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

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Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Boron
Target concentration	2 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+01	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.05E+01	mg/kg	(for comparison with soil analyses)
	or		
	2	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C _T	Boron	from Level 1
	2	from Level 1
	mg/l	

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.04E+00	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.10E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Boron		from Level 1
Target Concentration	C _T	2	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	9.90E+99	days	
Half life for degradation of contaminant in water	t _{1/2}	days	
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	
Effective porosity of aquifer	n	fraction	
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	m	
Distance (depth) to compliance point perpendicular to flow direction	v	m	
Time since pollutant entered groundwater	t	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	l/kg	see options
Longitudinal dispersivity	ax	m	see options
Transverse dispersivity	az	0.500	see options
Vertical dispersivity	ay	0.050	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	3.96E-02 m/d
Retardation factor	Rf	5.77E+01 fraction
Decay rate used	λ	1.21E-102 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00 fraction
Rate of contaminant flow due to retardation	u	6.86E-04 m/d
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00 fraction
Attenuation factor (C ₀ /C _{EQ})	AF	1.00E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	2.04E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.10E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	50	m	
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

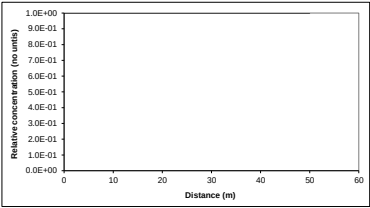
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	5.00E+00	2.98E-01 m
Vertical dispersivity	ay	0.00E+00	5.00E-01	2.98E-01 m
		0.00E+00	5.00E-02	2.98E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



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First released: 2006. Version 3.2: January 2013

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Cadmium		
Target Concentration (C _T)	0.00025	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Cadmium
Target concentration	0.00025 mg/l

Input Parameters Standard entry

Variable	Value	Unit
Water filled soil porosity θ_w	5.00E-01	fraction
Air filled soil porosity θ_a	3.70E-03	fraction
Bulk density of soil zone material ρ	1.90E+00	g/cm ³
Henry's Law constant H	1.00E+00	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+02	l/kg
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment Kd 1.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.51E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.00025	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Cadmium
0.00025

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.56E-04 or 2.56E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Cadmium		from Level 1
Target Concentration	C _T	0.00025	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+02	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.68E+02	fraction
Decay rate used	1.23E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.97E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.56E-04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.56E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

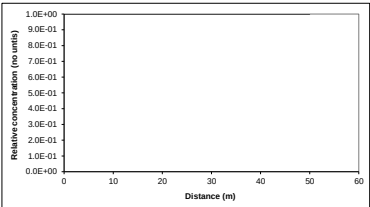
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.00E-01
		0.00E+00	5.00E-02	5.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chromium VI		
Target Concentration (C _T)	0.0034	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

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It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chromium VI
Target concentration	0.0034 mg/l

Input Parameters Standard entry

Variable	Value	Unit	Source of parameter value
Water filled soil porosity θ_w	5.00E-01	fraction	
Air filled soil porosity θ_a	3.70E-03	fraction	
Bulk density of soil zone material ρ	1.90E+00	g/cm ³	
Henry's Law constant H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.80E+01	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.80E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	6.21E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.0034	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chromium VI
0.0034

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.48E-03 or 6.35E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chromium VI		from Level 1
Target Concentration	C _T	0.0034	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.80E+01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	1.03E+02	fraction
Decay rate used	6.80E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	3.84E-04	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C ₅₀)	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.48E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	6.35E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
50		m	
Ratio of Compliance Point to Source Concentration	C ₀ /C ₅₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.80E+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 1.80E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

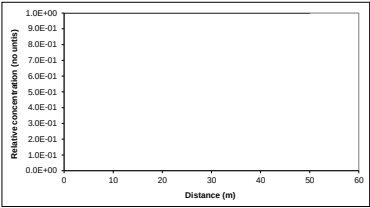
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.00E-01
		0.00E+00	5.00E-02	5.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Chromium		
Target Concentration (C _T)	0.0047	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chromium
Target concentration	0.0047 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction
Air filled soil porosity	θ_a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

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 soil)	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		pH units
Acid dissociation constant	pKa		
Fraction of organic carbon (in soil)	foc		fraction

Soil water partition coefficient used in Level Assessment	Kd	4.80E+03	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	2.26E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.0047	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Chromium
0.0047

