



Ashill Regen Ltd

West Hoathly, Ibstock Brickworks

Remediation Method Statement

1922410 R03 (00)

RSK GENERAL NOTES

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

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1 INTRODUCTION

1.1 Introduction

RSK Environment Limited (RSK) was commissioned by Ashill Regen Ltd ('the client') to prepare a Remediation Method Statement (RMS) for the West Hoathly, Hamsey Road, East Grinstead RH19 4PB, hereafter referred to as 'the site'.

1.2 Contaminated land process

It is understood that the site is being considered for residential redevelopment as per the proposed development plans included in **Appendix B**. Should the proposed layouts change then a revision of the remedial strategy would also subsequently be required. This report was commissioned to allow the safe redevelopment of the site and to mitigate any potential long-term environmental impacts associated with past operations at the site.

The assessment and development of "brownfield" sites follows a phased approach to managing the risks associated with land contamination. The following stages are defined in Land Contamination Risk Management (LCRM) published by the Environment Agency in 2020. The report addresses the following:

Remediation Options Appraisal:

The options appraisal also involves a staged approach, which commences with the identification of feasible remediation options for each relevant pollutant linkage. A detailed evaluation is then made of feasible remediation options to identify the most appropriate option for any particular linkage. Finally, a remediation strategy is developed that addresses all relevant pollutant linkages, where appropriate by combining and implementing remediation options into the proposed design.

Implementation of the Remediation Strategy:

There are three main stages in the implementation process: the preparation of the implementation plan; the design, implementation and verification of remediation; and (if required) long-term monitoring and maintenance.

This Remediation Method Statement combines the latter two phases, including a summary of the finding of the risk assessment. The remediation strategy defines the remedial measures required to break the pollutant linkages identified by the risk assessment process and conceptual model for the site, and the procedures to be adopted to enable verification of the correct implementation of those remedial measures.

1.3 Proposed development

The subject site is being considered for redevelopment into residential use. The proposed development consists of a mixture of houses and apartments with associated parking, shared and private soft landscaping/gardens and an open space.

The proposed layout of the site is shown in **Appendix B**.

1.4 Objectives

The objective of this report is to summarise the geo-environmental issues identified in preceding investigation reports and detail the propose remedial works to be undertaken to address residual potentially complete contaminant linkages. In addition, a Verification Plan is included.

1.5 Project background

1.5.1 General

RSK have conducted several phases of ground investigation works on site. The reports pertinent to Site are listed in **Table 1** below. The most recent site investigation report prepared by RSK in October 2022, and updated in January 2024, should be referred to for the most relevant information regarding ground conditions and the contamination status of the soils/groundwater underlying the site.

Table 1 Previously Completed Assessments

Report Title	Author	Date of Issue	Report Reference
Phase 1 and Phase 2 Geo-environmental Factual and Interpretive Report: West Hoathly, Hamsey Road, East Grinstead RH19 4PB	RSK Environment Ltd	October 2022 (Updates - March 2023 and January 2024)	1922410 R01 ((00) – (02))

Section 2 of this report summarises the relevant information extracted from the above reports.

1.6 Scope

This report has been designed with consideration of LCRM, BS 10175: 2011 (BSI, 2011+A2 2017), National Panning Policy Framework and guidance on land contamination reports issued by the Environment Agency (EA) (2010).

The scope of this report includes:

- A summary of the existing reports pertaining to the site;
- Identification of the complete pollutant linkages to be addressed by the remedial works;
- Provision of a remedial options appraisal;
- A summary of the remedial technique(s) to be implemented; and
- Details of the validation and verification works including reporting.

1.7 Definitions – Key Parties and responsibilities.

The following parties have direct interest or involvement in the works described herein.

Landowner / Client	Ashill Regen Ltd
Groundworks Contractor	TBC
Demolition Contractor	TBC
Piling Contractor	TBC
Local Authority	West Sussex County Council
Pollution Control and Waste Regulatory Authority	Environment Agency
Environmental Consultant	RSK Environment Ltd

1.8 Limitations

The Remediation Method Statement is based upon previous investigations designed generally to meet the objectives of a main investigation, as defined by BS 10175:2011 +A2 2017 “Code of Practice for the Investigation of Potentially Contaminated Sites”. The remediation strategy is therefore based on the ground conditions encountered during these investigations, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent a proportion of the materials present on-site, and therefore other conditions may be encountered during the remediation and ground works, which have not been revealed by these investigations.

The Remediation Method Statement contains details of the procedures to be adopted for inspection and validation of the works. However, it should be noted that responsibility for the correct implementation of the strategy lies with the Principal Contractor. RSK cannot be held responsible for any remedial works that are carried out without the agreed procedures involving either direct supervision by RSK, or inspection and verification of the works by a representative from RSK, or if suspect materials are not notified to RSK.

This document has been prepared following initial pre-planning correspondence with the Environmental Health Officer and Environment Agency representatives. The general approaches detailed within the document has been agreed in principal with these parties.

This report is subject to the RSK Environment Limited service constraints given in **Appendix A**.

2 SITE CHARACTERISTICS

2.1 Site description and historical review

2.1.1 General

The Site covers an area of c. 4.61 hectares. The Site is located on the northern edge of the village of Sharpthorne and comprises a former brickworks with expansive areas of hardstanding yard and open storage. A site location plan is provided as **Figure 1** (drawing ref 11101).

The (developable) site is irregular in shape containing multiple buildings previously utilised in the brick-making process. Approximately 80 percent of the site is covered with hardstanding. The south of the site is predominantly covered with tarmac with two car parks associated with the site office building situated in the south-west. Kiln dust lines the floor of the large brick sheds in the north-west consisting of a gravelly sand. The rest of the site is covered by concrete and minor areas of soft landscaping in the north-east.

The site level increases from west to east with a small retaining wall located in the centre of the site running north to south. The site is approximately 110 m AOD west of the retaining wall and 115 m AOD to the east.

A small attenuation pond is also located in the centre of the site and drains off site to the west.

A clay pit can be found in the northeast of the site and is currently filled with ponded water (likely to be seasonal).

The site houses multiple above ground tanks with two propane tanks in the centre and south and an oil tank to the east.

2.1.2 On site historical context

Throughout the site's history it has been utilised as a brick works since at least 1874 and according to anecdotal evidence from the site manager the site was used as brickworks as far back as 300 years ago. The processes involved in the brick-making project such as the use of coke in firing the bricks may have led to on site contamination. Furthermore, on site above ground oil tanks are potential on-site sources of contamination.

2.1.3 Off site historical context

The site vicinity from 1874 comprises woodland and agricultural land until 1896, where residential development occurred up until the present day. The bluebell railway runs along the western boundary and has been present since 1896.

2.1.4 Geology

Published records (British Geological Survey (BGS), 2022) for the area indicates the geology of the site to be characterised by made ground overlying the Wadhurst Clay Formation, which in-turn overly the Ashdown Formation.

2.1.5 Ground Conditions

The exploratory holes revealed that the site is underlain by a variable thickness of made ground over the Wadhurst Clay Formation with the Ashdown Formation encountered underlying the Wadhurst or Made ground directly (where absent).

The ground conditions underlying the site as encountered during the site investigation works, as presented in RSK Report Ref. 1922410 R01 (02), January 2024, are summarised in **Table 2** below and the following subsections.

Table 2 General succession of strata encountered

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl (Elevation m AOD)	Proven thickness (m)
September 2022			
Made Ground	All locations	Ground Level	0.08 to 6.00
Wadhurst Clay Formation	BH01, BH03, BH05, WS10, WS13, WS21, WS24, WS25, WS26, WS28, WS29, WS32, WS33, WS34, WS35, WS36, WS37, WS40, WS42, TP4, TP6, TP9, TP12, TP15, TP16, TP23, TP27, TP38, TP39, TP41	0.08 to 6.00	0.80 m to 1.82 m
Ashdown Formation	BH01 to BH05 WS5, WS10, WS11, WS13, WS14, WS18, WS24, WS25, WS26, WS28, WS29, WS30, WS31, WS32, WS33, WS34, WS37, WS40, WS42 TP3, TP4, TP9, TP12, TP15, TP16, TP17, TP19, TP22, TP23, TP27, TP39, TP41	0.40 to 6.50	Full depth not proven
December 2023			
Made ground	All Locations	Ground level	0.50 to 4.70

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl (Elevation m AOD)	Proven thickness (m)
Wadhurst Clay Formation	WS108	0.60	0.40
Ashdown Beds Formation	WS101 to WS107 and WS109 to WS112	0.50 to 4.70	Full depth not proven

2.1.6 Made ground

Most of the site was overlain by hardstanding material, with bituminous covering the site car park area and the rest of the site overlain by reinforced concrete. The reinforcement within the concrete was predominantly variably spaced steel ~20 mm in diameter. However, in the area of TP16 the reinforcement bars were measured to be 30mm in diameter. The thickness of the concrete varied between 140-480 mm site wide.

Made ground was identified within all exploratory locations during the September 2022 investigation and its thickness was proven between 0.08 m bgl and 6.00 m bgl. The made ground / fill material comprised predominately cobbles of brick and red sandy gravel overlying reworked green, grey and brown gravelly clay. Gravel consisted of brick, siltstone, glass, plastic and clinker. Rootlets were also present in some of the locations.

Kiln "dust" within the on-site sheds consisted of red and orange gravelly sand to a depth of 1.3 to 1.5 m bgl directly overlying the weathered siltstone.

Made ground encountered during the December 2023 investigation was generally consistent with that of the previous phase of investigation and its thickness was proven between 0.50 m bgl and 4.70 m bgl. The made ground materials generally comprised a reddish brown, brown or grey/greyish brown gravelly clay, silty sand or gravel. Gravel consisted of brick, concrete, flint, siltstone, ash, clinker, clear and white coloured glass, ceramic, sandstone, coal and wood. Occasional cobbles of brick and whole bricks were also noted.

2.1.7 Wadhurst Clay Formation

Soils representative of the Wadhurst Clay Formation were encountered during (both phases of) the investigation at exploratory locations BH01, BH03, BH05, WS10, WS13, WS21, WS24, WS25, WS26, WS28, WS29, WS32, WS33, WS34, WS35, WS36, WS37, WS40, WS42, WS108, TP4, TP6, TP9, TP12, TP15, TP16, TP23, TP27, TP38, TP39, TP41 at a depth of 0.08 to 6 m bgl.