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		4.80E-03 or 2.31E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chromium		from Level 1
Target Concentration	C _T	0.0047	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	4.80E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	v	3.96E-02	m/d
Retardation factor	R _f	2.72E+04	fraction
Decay rate used	λ	2.57E-105	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00	fraction
Rate of contaminant flow due to retardation	u	1.45E-06	m/d
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{EQ})	AF	1.00E+00	fraction
Calculated soil leachate concentration	C ₀	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	4.81E-03	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.31E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d 4.80E+03 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 4.80E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

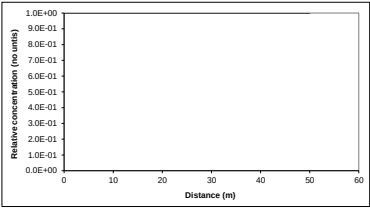
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.00E-01
		0.00E+00	5.00E-02	5.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Copper		
Target Concentration (C _T)	0.02146	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Copper
Target concentration	0.02146 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+02	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.15E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.02146	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Copper
0.02146

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.19E-02 or 2.20E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Copper		from Level 1
Target Concentration	C _T	0.02146	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.00E+02	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.68E+02	fraction
Decay rate used	1.23E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.97E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	2.19E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.20E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	50	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

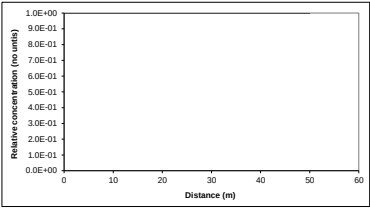
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.00E-01
		0.00E+00	5.00E-02	5.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Iron		
Target Concentration (C _T)	1	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Iron
Target concentration	C _T 1 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction	
Air filled soil porosity	θ _a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	1.60E+03	l/kg	
----------------------------------	----------------	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}		fraction	
Organic carbon partition coefficient	K _{oc}		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment K_d 1.60E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.60E+03	mg/kg	(for comparison with soil analyses)
	or		
	1	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Iron
1 mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.02E+00 or 1.64E+03	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Iron		from Level 1
Target Concentration	C _T	1	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	9.90E+99	days	
Half life for degradation of contaminant in water	t _{1/2}	days	
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	
Effective porosity of aquifer	n	fraction	
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	m	
Distance (depth) to compliance point perpendicular to flow direction	y	m	
Time since pollutant entered groundwater	t	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	l/kg	see options
Longitudinal dispersivity	ax	m	see options
Transverse dispersivity	az	m	see options
Vertical dispersivity	ay	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	3.96E-02 m/d
Retardation factor	Rf	9.07E+03 fraction
Decay rate used	λ	7.72E-105 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00 fraction
Rate of contaminant flow due to retardation	u	4.36E-06 m/d
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00 fraction
Attenuation factor (C ₀ /C _{EQ})	AF	1.00E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	1.02E+00	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.64E+03	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)
User specified value for partition coefficient

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	1.60E+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 _{ow,n}	l/kg
pH value	pH	
Acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction

Soil water partition coefficient Kd 1.60E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

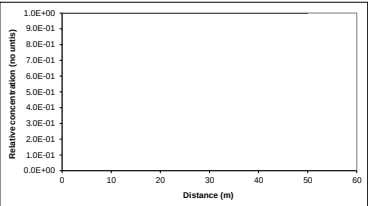
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	5.00E+00	2.98E-01 m
Vertical dispersivity	ay	0.00E+00	5.00E-01	2.98E-01 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.454}; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: #####
Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Lead		
Target Concentration (C _T)	0.014	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Lead
Target concentration	0.014 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+03	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.00E+03 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.40E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.014	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Lead
0.014 mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.43E-02 or 1.43E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Lead		from Level 1
Target Concentration	C _T	0.014	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	9.90E+99	days	
Half life for degradation of contaminant in water	7.00E-101	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.67E+03	fraction
Decay rate used	1.24E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	5.98E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.43E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.43E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
50	m		
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d 1.00E+03 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fraction

Organic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a fraction

Fraction of organic carbon in aquifer f_{oc} fraction

Soil water partition coefficient K_d 1.00E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