The strata comprised predominately grey, brown and orange mottled slightly gravelly silty CLAY with frequent relic rootlets in the top 0.5 m. Gravels encountered ranged from angular to subangular fine to coarse siltstone.

2.1.8 Ashdown Beds Formation

The Ashdown Formation was identified (during both phases of investigation) below the Wadhurst Clay Formation and directly underlying Made Ground in several locations with a top depth of 0.4 m to 6.5 m. The unit generally comprised a heavily weathered siltstone with interbedded fine sandstone. This unit was recovered as silty gravel in the exploratory locations. Cobbled sized siltstone fragments were also recovered from the trial pit locations.

2.1.9 Visual/olfactory evidence of soil contamination

Slight hydrocarbon odours were noted in TP41 and WS32, locations positioned near the above ground oil tank and some minor staining was also identified within TP41. Hydrocarbon odours were also noted within the Made ground of TP39 in the southern area of the site, previously used for storage.

A moderate solvent odour was noted during the December 2023 investigation, within soils immediately around wood (likely to be a treated railway sleeper) within WS110 at 1.70 m bgl. In addition an organic odour was also noted to be present in the made ground within WS102 at 2.90 m bgl. No visual or olfactory evidence of contamination was identified in any of the other exploratory locations.

2.2 Hydrogeology and Hydrology

The site is underlain by a secondary A aquifer relating to the Ashdown Formation and unproductive strata of the Wadhurst Clay Formation.

Groundwater was not encountered during the September 2022 investigation works. However, perched water was identified during the subsequent monitoring visits.

Groundwater was encountered during the December 2023 investigation works at shallow depths ranging between 0.17 m and 3.59 m bgl, however given the variable elevations and the period of heavy rainfall preceding the site works, the water was considered likely to be perched within the made ground.

Resting groundwater levels recorded during the monitoring programme are summarised in **Table 3**.

Table 3 Summary of groundwater monitoring results

Monitoring well	GL elevation (m AOD)	Depth to water min. (mb TOC)	Depth to water max. (mb TOC)	Offset to GL from TOC (m)	Groundwater elevation (m AOD) – min.	Groundwater elevation (m AOD) – max.
BH1	112.17	5.96	6.06	0.2	106.41	106.31
BH2	112.36	4.56	4.62	1.04	108.84	108.78
BH3	112.51	1.92	2.09	0.43	111.02	110.85
BH4	112.46	2.25	2.5	1	111.21	111.96

Monitoring well	GL elevation (m AOD)	Depth to water min. (mb TOC)	Depth to water max. (mb TOC)	Offset to GL from TOC (m)	Groundwater elevation (m AOD) – min.	Groundwater elevation (m AOD) – max.
BH5	110.82	2.09	2.36	0.86	109.59	109.32
WS2	111.25	DRY	DRY	0.79	DRY	DRY
WS5	111.81	1.87	DRY	0.27	110.21	DRY
WS10	112.44	1.4	DRY	0.32	111.36	DRY
WS11	112.32	1.85	1.85	0.4	110.87	110.87
WS14	112.33	1.14	1.2	0.66	111.85	111.79
WS18	112.43	0.85	0.94	0.21	111.79	111.7
WS20	112.17	0.82	DRY	0.66	112.01	DRY
WS24	115.50	1.44	1.44	0.8	114.86	114.86
WS28	113.38	0.77	0.87	0.41	113.02	112.92
WS29	116.34	0.53	0.76	0.29	116.1	115.87
WS34	112.80	0.75	DRY	0	112.05	DRY
WS35	115.13	1.04	1.08	0.3	114.39	114.35
WS40	112.28	0.63	1.05	0	111.65	111.23
WS42	116.68	1.13	1.22	0.72	116.27	116.18

The findings reflect the perched water within made ground which is at an elevation of 106.31-116.27 m AOD.

In terms of aquifer protection, the EA generally adopts a three-fold classification of Source Protection Zones (SPZ) for public supply abstraction wells. The site does not lie within a currently designated groundwater Source Protection Zone (SPZ). There is a lagoon and drainage pond present on site and the nearest groundwater abstraction is located 237m north of the site and is understood to be operated for general farming and domestic uses.

2.3 Contamination Status

2.3.1 Human health

The human health generic quantitative risk assessment (GQRA) assessment, included in the RSK report ref. 1922410 R01 (02) confirmed exceedances within soils for a residential end use scenario as summarised in **Table 4**.

Table 4 Data summary table

Determinand	No. of samples tested	GAC (mg/kg)	No of exceedances	Maximum concentration (mg/kg)	
				Value	Location / depth (m bgl)
September 2022					
Lead	23	200	2	300	BH5 / 2 m
December 2023					
Arsenic	12	37	1	38	WS112 / 0.55 m
Lead	12	200	2	1240	WS112 / 0.55 m

Detectable concentrations of asbestos were encountered during the December 2023 phase of investigation, through areas of general Made Ground. The results confirmed the presence of Chrysotile, as shown below.

Table 5 Data summary table – asbestos in made ground

Sample location (depth m bgl)	Laboratory Screening Result	Quantification (%)
WS101 (0.60m)	Chrysotile – Loose fibres	<0.001

The assessment considered that there were potential risks associated with arsenic, lead and asbestos locally within Made Ground and, as such, either additional risk assessment or remediation would be required.

2.3.2 Potable Water Supply Pipes

Soil samples collected from made ground at the site indicate that a relevant linkage may exist locally, with organic contaminants having the potential to degrade PE water supply pipes. Polyvinyl chloride (PVC) pipes may therefore be best suited to the site.

2.3.3 Plant phytotoxicity

The chemical testing results for made ground indicate that a relevant contaminant linkage may exist associated with phytotoxic effects, if made ground soils are in direct contact with proposed vegetation at the site.

2.3.4 Ground Gas

The potential sources of ground gas identified at the preliminary risk assessment stage included made ground soils (relating to site development and infilled pits) and from on site and of site sources with low degradable organic content.

The ground gas risk assessment comprised 3No monitoring visits, including low pressure events.

The characteristic gas situation, based on the initial calculated gas screening value for the entire site, was classified as Characteristic Situation 1 (CS1) where no formal gas protection measures are considered necessary.

Notwithstanding the above, although gas precautions are not considered to be required throughout the site, due to the presence of trace gases identified during gas monitoring, (albeit in localised locations i.e. WS42 adjacent to above ground tank), further assessment of the source/constituents was recommended prior to development once remediation/demolition has been completed.

2.3.5 Controlled Waters

The assessment concluded that the sites does not appear to pose a risk to controlled waters and therefore further detailed assessment is not considered to be required at the present time.

Notwithstanding the above, the assessment also noted that if unforeseen contamination is identified to redevelopment, the risks to controlled waters may require reassessment and a foundation works risk assessment may be required.

2.4 Complete Contaminant Linkages

Based upon the results of the preceding RSK site investigation and subsequent generic quantitative risk assessment (GQRA), the identified potentially complete contaminant linkages include:

- Risks to future site occupants (via direct contact and ingestion pathways) from the presence of elevated concentrations of contaminants (specifically heavy metals and asbestos) within areas of proposed soft landscaping;
- Risks to groundworkers during construction (via inhalation pathways) and adjacent site users from the presence of asbestos (loose fibres) encountered within general made ground;
- Risks to plants and vegetation from elevated heavy metals within made ground for future areas of proposed soft landscaping; and
- Risk to potable water supply pipes from organic contaminants permeating potable water supply pipes.

Measures set out within RSK's Remediation Method Statement (this report) have been selected to appropriately address linkages listed above.

2.5 Site Investigation Uncertainties

Following completion of the most recent phase of site investigation (report 1922410 R01 (02), Janaury 2023), the following data gaps were noted with regards to ground conditions at the site:

Table 6 Data gaps and uncertainties

Data gap/ uncertainty	Details	Implications
September 2022		
Some site buildings were not accessible for the investigation.	Potential for unforeseen contamination to be present	There is a gap in coverage for soil for these areas.
Asbestos not widely found in made ground samples tested	Although not encountered widely to date, given the age the buildings on site, asbestos containing material (ACM) could still be present in other locations	Vigilance should be maintained for any potential ACM or fibrous material during below ground works

The data gap related to the inaccessibility of buildings during the September 2022 investigation has been partially resolved following the December 2023 investigation and it is considered that the soils beneath the majority of the buildings have been investigated. The soils beneath a small number of buildings remain inaccessible due to very low ceilings or the presence of kiln infrastructure. A watching brief should be maintained during below ground works demolition for any signs of previously unidentified contamination and if identified treated in line with a discovery strategy.

Asbestos was encountered within one sample during the December 2023 investigation and therefore the implication remains of vigilance being maintained during below ground demolition works.

3 REMEDIATION STRATEGY

3.1 Introduction

This Remediation Strategy is intended to fulfil the requirements of contaminated land process outlined within LCRM, in relation to options appraisal and remediation strategy for the site remediation, enabling works and construction phase.

3.2 Options appraisal

An appraisal of the remedial options available to achieve the above objectives has been conducted, taking into consideration technical and economic viability and the need to adopt a sustainable approach to the remediation.

During the proposed redevelopment, there may be a surplus of materials on site as a result of levelling exercises. Based upon the chemical analysis it should be possible to retain and re-use these materials on site.

3.3 Remedial objectives

The remedial strategy has been designed to break or remove the potential pollutant linkages identified (Section 2.4). The aim of the remediation works is to provide a site that is suitable for its subsequent redevelopment and does not pose a risk to future site users, controlled waters or the surrounding environment.

The main objectives of the remediation are as follows:

Enabling phase (Section 3.4)

- Adoption of safe working procedures with respect to asbestos and removal of identified asbestos containing materials (Section 3.4.2);
- Site clearance, removal of hardstanding and sealing redundant services (Section 3.4.3);
- Decommissioning, cleaning and/or removal of remaining above/below ground infrastructure such as tanks and interceptors, followed by inspection / validation of remaining soils by an Environmental Engineer. (See Section 3.4.8 and 3.4.9);
- Monitoring well decommissioning to ensure existing wells do not create preferential pathways for contaminant migration (Section 3.4.7);
- Discovery Strategy: Procedures to be followed in the event that unexpected contamination is identified (See Section 3.6).