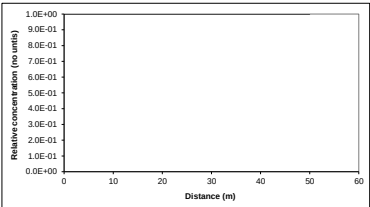
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	5.00E+00	5.00E+00 m
Transverse dispersivity	az	5.00E-01	5.98E-01 m
Vertical dispersivity	ay	5.00E-02	5.98E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Manganese		
Target Concentration (C _T)	0.123	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Manganese
0.123 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.00E+00

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

1.00E+03

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.00E+03

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

1.23E+02

mg/kg

(for comparison with soil analyses)

or

0.123

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Manganese
0.123

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		1.26E-01 or 1.26E+02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Manganese		from Level 1
Target Concentration	C _T	0.123	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	1.00E+03	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	5.67E+03	fraction
Decay rate used	1.24E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	6.98E-06	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	fraction
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.26E-01	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.26E+02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	50	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+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 1.00E+03 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

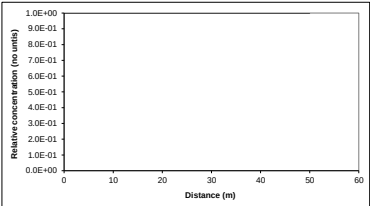
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.98E-01
		0.00E+00	5.00E-02	5.98E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Mercury		
Target Concentration (C _T)	0.00007	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Mercury
Target concentration	C _T 0.00007 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-03	fraction
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	5.00E+02	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}		fraction	
Organic carbon partition coefficient	K _{oc}		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment K_d 5.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	3.50E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.00007	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Mercury
0.00007

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		7.16E-05 or 3.58E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Mercury		from Level 1
Target Concentration	C _T	0.00007	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.00E+02	l/kg	see options
Longitudinal dispersivity	ax	5.000	m	see options
Transverse dispersivity	az	0.500	m	see options
Vertical dispersivity	ay	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	7.16E-05	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	3.58E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
50		m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

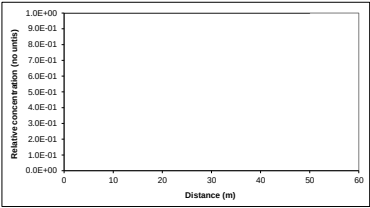
Longitudinal dispersivity	ax	5.00E+00	5.00E+00	5.00E+00	m
Transverse dispersivity	az	0.00E+00	5.00E-01	5.00E-01	m
Vertical dispersivity	ay	0.00E+00	5.00E-02	5.00E-02	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Nickel		
Target Concentration (C _T)	0.034	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Nickel
Target concentration	0.034 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction		This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.
Air filled soil porosity	θ_a	3.70E-03	fraction		
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³		
Henry's Law constant	H	1.00E+00	dimensionless		

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	5.00E+02	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 5.00E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.70E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.034	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Nickel
0.034

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.48E-02 or 1.74E+01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Nickel		from Level 1
Target Concentration	C _T	0.034	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.00E+02	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.83E+03	fraction
Decay rate used	2.47E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.40E-05	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.48E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.74E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	50	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.00E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

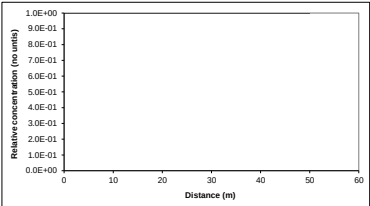
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	5.00E+00	5.00E+00 m
Transverse dispersivity	az	0.00E+00	5.00E-01 m
Vertical dispersivity	ay	0.00E+00	5.00E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Vanadium		
Target Concentration (C _T)	0.02	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 comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Vanadium
Target concentration	0.02 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction	
Air filled soil porosity	θ_a	3.70E-03	fraction	
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³	
Henry's Law constant	H	1.00E+00	dimensionless	

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.26E+01	l/kg	
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 1.26E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.57E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.02	mg/l	(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Vanadium
0.02

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		2.04E-02 or 2.63E-01	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Vanadium		from Level 1
Target Concentration	C _T	0.02	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	9.90E+99	days	
Half life for degradation of contaminant in water	t _{1/2}	days	
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	
Effective porosity of aquifer	n	fraction	
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	m	
Distance (depth) to compliance point perpendicular to flow direction	v	m	
Time since pollutant entered groundwater	t	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	l/kg	see options
Longitudinal dispersivity	ax	m	see options
Transverse dispersivity	az	m	see options
Vertical dispersivity	ay	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	3.96E-02 m/d
Retardation factor	Rf	7.24E+01 fraction
Decay rate used	λ	9.67E-103 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	1.37E+00 fraction
Rate of contaminant flow due to retardation	u	5.46E-04 m/d
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00 fraction
Attenuation factor (C ₀ /C _{EQ})	AF	1.00E+00 fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	2.04E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2.63E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
	50	m	
Ratio of Compliance Point to Source Concentration	C _{EQ} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.26E+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 1.26E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

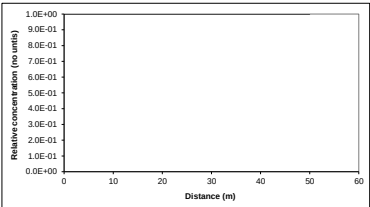
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	5.00E+00
Transverse dispersivity	az	0.00E+00	5.00E-01
Vertical dispersivity	ay	0.00E+00	5.00E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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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:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Zinc		
Target Concentration (C _T)	0.0302	mg/l	Origin of C _T : PNEC

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Zinc
Target concentration	0.0302 mg/l

Input Parameters
Standard entry

Water filled soil porosity	θ_w	5.00E-01	fraction		This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.
Air filled soil porosity	θ_a	3.70E-03	fraction		
Bulk density of soil zone material	ρ	1.90E+00	g/cm ³		
Henry's Law constant	H	1.00E+00	dimensionless		

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	3.80E+01	l/kg	
----------------------------------	----	----------	------	--

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment Kd 3.80E+01 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	1.16E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0302	mg/l	(for comparison with leachate test results)

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	20-Sep-24
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Zinc
0.0302 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		3.09E-02 or 1.18E+00	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Zinc		from Level 1
Target Concentration	C _T	0.0302	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	9.90E+99	days	
Calculated decay rate	7.00E-101	days ⁻¹	calculated
Width of plume in aquifer at source	3.00E+02	m	from Level 2
Plume thickness in aquifer at source	9.80E+00	m	from Level 2
Bulk density of aquifer materials	1.70E+00	g/cm ³	
Effective porosity of aquifer	3.00E-01	fraction	
Hydraulic gradient	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	8.64E-03	m/d	from Level 2
Distance to compliance point	5.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	3.80E+01	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.16E+02	fraction
Decay rate used	3.24E-103	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.83E-04	m/d
Ratio of Compliance Point to Source Concentration	1.00E+00	
Attenuation factor (C ₀ /C _{eq})	1.00E+00	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	3.09E-02	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	1.18E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	50	m	
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	1.00E+00	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 3.80E+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 3.80E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

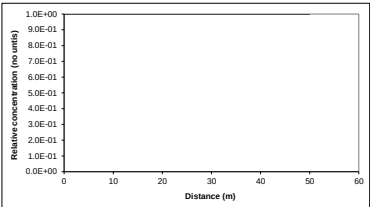
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	5.00E+00	5.00E+00	5.00E+00
Vertical dispersivity	ay	0.00E+00	5.00E-01	5.98E-01
		0.00E+00	5.00E-02	5.98E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	1.00E+00	0.00E+00
5.0	1.00E+00	0.00E+00
7.5	1.00E+00	0.00E+00
10.0	1.00E+00	0.00E+00
12.5	1.00E+00	0.00E+00
15.0	1.00E+00	0.00E+00
17.5	1.00E+00	0.00E+00
20.0	1.00E+00	0.00E+00
22.5	1.00E+00	0.00E+00
25.0	1.00E+00	0.00E+00
27.5	1.00E+00	0.00E+00
30.0	1.00E+00	0.00E+00
32.5	1.00E+00	0.00E+00
35.0	1.00E+00	0.00E+00
37.5	1.00E+00	0.00E+00
40.0	1.00E+00	0.00E+00
42.5	1.00E+00	0.00E+00
45.0	1.00E+00	0.00E+00
47.5	1.00E+00	0.00E+00
50.0	1.00E+00	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: #####

Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment

Site Name:	Former Jacksons Brickworks		
Site Address:	Ten Acres Lane, Newton Heath, Manchester		
Completed by:	M Kelly	Version:	1
Date:	20-Sep-24		
Contaminant	Cyanide		
Target Concentration (C _T)	0.005	mg/l	Origin of C _T : EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Cyanide
0.005 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