Construction phase (Section 3.5)

- Installation of appropriate potable water supply pipes (Section 3.5.2); and
- Placement of clean cover soils within areas of soft landscaping/gardens (Section 3.5.3);

3.4 Enabling phase

3.4.1 Site security

Prior to the main works the application site will be required to have security measures in place, to prevent unauthorised access by members of the public.

3.4.2 Asbestos Survey

Prior to demolition of the existing structures, an asbestos clearance survey will be undertaken to confirm the presence or absence of asbestos containing materials within all structures present on site.

Where asbestos containing materials are encountered, removal works should be undertaken by an appropriately licensed contractor such that all identified asbestos containing materials are safely removed off-site to a suitably licensed facility in advance of demolition works commencing.

Copies of the relevant survey and clearance documents, including disposal records and air monitoring/clearance results should be made available for inclusions within the site verification report.

3.4.3 Site clearance, removal of hardstanding and sealing redundant services.

Prior to any remedial works being undertaken, where applicable the site should be cleared of any buildings and below ground obstructions.

During the subsequent site clearance works, any redundant services encountered on site should be sealed with impermeable clay (i.e. a bentonite plug or similar) to prevent them acting as a conduit for the migration of mobile contamination.

It is recommended that hardstanding overlying any known areas of gross contamination should remain in place until remediation excavations can be undertaken in conjunction with this activity to limit any additional leaching caused by potential additional infiltration to the underlying aquifer.

3.4.4 Silt Management

In order to assess and mitigate the potential issues associated with silt run-off from the site during enabling and construction, it is recommended that a silt management plan is in place to prevent any unacceptable environmental issues during the enabling and construction phases.

The Silt management plan should include the following:

- Site description;
- Identification of receptors at risk;
- Proposed protection measures within active development areas, during both the initial enabling works and subsequent construction phase;
- Proposed protection measures within non-active development areas, during both the initial enabling works and subsequent construction phase; and

- Recommendations for monitoring procedures and record keeping.

3.4.5 Air Quality and Odour Monitoring

Prior to any groundworks on site, monitoring should be undertaken to provide baseline data for air quality and dust. Prior to enabling works commencing on site, an Air Quality Management Plan (AQMP) inclusive of dust and fugitive emissions should be compiled by the contractor and provided to the local authority for review. Where permissible the contractor should seek to agree methods, locations, reporting arrangement and assessment criteria prior to works commencing.

The requirement for completion of an AQMP is stated within this document however RSK recommend that a suitably qualified consultant should be employed by the contractor to fulfil this element of work prior to the enabling phase. The AQMP should be completed in accordance with best practice guidance such as the Institute of Air Quality Management Guidance.

In addition to the AQMP, it is recommended that an odour management plan (OMP) is produced by the contractor and agreed with the Local Authority prior to the commencement of works. The excavation of any gross contamination on site provides a potential emission source for odours to get into the atmosphere and migrate off-site to receptors where an annoyance / nuisance may be reported by residents or other off-site users. The odour management plan should include and consider.

- Description of baseline odour conditions;
- Location of receptors;
- Odour sources on site;
- Description of control / mitigation measures;
- Reporting requirements; and
- Communication methods should odour nuisance be realised.

3.4.6 Adoption of safe working procedures with respect to asbestos

Loose asbestos fibres were generally encountered at shallow depths within general Made Ground deposits, the % concentration has been identified to be low. Given the proposed plans for redevelopment of the site comprising mainly buildings and hardstanding it is considered that the end-use breaks the pollutant linkage for future users of the site. In the proposed areas of soft landscaping / gardens, the use of a cover layer will break the linkage. However, a potential linkage is considered to exist during the ground works and demolition associated with the possible inhalation of asbestos fibres liberated from disturbed soils. Receptors are considered to be present comprising groundworkers and occupants of the wider site area/immediate surroundings.

Based on the Joint Industry Working Group (JWIG) decision tool for the categorisation of working activities, works in areas that will involve the disturbance of potentially asbestos impacted soils are currently considered to constitute as non-licensed works in line with the Care of Asbestos Regulations 2012 and associated CAR-Soil guidance.

Should any excavation work encounter more onerous conditions (such as the presence of potentially notifiable asbestos containing materials), then this classification may need to be revisited as the works progress. Furthermore, the continuation of works may require the use of licensed asbestos contactors to handle the materials. In this instance the HSE would need to be notified of the works via the submission of an ASB5 notification.

Based upon a non-licensed classification, these works may be undertaken by operatives deemed competent and suitably experienced under appropriate method statements.

Notwithstanding the above, during targeted excavation works (and subsequent placement of the associated soil arisings where they are deemed suitable for re-use) in areas where asbestos has been identified, the appointed groundworkers' method statements should set out all relevant control measures to be implemented and include the damping down of soils, air monitoring (both personal and boundary) and use of appropriate personal protective equipment (PPE) and respiratory protective equipment (RPE) along with the availability of appropriate decontamination facilities. Consideration should be made to the provision of a watching brief by a suitably qualified asbestos engineer.

Works to these areas of the site should be conducted as a stand along phase of works with dedicated plant in order to prevent cross-contamination issues with the specific work areas secured as necessary to control access and egress.

Groundworkers should be made aware of the potential presence of asbestos within the soils and the risks should be incorporated into the appropriate working method statements prepared by the principal contractor.

3.4.7 Monitoring well decommissioning

Monitoring wells should be decommissioned / grouted up in line with EA best practice to ensure they do not create preferential pathways for contaminant migration.

The following monitoring wells are currently present on site from the previous site investigations:

RSK Monitoring Wells

- BH1, BH2, BH3, BH3, BH5, WS2, WS5, WS10, WS11, WS14, WS18, WS20, WS24, WS28, WS29, WS34, WS35, WS40, WS42, WS102 and WS110.

The location of the monitoring wells are shown on **Figure 2**.

3.4.8 Empty/make safe and removal of remaining onsite above-ground infrastructure

Live services to remaining infrastructure will need to be isolated/disconnected before removal.

The above ground higher risk features remaining at the application site (such as above ground fuel storage tanks, electric substations, kilns etc) and their associated pipe work, should be removed by a suitably qualified contractor, under the 'watching brief' of an environmental consultant and disposed off-site.

Whilst gross contamination has not been identified, validation of the soils underlying these features, in relation to potential contamination, should be completed at the discretion of the Environmental Consultant. Validation of the underlying soils is likely to include some or all of the following:

- Logging of the underlying materials to BS5930 (2015);
- In-situ screening by a photo-ionisation device; and
- laboratory analysis of representative soils validation samples (determinants specific to contaminant/area of concern) within the immediate footprint of the tank/feature to verify the absence of contamination from underlying soils.

All soils should comply with validation criteria given in **Section 4**. Although not anticipated in the event that significant impacts are observed during the validation works described above, additional investigation/assessment and/or remediation (potentially including localised removal of impacted soils, the installation of additional groundwater monitoring wells and/or trial pit delineation works) may be required, with repeat validation testing to verify full removal of any identified areas of contamination. In addition, detailed risk assessment may be required to generate site specific validation up criteria.

Any additional remedial requirements would need to be discussed and agreed with the Local Authority/EA/NHBC (where applicable).

Any soils excavated as part of these works should be removed off-site unless ex-situ remediation is considered viable to render contaminated soils suitable for re-use within the site. Where the excavated soils are temporarily held on site awaiting removal, treatment and/or waste classification testing, they should be stored on a bunded plastic membrane or similar and covered over to prevent the leaching of contamination during periods of wet weather.

Any remaining drains or service ducts associated with these features, which have the potential to provide a pathway for contaminant migration, should be removed or sealed.

Copies of the Environmental Consultants site records, subsequent laboratory validation test results, disposal records and comparison of validation samples to the applicable generic (or site specific if latterly required) assessment criteria (GAC) shall be made available for inclusion within a verification report to be submitted to the Local Authority following completion of the remedial works for sign-off.

3.4.9 Empty/make safe and removal of remaining onsite below-ground infrastructure

Live services to remaining infrastructure will need to be isolated/disconnected before removal.

The below-ground higher risk features remaining at the site (including drains and interceptors) and their associated pipe work, should be removed by a suitably qualified contractor, under the watching brief of the environmental consultant and disposed off-site and disposed off-site.

Whilst gross contamination has not been identified, validation of the soils underlying these features, in relation to potential contamination, should be completed at the discretion of

the Environmental Consultant. Validation of the underlying soils is likely to include some or all of the following:

- Logging of the underlying materials to BS5930 (2015);
- In-situ screening by a photo-ionisation device; and
- laboratory analysis of representative soils validation samples (determinants specific to contaminant/area of concern) from the side and base of excavation in the immediate footprint of the feature to verify the absence of contamination from underlying soils.

All soils should comply with validation criteria given in **Section 4**. Although not anticipated in the event that significant impacts are observed during the validation works described above, additional investigation/assessment and/or remediation (potentially including localised removal of impacted soils, the installation of additional groundwater monitoring wells and/or trial pit delineation works) may be required, with repeat validation testing to verify full removal of any identified areas of contamination. In addition, detailed risk assessment maybe required to generate site specific validation up criteria.

Any additional remedial requirements would need to be discussed and agreed with the Local Authority/EA/NHBC (where applicable).

Any soils excavated as part of these works should be removed off-site unless ex-situ remediation is considered viable to render contaminated soils suitable for re-use within the site. Where the excavated soils are temporarily held on site awaiting removal, treatment and/or waste classification testing, they should be stored on a bunded plastic membrane or similar and covered over to prevent the leaching of contamination during periods of wet weather.

Copies of the Environmental Consultants site records, subsequent laboratory validation test results, disposal records and comparison of validation samples to the applicable generic (or site specific if latterly required) assessment criteria (GAC) shall be made available for inclusion within a verification report to be submitted to the Local Authority following completion of the remedial works for sign-off.

3.4.10 Licensing

All hauliers transporting waste soils from site will hold a Waste Carriers Licence. All facilities receiving waste soils from the site will either be licensed to accept the waste that they receive or hold an exemption that allows the waste to be received without a licence.

All vehicles transporting hazardous waste soils from site will be issued with a Consignment Note.

All waste transfer notes and consignment notes must be signed prior to the vehicle leaving site.

3.5 Construction phase

The principal objectives of the remedial strategy for the construction phase are to break pathways via which end users of the site may be exposed to contaminants within the shallow ground conditions identified on site.

3.5.1 Foundations and service trenches

Underground services placed on the site should be laid within trenches. Clean granular fill should be used as a bedding material for all services and as backfill material for all service trenches.

During excavation works to place services and/or foundations or other infrastructure, any excavated materials intended to be re-used on site will be segregated and stockpiled for inspection and testing where applicable.

Due to piling/vibro being the most likely/appropriate form of foundation, a foundation works risk assessment may need to be submitted to the Environment Agency for approval due to the nature of site, prior to the construction phase.

During the construction of foundations consideration will need to be given to the potential presence of asbestos fibres and asbestos containing materials (ACM). The contractor's method statement will need to adequately demonstrate compliance with CAR 2012, for example by damping down of soil during the disturbance and subsequent removal of the made ground. In all areas, foundation and service trench works should be undertaken by personnel trained in the identification of ACM and any identifications reported in accordance with the discovery strategy detailed in **Figure 3**.

The identification and removal of any ACM will need to be documented and detailed in the final verification report.

3.5.2 Installation of potable water supply pipes

An initial assessment of potable water supply pipes was undertaken based upon criteria reproduced from UKWIR Report 10/WC/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites UKWIR, 2010).

Soil samples collected from the site indicate that a relevant linkage may exist locally, with organic contaminants having the potential to degrade PE water supply pipes. Polyvinyl chloride (PVC) pipes may therefore be best suited to the site.

Confirmation of the specification for water supply pipes will ultimately need to be obtained from the water authority to confirm suitability for use.

3.5.3 Placement of clean cover soils – areas of soft landscaping/private garden areas

Given the identified presence of soil bound contamination within general made ground, it will be necessary to place a clean cover soil horizon within areas of proposed soft landscaping/garden areas, to break the identified pollutant linkages relating to end users of the site.

At this stage, it is considered that the replacement of made ground soils with chemically suitable soils will be required within areas of soft landscaping/private gardens.

As a minimum, this should comprise the placement of 600 mm within all private gardens with a 450 mm layer placed through areas of communal soft landscaping.

A minimum of 150 mm certified clean topsoil should be included, which may be required to a greater depth (at the discretion of the landscape architect) where planting beds or shrubs / tree pits dictate. To mark the presence of potentially contamination soils (beneath) and to prevent the future mixing of soils, a high visibility permeable geo-membrane marker layer should be placed at the base of the clean cover soils.

Notwithstanding the above, should natural basal soils be encountered at a shallower depth than the intended cover soils (i.e. by reduction of levels etc), then subject to verification (by the environmental consultant), the existing basal formation soils may be considered suitable as a subsoil (i.e. without the requirement for a formal cover system), whereby a minimum thickness (150 mm) of placed topsoil is the only requirement.

Made ground excavation during the construction of the clean cover horizon should be removed off-site to a suitably licensed or exempt facility.

Where formation level soils are overly compacted as a result of the passage of construction traffic, this will need to be suitably rectified prior to the placement of soils.

Outside of garden and soft landscaped areas (i.e. beneath proposed buildings and roads) a plausible pathway (for human health) is unlikely to be present and therefore no specific remedial actions are considered necessary.

3.5.3.1 Site won subsoil/formation/topsoil intended for cover system

Validation testing must be undertaken for any site generated natural soils intended for use within garden / landscaping cover soils to ensure their suitability. Testing should be at a frequency of one sample for every 50 m³ (i.e. 1 in 3 plot basis) of material unless otherwise agreed. A minimum of three samples is required from each material type.

3.5.3.2 Imported subsoil/topsoil intended for cover system

Whilst there is a potential for re-use of site derived natural soils if validated clean, it is considered that the majority of soils will be imported for the cover system. All imported material should be from a known source, preferably 'Greenfield' or from a reputable source, with haulage certification provided to confirm collection and delivery addresses.

Before importing to site, the materials should be provided with a current certificate of analyses with concentrations of determinants that comply with the applicable RSK generic assessment criteria (GAC) (as outlined in Section 4 and contained in **Appendix C**). This should be confirmed by the Environmental Consultant, who will then confirm suitability.

3.5.4 Gas/vapour protection measures

Monitoring results to date would characterise the site as being Characteristic Situation CS1/Green for low-rise apartments and traditional low-rise houses. On this basis, ground gas protection measures are not considered necessary. Notwithstanding this passive sub-floor ventilation is recommended.

Notwithstanding the above, although gas precautions are not considered to be required throughout the site, due to the presence of trace gases identified during gas monitoring, (albeit in localised locations i.e. WS42 adjacent to above ground tank), following validation

and/or further assessment protection measures may be required locally. Any requirements should be confirmed prior to development.

In areas of proposed roads, parking or soft landscaped areas, it is considered that gas protective measures will not be required (i.e. no gas resistant membrane).

3.5.5 Materials Tracking

If material is anticipated to be re-used, subject to confirmation of suitability, as part of the development by the main contractor, a material management plan (MMP) will need to be prepared and implemented in accordance with the Definition of Waste: Development of Waste: Development Industry Code of Practice (CL:AIRE, Version 2, March 2011).

The MMP will enable the re-use of surplus suitable arisings generated during construction to be stockpiled and re-used elsewhere on the development.

The MMP will include a robust system for tracking the movement of materials from the point of excavation to the point of re-use, including the locations of temporary stockpiles.

If re-use is not feasible, and dependent on the results of characterisation and waste classification testing, the soils will be disposed of off-site to either a licensed soil treatment facility or licensed landfill.

3.5.6 Site-derived Soils for re-use onsite

Where site derived fill materials are intended for re-use (i.e. site regrade or backfilling excavations), materials should be inspected and be subjected to classification testing for the following suite of determinants at a frequency of at least one sample for every 250 m³ or three per stockpile to assess the soils chemical suitability for use on site:

- Metals: arsenic, cadmium, total chromium and chromium VI, copper, nickel, lead, mercury, selenium and zinc and pH;
- Speciated total petroleum hydrocarbons - split into aliphatic and aromatic carbon bands (TPH CWG) with benzene, toluene, ethyl benzene, and xylenes (BTEX) compounds;
- Speciated 16 No. polycyclic aromatic hydrocarbons (PAH);
- Asbestos in soil (with identification and quantification where applicable).
- pH; and
- Total organic carbon.

Recycled aggregates (i.e. provided by demolition contractor) without sufficient recent chemical analysis including the full suite of contaminants listed above, should be sampled and tested.

All soils to be re-used on site should initially comply with validation criteria given in **Section 4** unless agreed otherwise.

Where soils are to be stored on site, works should be undertaken in line with the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.

It is recommended that (where applicable) the re-used site-won soils are controlled through the implementation of a CL:AIRE Definition of Waste: Code of Practice Materials

Management Plan that can show compliance with the four factors set out therein. The plan would have to show that soils are suitable for their intended use in the volumes required, and that they would not pose a risk to either human health or the wider environment.

3.6 Discovery Strategy and Materials of a suspect nature

It is possible that groundworks will encounter different conditions from those revealed by the previous ground investigations that may require special treatment or other alleviation measures.

Where unexpected contamination or potentially suspect materials are encountered, the contractor shall immediately inform the Environmental Consultant, who shall then carry out an inspection as soon as is reasonably practical. During or immediately following the inspection, the Environmental Consultant shall consult the Environmental Health Officer at the Local Authority with any modifications to the remedial strategy for approval and advise the Principal Contractor accordingly.

A discovery strategy is outlined below, which sets out in principle the proposed methods for identifying and managing risks in the event potential contamination is uncovered during development.

A record of unforeseen ground conditions must be included in the final verification report along with details of remedial works undertaken.

3.6.1 Identification of potential contaminated material

All operatives and ground workers should remain vigilant for unforeseen or suspicious ground conditions. Initial identification will be based on visual and or olfactory assessment. General indicators of possible contamination could be arising that quickly change appearance or appear inconsistent with the general soil profile outlined within the RSK previous report. Potential unexpected contamination and/or suspicious ground conditions may include the following examples (although this is not an exclusive list):

- Hydrocarbons in the form of oily (or free phase) pockets;
- Strong odours or/and discolouration associated with the underlying soils itself;
- Cement bound debris or other 'bulk' materials suspected of containing asbestos; and
- Fibrous materials.

3.6.2 Managing Suspicious Ground Conditions

On the discovery of the suspicious material/unexpected contamination during excavation works, the following sequence should be adopted:

- Contractor should assess the requirement for any additional health and safety or environmental management control measures;
- Contractor's suitably experienced person should take note of the nature and extent of 'contamination' (including recording the location, type and quantity of suspected

contamination) and immediately inform the Environmental Consultant and the Local Authority;

- Working area will be cordoned off/quarantined and works will cease in the vicinity;
- Environmental Consultant will attend site to undertake sampling regime with subsequent laboratory testing as deemed necessary;
- Findings will be discussed with the Local Authority along with the provision of the test records;
- Remedial action, if necessary, and programming of the works are to be agreed with the Environmental Quality Officer (and where necessary the Planning Officer);
- Contractor is to be informed of the remedial action required;
- Contractor is to prepare an amended Method Statement that details how the agreed remedial action will be carried out; and
- Amended method Statement to be agreed by Environmental Consultant and Environmental Quality Officer (and where necessary the Planning Officer).

Evidence of work carried out is to be collated for inclusion in the site verification report

4 VALIDATION

4.1 Validation assessment criteria (VAC) – Human Health

As part of the remediation/validation, it will be necessary to confirm that re-used or imported materials (primarily topsoil/subsoil for garden/landscaped cover system) are suitable for the proposed end-use.