Air filled soil porosity

θ_a

3.70E-03

fraction

Bulk density of soil zone material

ρ

1.90E+00

g/cm³

Henry's Law constant

H

1.00E+00

dimensionless

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

5.00E+00

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

5.00E+00

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

2.63E-02

mg/kg

(for comparison with soil analyses)

or

0.005

mg/l

(for comparison with leachate test results)

Site being assessed: Former Jacksons Brickworks

Completed by: M Kelly

Date: 20-Sep-24

Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Cyanide
0.005

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	4.55E-04	m/d	
Area of contaminant source	A	6.25E+05	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	2.50E+02	m	
Saturated aquifer thickness	da	9.80E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	8.64E-03	m/d	
Hydraulic gradient of water table	i	3.00E-02	fraction	
Width of contaminant source perpendicular to groundwater flow	w	3.00E+02	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	9.80E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	1.02E+00		
Level 2 Remedial Target		5.11E-03 or 2.69E-02	mg/l mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
				For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed: Former Jacksons Brickworks
Completed by: M Kelly
Date: 20-Sep-24
Version: 1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Cyanide		from Level 1
Target Concentration	C _T	0.005	mg/l	from Level 1
Dilution Factor	DF	1.02E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	2.40E+01	days	
Half life for degradation of contaminant in water	2.89E-02	days ⁻¹	calculated
Calculated decay rate	3.00E+02	m	from Level 2
Width of plume in aquifer at source	9.80E+00	m	from Level 2
Plume thickness in aquifer at source	1.70E+00	g/cm ³	
Bulk density of aquifer materials	3.00E-01	fraction	
Effective porosity of aquifer	1.37E+00	fraction	from Level 2 (adjusted)
Hydraulic gradient	8.64E-03	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	5.00E+01	m	
Distance to compliance point		m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	5.00E+00	l/kg	see options
Longitudinal dispersivity	5.000	m	see options
Transverse dispersivity	0.500	m	see options
Vertical dispersivity	0.050	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable		
Groundwater flow velocity	3.96E-02	m/d
Retardation factor	2.93E+01	fraction
Decay rate used	9.85E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	1.37E+00	fraction
Rate of contaminant flow due to retardation	1.35E-03	m/d
Ratio of Compliance Point to Source Concentration	3.93E-07	
Attenuation factor (C ₀ /C _{eq})	2.55E+06	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.30E+04	mg/l	For comparison with measured pore water concentration.
Domenico - Steady state	or		This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	6.86E+04	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
50	m		
Ratio of Compliance Point to Source Concentration	C _{eq} /C ₀	3.93E-07	fraction Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 5.00E+00 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 5.00E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

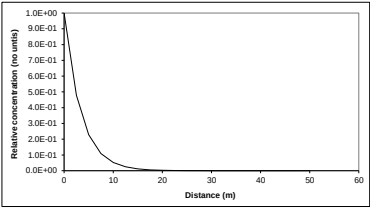
Longitudinal dispersivity	ax	Enter value	Calc value	Xu & Eckstein
Transverse dispersivity	az	0.00E+00	5.00E+00	2.98E-01
Vertical dispersivity	ay	0.00E+00	5.00E-02	2.98E-02

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.434}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Distance	concentration	Concentration
	Relative	
	(No units)	mg/l
0	1.0E+00	0.00E+00
2.5	4.78E-01	0.00E+00
5.0	2.28E-01	0.00E+00
7.5	1.09E-01	0.00E+00
10.0	5.23E-02	0.00E+00
12.5	2.50E-02	0.00E+00
15.0	1.20E-02	0.00E+00
17.5	5.73E-03	0.00E+00
20.0	2.74E-03	0.00E+00
22.5	1.31E-03	0.00E+00
25.0	6.27E-04	0.00E+00
27.5	3.00E-04	0.00E+00
30.0	1.43E-04	0.00E+00
32.5	6.86E-05	0.00E+00
35.0	3.28E-05	0.00E+00
37.5	1.57E-05	0.00E+00
40.0	7.50E-06	0.00E+00
42.5	3.59E-06	0.00E+00
45.0	1.72E-06	0.00E+00
47.5	8.21E-07	0.00E+00
50.0	3.93E-07	0.00E+00

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Former Jacksons Brickworks
Completed by:	M Kelly
Date:	#####
Version:	1

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