To assess human health risks via soil ingestion, dermal contact and inhalation, results of validation sampling will be compared against the appropriate RSK derived Generic Assessment Criteria (GAC) as presented in **Appendix C**. The GAC have been derived to be protective of human health for a residential scenario with private gardens (with homegrown produce) and communal landscaping (without homegrown produce) and therefore are suitable for this validation exercise.

In addition, where deeper tree/shrub pits are dug, the phytotoxic Generic Assessment Criteria (GAC) should be used as a supplement to the GAC's outlined above. as **Appendix D**.

Should previously unidentified areas of significant contamination be identified during redevelopment then further risk assessment may/should be undertaken specific to the source identified (i.e. to produce site-specific VAC).

4.1.1 Validation of Cover System

The cover system thickness should be validated by digging trial pits in soft landscaped areas to the required depths (on a 1 in 4 plot basis or a minimum of 3 locations in landscaped areas). Photographs showing the measurement of the soil thickness within each inspection pit should then be taken and the composition of the clean cover noted.

In addition to the above, in-situ chemical testing of the materials placed as part of the cover system (both top soil and sub soils) must be carried out irrespective of the source to assess the soils chemical suitability as described within the respective British Standards for subsoil and topsoil (BS8601:2013 and BS3882:2007 respectively). The in-situ sampling and testing must be carried out at a frequency of:

- All topsoil/subsoil should be tested in private garden areas on a one in four plot basis (or a minimum of 1 in 50 m³); and
- Public open spaces and communal gardens will be subject to a minimum of three tests per source location and one test per 250 m³ thereafter.

The analytical suite should include:

- Metals: arsenic, cadmium, total chromium and chromium VI, copper, nickel, lead, mercury, selenium and zinc and pH;
- Speciated total petroleum hydrocarbons (TPH CWG) (split into aliphatic and aromatic carbon bands) with benzene, toluene, ethylbenzene and xylenes (BTEX);
- Speciated 16 No. polycyclic aromatic hydrocarbons (PAH); and
- Asbestos in soil (with identification and quantification where applicable).

- pH; and
- Total organic carbon.

Concentrations of determinants should comply with the applicable RSK GAC (as outlined in **Section 4.1**).

4.2 Validation of soil movements

To enable the re-use of soil (see Section 3.5.6), a verification plan will be required that demonstrates where soil was excavated from, any treatment undertaken and where it was re-used on site or where it was disposed to. This verification plan is required as part of the Materials Management Plan process to facilitate material re-use in line with the CL: AIRE Code of Practice.

4.3 Inspection and testing

Responsibility for the correct implementation of the remedial strategy lies with the Principal Contractor. However, the remedial works shall be monitored, inspected and validated by the Environmental Consultant's experienced Geo-environmental Engineers with part time attendance on-site dependent on the operations being undertaken.

During periods of part time supervision, it will be the Principal Contractors responsibility to provide adequate notice (at least three days) of any key activities that will require the attendance of the Environmental Consultant.

Validation testing shall be conducted as specified in the relevant sections. Laboratory analysis shall be carried out at an MCERTS and UKAS-accredited laboratory.

4.4 Validation statement/report

A validation report should be produced on completion of the site remedial works by the environmental consultant and should be issued to the relevant authorities for comment. This document should include the following sections:

- Extent of the works that have actually been carried out, with reference to method statements and detailed designs and results of all monitoring and testing carried out;
- Description of the inspection regime (who carried out the inspections, level competence, over what period, frequency and supported by progress record (i.e., pro-forma and monitoring);
- Supporting information in a series of appendices such as photographic records, as-built drawings, plans, contractors records, specifications, method statements, details of waste movements including waste transfer notes, test certificates of imported materials and test results; and
- Details of all communications held with regulatory bodies during implementations.

The Verification Report should be provided to the regulatory authorities for their approval such that planning conditions can be discharged.

4.5 Regulatory approval

This report will need to be forwarded to the Local Authority, and if applicable the Environment Agency and NHBC before commencement of works.

5 WORKING PRACTICE

5.1 Securing the site against unauthorised access

Suitable fencing shall be erected around the site and shall be maintained to prevent members of the public and any other unauthorised personnel from entering the site. On the site, individual remedial excavations shall also be fenced off when being left unattended.

5.2 Health and safety of site personnel

It is the responsibility of the PC and any appointed sub-contractors to enforce an appropriate health and safety regime for all site personnel. Full details regarding the proposed working practices in connection with the remediation works shall be agreed in advance of the commencement of the works with the Planning Supervisor and, if appropriate, with the Environmental Health Officer.

Measures will be necessary to protect the health and safety of site workers during the site works. The following measures are suggested to provide a minimum level of protection. All ground workers on-site should be issued with protective clothing, dust masks, footwear and gloves. These should not be removed from site, and advice should be given on when and how they are to be used.

Great care should be taken to minimise the amount of dust and mud generated on-site, especially given the requirement to excavate and remove asbestos impacted soils.

Reference should also be made to CIRIA C733: Asbestos in soil and made ground: a guide to understanding and managing risks and the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Development of Contaminated Land".

Where additional measures are required with respect to the presence of asbestos containing materials, these should be documented within the contractors working method statements and approved prior to the works being undertaken.

Good practices relating to personal hygiene should be adhered to on-site, i.e. food and drink should only be consumed within designated areas on the site and smoking should be prohibited in all working areas.

When working in and near asbestos contaminated areas, reference should be made to PPE and control methods to reduce asbestos exposure as set out in HSE guidance (access from: <http://www.hse.gov.uk/asbestos/essentials/>).

5.3 Prevention of pollution

5.3.1 General

The targets perceived to be potentially most at risk from pollution during the remediation of the site are the workers on-site together with nearby residents.

All contractors on-site shall adhere to environmental good practice as set out in CIRIA publication C650 (2005) and in particular those issues identified below.

5.3.2 Airborne pollution (dust and asbestos)

Care shall be taken by the contractor to minimise the amount of dust generated on-site during excavation, backfilling and trafficking. In the event that dry weather leads to excessive dust generation, exposed soils shall be damped down, but not flooded, with clean water.

The Contractor's method statement shall include a detailed dust control plan together with air monitoring procedures to be implemented during the removal of soils identified to contain asbestos fibres.

5.3.3 Surface runoff

The PC shall implement appropriate procedures to prevent surface run-off, including forming bunds around any temporary stockpiles of contaminated soils.

5.3.4 Discharge of pumped water

Any potentially contaminated perched groundwater, groundwater or surface water runoff encountered on site shall be contained or either treated onsite to permit disposal to the public sewer, subject to the approval of the sewerage authority, or tankered offsite for appropriate disposal as dictated by the results of the chemical testing.

5.3.5 Vehicles

Wheel cleaning/washing facilities shall be provided on-site if operations are likely to result in vehicles leaving site with potentially contaminated soil/mud clinging to them. Contaminated water on-site, including water and other liquid collected from vehicle washing facilities, shall be disposed of off-site in an approved manner with full regard to current legislation and good practice.

All vehicles leaving the site shall be clear of contaminated materials other than that contained within the load container, which shall be sheeted to prevent the loss of dust and other materials.

5.3.6 Re-contamination

The programme of works and any subsequent modifications shall be designed to avoid the potential re-contamination of areas already worked, e.g. site traffic shall be routed to avoid passing from contaminated to clean areas and contaminated soils shall not be stockpiled on clean areas.

5.3.7 Migration pathways

During construction of the site, redundant services may be exposed. To prevent these acting as conduits for the movement of contamination, where encountered, they features should be sealed.

5.4 Waste disposal and Materials Re-use

In accordance with the definition provided in the Waste Framework Directive, materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Thus, soils that are not of clean and natural origin, i.e. made ground (whether contaminated or not) and other materials such as recycled aggregate, do not become waste until the aforementioned criteria are met.

The Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2015) (CoP) was developed in consultation with the Environment Agency and development industry to enable the re-use of materials under certain scenarios and subject to demonstrating that specific criteria are met.

If materials are intended for re-use then in accordance with the CoP a materials management plan (MMP) will need to be completed for the site prior to commencement of any excavation works by the principal contractor. This plan needs to be reviewed by a 'Qualified Person' (QP) who will then issue a declaration form to the EA. As the project progresses, data must be collated by the Contractor demonstrating that the MMP was followed and describe any changes. An verification report specific to the MMP shall need to be completed and submitted to CL:AIRE on completion of the works. Copies of the relevant documents shall also need to be provided to the Environmental Consultant for inclusion in the post remediation verification report.

All contaminated materials removed off-site shall:

- Be transported to an approved licensed waste management facility for treatment or final disposal; or
- Be disposed of to the foul sewer under an appropriate discharge consent.

The contractor shall provide a full documentary record of this operation in accordance with the Duty of Care. This should, where appropriate, include waste transfer notes, discharge consents, laboratory results and details of the receiving site. Copies of the relevant documents shall be provided to the Environmental Consultant for inclusion in the post remediation verification report.

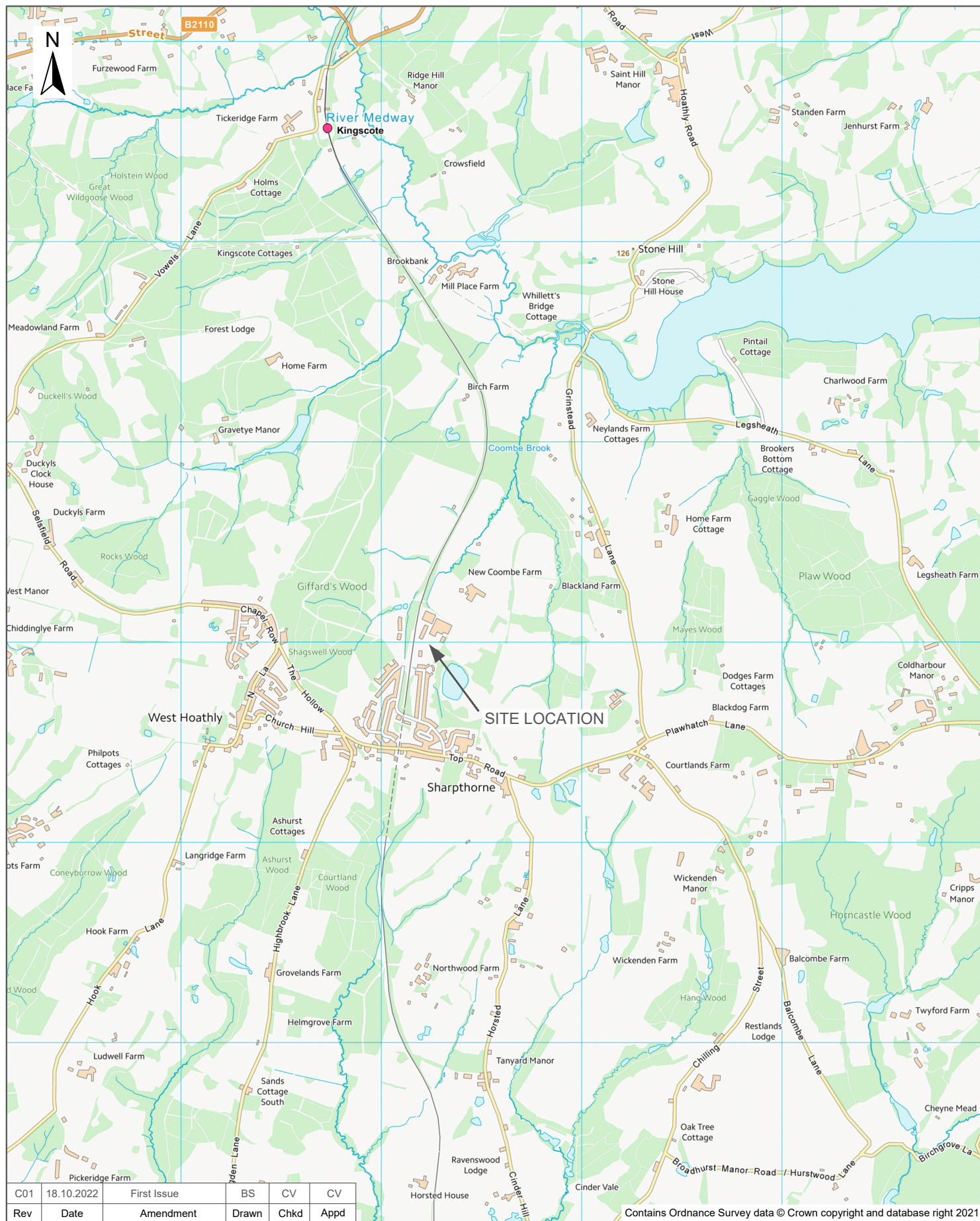
Classification of any material to be disposed of to landfill shall be agreed in advance with the landfill operator(s), as appropriate. Any waste classified as Hazardous shall be disposed of in accordance with the Hazardous Waste Regulations 2005.

5.5 Documentation

All contaminated materials removed off-site shall be transported to an approved licensed landfill for final disposal. The PC shall provide a full documentary record of this operation in accordance with the Duty of Care. Copies of the landfill documents shall be provided to the Environmental Consultant for inclusion in the verification report.

FIGURES

Figure 1 Site location plan



C01	18.10.2022	First Issue	BS	CV	CV
Rev	Date	Amendment	Drawn	Chkd	Appd

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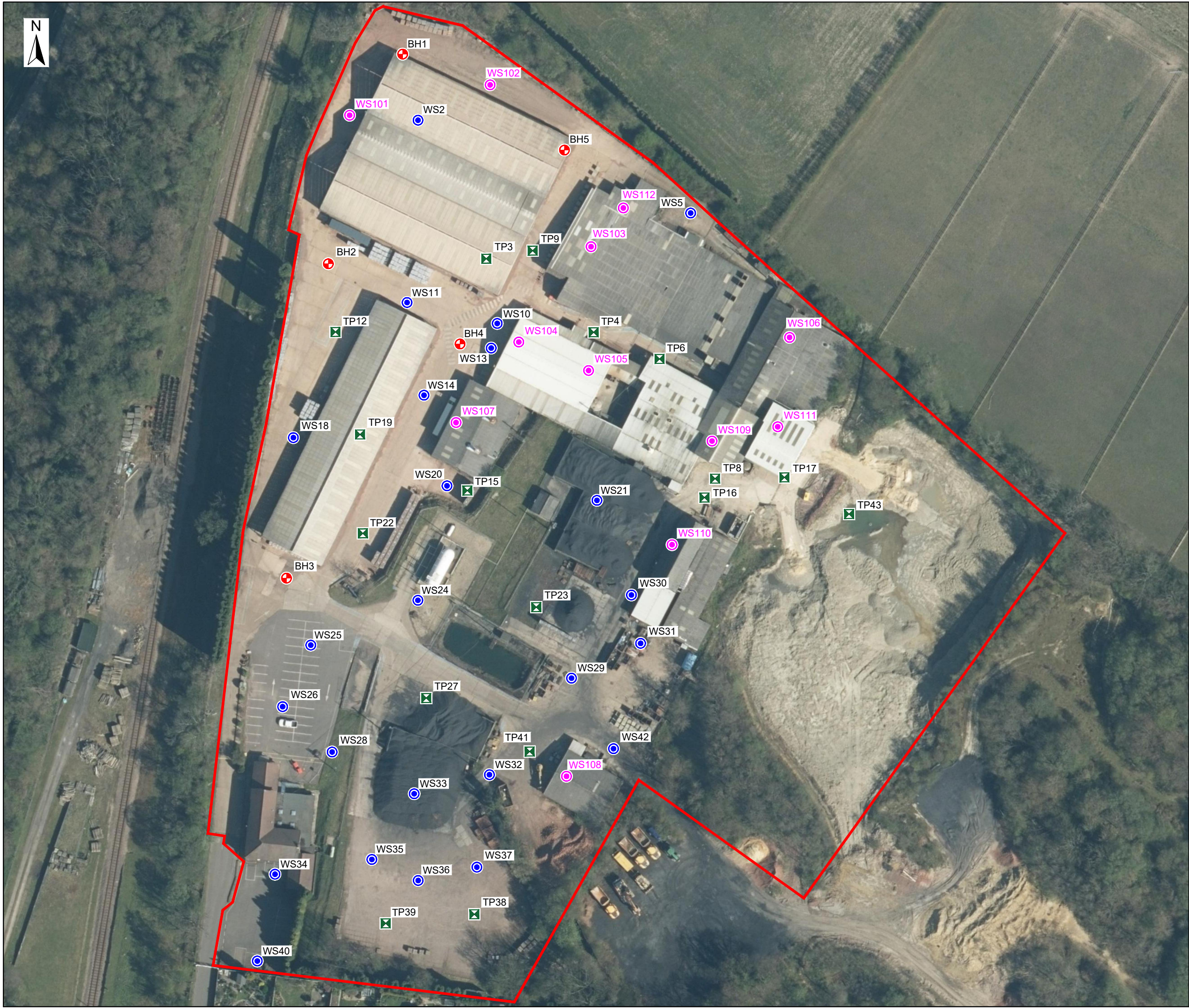


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Client		Ashill			
Project Name		West Hoathly			
Description		Site Location Plan			
Dimension	Size	Scale	Geolocation	Project ID	Drawing no.
m	A4	1:25,000	537234,132995	1922410	11101
		Rev	File name		
		C01	1922410-HH-111-SS-D-C-11101-C01		

Figure 2 Exploratory hole location plan



LEGEND

Site boundary

Trial Pit Location

Borehole Location

Window Sample Location

Window Sample Location (2023 Investigation)

Notes:

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Ordnance Survey 0100031673

C01	03.01.2024	First Issue	BS	VR	VR
Rev	Date	Amendment	Drawn	Chkd	Appd

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Client

Ashill Regen

Project Name

West Hoathly

Description

West Hoathly, Ibstock Brickworks –
Exploratory Hole Location Plan

Project ID	Drawing no.	Revision
1922410	22202	C01

File name

1922410-HH-222-SS-D-C-22202-C01

Dimensions	Scale	Size
m	1:500	A3

APPENDICES

APPENDIX A

SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Ashill Regen (the "client") in accordance with the terms of a contract [RSK Group Standard Terms and Conditions]. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials, unless specifically identified in the Services.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):
 - a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.

- b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.
- c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

- 8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.
- 9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.
- 10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.
- 11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.
- 12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

APPENDIX B

PROPOSED DEVELOPMENT PLANS



0 m 10 m 20 m 30 m 40 m 50 m 100 m

Scale

A R

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APPENDIX C
**HUMAN HEALTH GAC (RESIDENTIAL WITH AND WITHOUT HOME-
GROWN PRODUCE)**

Generic assessment criteria for human health: residential scenario with home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009⁽¹⁾. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009⁽²⁾. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)^(3,4), as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)⁽⁵⁾ used in the generation of SGVs.

C4SL were initially published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010⁽³⁾). Further C4SL were published in 2021 for vinyl chloride, tetrachloroethene (PCE) and trichloroethene (TCE). Where a C4SL has been published, the RSK GAC duplicates the C4SL using all input parameters within the SP1010 final project report⁽³⁾ and associated chemical specific reports⁽⁶⁾, and adopts them as GAC for these substances. Due to the use of decimal places rather than significant figures applied to the Contaminated Land Exposure Assessment (CLEA) tool outputs, the GAC presented may be marginally differently to the C4SL values, however any differences between the values are minimal and would not equate to an unacceptable risk.

For all other substances the C4SL exposure modifications, with the exception of the “top two” produce type approach taken in the C4SL, have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) for residential land use, reducing exposure frequency for dermal contact outdoors for residential land use, and updated produce type consumption rates (90th percentile) based on recent data from the National Diet and Nutrition Survey.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015⁽⁷⁾ or by the USEPA⁽¹⁴⁾, where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the CLEA tool v1.071, supporting EA guidance^(5,8,9) and revised exposure scenarios published for the C4SL⁽³⁾. The SAC are also termed GAC.

Conceptual model

In accordance with SR3⁽⁵⁾, the residential with home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance with Box 3.1 of SR3⁽⁵⁾, the pathways considered for production of the SAC in the residential with home-grown produce scenario are

- direct soil and dust ingestion
- consumption of home-grown produce
- consumption of soil attached to home-grown produce
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium⁽¹⁾, the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh} , are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase⁽⁹⁾. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached⁽⁹⁾. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required⁽⁹⁾:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook⁽⁹⁾, this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook⁽⁹⁾, which explains how to calculate an effective assessment criterion manually.

SR3⁽⁵⁾ states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7⁽¹⁰⁾, the EA TOX⁽¹⁾ reports, the C4SL SP1010 project report and associated appendices^(3,6), the 2015 LQM/CIEH report⁽⁷⁾ or the USEPA IRIS database⁽¹⁴⁾. Where a LLTC^(3,6) has been published for a substance, RSK has used these input parameters to derive the RSK GAC. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium, methyl tertiary-butyl ether (MTBE), 1,1,2-trichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, 2-chloronaphthalene, chloroethane, chloromethane, cis 1,2-dichloroethene, dichloromethane, hexachloroethane and trans 1,2-dichloroethene were obtained from the CL:AIRE Soil Generic Assessment Criteria report⁽¹¹⁾.

For TPH, aromatic hydrocarbons C₅–C₈ were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential with home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. The house is assumed to have a 100m² private garden consisting of lawn and flowerbeds, incorporating a 20m² plot for growing fruit and vegetables consumed by the residents. SR3⁽⁵⁾ notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3⁽³⁾, with a dust loading factor detailed in Section 9.3 of SR3⁽⁵⁾. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3⁽⁵⁾. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3⁽⁵⁾ input parameters for residential with home-grown produce land-use scenario

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3⁽⁵⁾. Modifications to the default SR3⁽⁵⁾ exposure scenarios based on the C4SL exposure scenarios⁽³⁾ are presented in Tables 2 and 3 below.

The final selected GAC are presented by pathway in Table 4 and the combined GAC in Table 5.

Figure 1: Conceptual model for residential scenario with home-grown produce

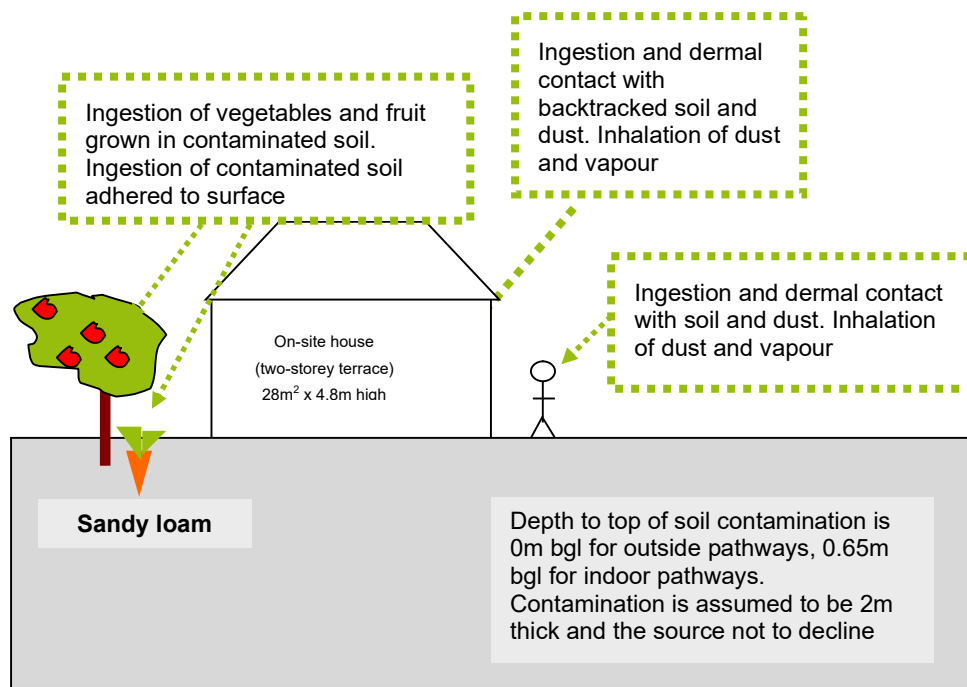


Table 1: Exposure assessment parameters for residential scenario with home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, SR3 ⁽⁵⁾
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3) ⁽⁵⁾
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3) ⁽⁵⁾
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3 ⁽⁵⁾
End AC (age class)	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents' ⁽¹³⁾
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential with home-grown produce – modified home-grown produce data

Name	Consumption rate 90 th percentile (g FW kg ⁻¹ BW day ⁻¹) by age class						Dry weight conversion factor (g DW g ⁻¹ FW)	Home-grown fraction (average)	Home-grown fraction (high end)	Soil loading factor (g g ⁻¹ DW)	Preparation correction factor
	1	2	3	4	5	6					
Green vegetables	7.12	5.87	5.87	5.87	4.53	4.53	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.7	2.83	2.83	2.83	2.14	2.14	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16	6.6	6.6	6.6	4.95	4.95	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.39	3.39	3.39	2.24	2.24	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.46	0.46	0.46	0.19	0.19	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	10.3	10.3	10.3	5.16	5.16	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 3.4, SP1010 ⁽³⁾						Table 6.3, SR3 ⁽⁵⁾	Table 4.19, SR3 ⁽⁵⁾		Table 6.3, SR3 ⁽⁵⁾	

Table 3: Residential with home-grown produce – modified use and receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr ⁻¹	180	365	365	365	365	365
EF (consumption of home-grown produce)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, indoor)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr ⁻¹	170	170	170	170	170	170
EF (inhalation of dust and vapour, indoor)	day yr ⁻¹	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr ⁻¹	365	365	365	365	365	365
Justification		Table 3.5, SP1010 ⁽³⁾ ; Table 3.1, SR3 ⁽⁵⁾					
Soil to skin adherence factor (outdoor)	mg cm ⁻² day ⁻¹	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010 ⁽³⁾					
Inhalation rate	m ³ day ⁻¹	5.4	8.0	8.9/f	10.1	10.1	10.1
Justification		Mean value USEPA, 2011 ⁽¹²⁾ ; Table 3.2, SP1010 ⁽³⁾					
Notes: For cadmium , the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI _{oral} and TDI _{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3 ⁽¹⁾ , Science Report SC050021/Cadmium SGV ⁽¹⁾ and the project report SP1010 ⁽³⁾ for more information.							

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 4

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce Scenario

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR
Barium	(b)	1.34E+03	NR	NR	NR	1.34E+03	NR	NR	NR	1.34E+03	NR	NR	NR
Beryllium		1.13E+02	1.72E+00	NR	NR	1.13E+02	1.72E+00	NR	NR	1.13E+02	1.72E+00	NR	NR
Boron		3.00E+02	5.20E+06	NR	NR	3.00E+02	5.20E+06	NR	NR	3.00E+02	5.20E+06	NR	NR
Cadmium	(a)	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR
Chromium (III) - trivalent	(c)	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR
Copper		2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR
Lead	(a)	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR
Elemental Mercury (Hg ⁰)	(d)	NR	2.35E-01	NR	4.31E+00	NR	5.60E-01	NR	1.07E+01	NR	1.22E+00	NR	2.58E+01
Inorganic Mercury (Hg ²⁺)		3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR
Methyl Mercury (Hg ⁴⁺)		1.26E+01	1.87E+01	7.52E+00	7.33E+01	1.26E+01	3.62E+01	9.34E+00	1.42E+02	1.26E+01	7.68E+01	1.08E+01	3.04E+02
Nickel	(d)	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR
Selenium	(b)	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR
Vanadium		4.13E+02	1.46E+03	NR	NR	4.13E+02	1.46E+03	NR	NR	4.13E+02	1.46E+03	NR	NR
Zinc	(b)	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR
Cyanide (free)		1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR
Volatile Organic Compounds													
Benzene	(a)	2.62E-01	9.01E-01	2.03E-01	1.22E+03	5.39E-01	1.68E+00	4.08E-01	2.26E+03	1.16E+00	3.48E+00	8.72E-01	4.71E+03
Toluene		1.53E+02	9.08E+02	1.31E+02	8.69E+02	3.49E+02	2.00E+03	2.97E+02	1.92E+03	7.95E+02	4.55E+03	6.77E+02	4.36E+03
Ethylbenzene		1.10E+02	8.34E+01	4.74E+01	5.18E+02	2.61E+02	1.96E+02	1.12E+02	1.22E+03	6.00E+02	4.58E+02	2.60E+02	2.84E+03
Xylene - m		2.10E+02	8.25E+01	5.92E+01	6.25E+02	5.01E+02	1.95E+02	1.40E+02	1.47E+03	1.15E+03	4.56E+02	3.27E+02	3.46E+03
Xylene - o		1.92E+02	8.87E+01	6.07E+01	4.78E+02	4.56E+02	2.08E+02	1.43E+02	1.12E+03	1.05E+03	4.86E+02	3.32E+02	2.62E+03
Xylene - p		1.98E+02	7.93E+01	5.66E+01	5.76E+02	4.70E+02	1.86E+02	1.33E+02	1.35E+03	1.08E+03	4.36E+02	3.10E+02	3.17E+03
Total xylene		1.92E+02	7.93E+01	5.66E+01	6.25E+02	4.56E+02	1.86E+02	1.33E+02	1.47E+03	1.05E+03	4.36E+02	3.10E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		1.54E+02	1.04E+02	6.22E+01	2.04E+04	2.97E+02	1.69E+02	1.08E+02	3.31E+04	6.03E+02	3.21E+02	2.10E+02	6.27E+04
1,1,1,2-Tetrachloroethane		5.39E+00	1.54E+00	1.20E+00	2.60E+03	1.27E+01	3.56E+00	2.78E+00	6.02E+03	2.92E+01	8.29E+00	6.46E+00	1.40E+04
1,1,2,2-Tetrachloroethane		2.81E+00	3.92E+00	1.64E+00	2.67E+03	6.10E+00	8.04E+00	3.47E+00	5.46E+03	1.36E+01	1.76E+01	7.67E+00	1.20E+04
1,1,1-Trichloroethane		3.33E+02	9.01E+00	8.77E+00	1.43E+03	7.26E+02	1.84E+01	1.80E+01	2.92E+03	1.62E+03	4.04E+01	3.94E+01	6.39E+03
1,1,2 Trichloroethane		1.95E+00	1.25E+00	7.62E-01	4.03E+03	4.21E+00	2.55E+00	1.59E+00	8.21E+03	9.35E+00	5.59E+00	3.50E+00	1.80E+04
1,1-Dichloroethene		1.93E+01	3.29E-01	3.23E-01	2.23E+03	3.85E+01	5.82E-01	5.74E-01	3.94E+03	8.15E+01	1.17E+00	1.16E+00	7.94E+03
1,2-Dichloroethane		3.17E-02	9.20E-03	7.13E-03	3.41E+03	5.73E-02	1.33E-02	1.08E-02	4.91E+03	1.09E-01	2.28E-02	1.88E-02	8.43E+03
1,2,4-Trimethylbenzene		NR	1.76E+00	NR	4.74E+02	NR	4.26E+00	NR	1.16E+03	NR	9.72E+00	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
1,2-Dichloropropane		4.28E+00	3.40E-02	3.37E-02	1.19E+03	8.44E+00	6.00E-02	5.96E-02	2.11E+03	1.77E+01	1.21E-01	1.20E-01	4.24E+03
Carbon Tetrachloride (tetrachloromethane)		3.10E+00	2.58E-02	2.57E-02	1.52E+03	7.11E+00	5.65E-02	5.62E-02	3.32E+03	1.62E+01	1.28E-01	1.27E-01	7.54E+03
Chloroethane		NR	1.17E+01	NR	2.61E+03	NR	1.59E+01	NR	3.54E+03	NR	2.57E+01	NR	5.71E+03
Chloromethane		NR	1.17E-02	NR	1.91E+03	NR	1.38E-02	NR	2.24E+03	NR	1.85E-02	NR	2.99E+03
Cis 1,2 Dichloroethene		1.56E-01	NR	NR	3.94E+03	2.66E-01	NR	NR	6.61E+03	5.18E-01	NR	NR	1.29E+04
Dichloromethane		7.04E-01	3.05E+00	6.24E-01	7.27E+03	1.27E+00	4.06E+00	1.08E+00	9.68E+03	2.33E+00	6.42E+00	1.92E+00	1.53E+04
Tetrachloroethene (PCE)		1.33E+01	3.19E-01	3.11E-01	4.24E+02	3.11E+01	7.15E-01	6.99E-01	9.51E+02	7.12E+01	1.64E+00	1.60E+00	2.18E+03
Trans 1,2 Dichloroethene		6.45E+00	2.76E-01	NR	3.42E+03	1.29E+01	4.99E-01	NR	6.17E+03	2.74E+01	1.02E+00	NR	1.26E+04
Trichloroethene (TCE)		9.30E-03	3.61E-02	NR	1.54E+03	1.95E-02	7.57E-02	NR	3.22E+03	4.34E-02	1.68E-01	NR	7.14E+03
Vinyl Chloride (chloroethene)		1.13E-02	1.47E-02	6.38E-03	1.36E+03	2.09E-02	1.90E-02	9.97E-03	1.76E+03	3.88E-02	2.91E-02	1.66E-02	2.69E+03
Semi-Volatile Organic Compounds													
2-Chloronaphthalene		2.76E+02	5.39E+00	5.29E+00	1.14E+02	6.59E+02	1.33E+01	1.30E+01	2.80E+02	1.45E+03	3.17E+01	3.10E+01	6.69E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 4

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce Scenario

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Acenaphthene		2.27E+02	4.86E+04	2.26E+02	5.70E+01	5.41E+02	1.18E+05	5.38E+02	1.41E+02	1.18E+03	2.68E+05	1.17E+03	3.36E+02
Acenaphthylene		1.85E+02	4.59E+04	1.84E+02	8.61E+01	4.42E+02	1.11E+05	4.40E+02	2.12E+02	9.78E+02	2.53E+05	9.74E+02	5.06E+02
Anthracene		2.43E+03	1.53E+05	2.39E+03	1.17E+00	5.53E+03	3.77E+05	5.45E+03	2.91E+00	1.10E+04	8.76E+05	1.09E+04	6.96E+00
Benzo(a)anthracene		1.01E+01	2.47E+01	7.18E+00	1.71E+00	1.42E+01	4.37E+01	1.07E+01	4.28E+00	1.69E+01	6.26E+01	1.33E+01	1.03E+01
Benzo(a)pyrene	(a)	4.96E+00	3.51E+01	NR	9.11E-01	4.96E+00	3.77E+01	NR	2.28E+00	4.96E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		2.96E+00	1.93E+01	2.56E+00	1.22E+00	3.89E+00	2.13E+01	3.29E+00	3.04E+00	4.43E+00	2.22E+01	3.69E+00	7.29E+00
Benzo(g,h,i)perylene		3.77E+02	1.87E+03	3.14E+02	1.54E-02	4.09E+02	1.94E+03	3.38E+02	3.85E-02	4.23E+02	1.97E+03	3.48E+02	9.23E-02
Benzo(k)fluoranthene		8.92E+01	5.41E+02	7.66E+01	6.87E-01	1.10E+02	5.76E+02	9.22E+01	1.72E+00	1.21E+02	5.91E+02	1.00E+02	4.12E+00
Chrysene		1.66E+01	1.19E+02	1.46E+01	4.40E-01	2.54E+01	1.49E+02	2.17E+01	1.10E+00	3.19E+01	1.66E+02	2.67E+01	2.64E+00
Dibenzo(a,h)anthracene		2.90E-01	1.45E+00	2.41E-01	3.93E-03	3.43E-01	1.64E+00	2.84E-01	9.82E-03	3.69E-01	1.74E+00	3.04E-01	2.36E-02
Fluoranthene		2.87E+02	3.83E+04	2.85E+02	1.89E+01	5.63E+02	8.87E+04	5.60E+02	4.73E+01	9.00E+02	1.83E+05	8.96E+02	1.13E+02
Fluorene		1.77E+02	6.20E+03	1.72E+02	3.09E+01	4.19E+02	1.53E+04	4.07E+02	7.65E+01	8.98E+02	3.62E+04	8.77E+02	1.83E+02
Hexachloroethane		2.68E-01	NR	NR	8.17E+00	6.57E-01	NR	NR	2.01E+01	1.55E+00	NR	NR	4.81E+01
Indeno(1,2,3-cd)pyrene		3.09E+01	2.12E+02	2.70E+01	6.13E-02	4.22E+01	2.38E+02	3.59E+01	1.53E-01	4.92E+01	2.50E+02	4.11E+01	3.68E-01
Naphthalene		2.78E+01	2.33E+01	1.27E+01	7.64E+01	6.66E+01	5.58E+01	3.04E+01	1.83E+02	1.53E+02	1.31E+02	7.06E+01	4.32E+02
Phenanthrene		9.85E+01	7.17E+03	9.72E+01	3.60E+01	2.24E+02	1.76E+04	2.22E+02	8.96E+01	4.48E+02	4.07E+04	4.43E+02	2.14E+02
Pyrene		6.25E+02	8.79E+04	6.20E+02	2.20E+00	1.25E+03	2.04E+05	1.24E+03	5.49E+00	2.05E+03	4.23E+05	2.04E+03	1.32E+01
Phenol		1.60E+02	4.58E+02	1.20E+02	2.42E+04	2.96E+02	6.95E+02	2.09E+02	3.81E+04	5.86E+02	1.19E+03	3.93E+02	7.03E+04

Total Petroleum Hydrocarbons

Aliphatic hydrocarbons EC ₅ -EC ₆		4.99E+03	4.24E+01	4.23E+01	3.04E+02	1.13E+04	7.79E+01	7.78E+01	5.58E+02	2.50E+04	1.61E+02	1.60E+02	1.15E+03
Aliphatic hydrocarbons >EC ₅ -EC ₆		1.49E+04	1.04E+02	1.03E+02	1.44E+02	3.43E+04	2.31E+02	2.31E+02	3.22E+02	7.11E+04	5.29E+02	5.28E+02	7.36E+02
Aliphatic hydrocarbons >EC ₆ -EC ₁₀		1.61E+03	2.68E+01	2.67E+01	7.77E+01	2.91E+03	6.55E+01	6.51E+01	1.90E+02	4.26E+03	1.56E+02	1.54E+02	4.51E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂		4.57E+03	1.33E+02	1.32E+02	4.75E+01	5.51E+03	3.31E+02	3.26E+02	1.18E+02	5.98E+03	7.93E+02	7.65E+02	2.83E+02
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆		6.27E+03	1.11E+03	1.06E+03	2.37E+01	6.34E+03	2.78E+03	2.41E+03	5.91E+01	6.36E+03	6.67E+03	4.34E+03	1.42E+02
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	(b)	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC ₈ -EC ₁₀		5.76E+01	4.74E+01	3.45E+01	6.13E+02	1.38E+02	1.16E+02	8.38E+01	1.50E+03	3.07E+02	2.77E+02	1.94E+02	3.58E+02
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂		8.29E+01	2.58E+02	7.52E+01	3.64E+02	1.96E+02	6.39E+02	1.79E+02	8.99E+02	4.25E+02	1.52E+03	3.91E+02	2.15E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆		1.47E+02	2.85E+03	1.45E+02	1.69E+02	3.36E+02	7.07E+03	3.32E+02	4.19E+02	6.81E+02	1.68E+04	6.74E+02	1.00E+03
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	(b)	2.63E+02	NR	NR	5.37E+01	5.45E+02	NR	NR	1.34E+02	9.34E+02	NR	NR	3.21E+02
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	(b)	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

	Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.
	Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.
	Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs naphthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for boron and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC₁₆ should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 5
Human Health Generic Assessment Criteria for Residential with home-grown produce

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	37	37	37
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	300	300	300
Cadmium	22	22	22
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	2,500	2,500	2,500
Lead	200	200	200
Elemental Mercury (Hg ⁰)	0.2	0.6	1.2
Inorganic Mercury (Hg ²⁺)	39	39	39
Methyl Mercury (Hg ⁴⁺)	10	10	10
Nickel	130	130	130
Selenium	258	258	258
Vanadium	410	410	410
Zinc	3,900	3,900	3,900
Cyanide (free)	1.4	1.4	1.4
Volatile Organic Compounds			
Benzene	0.20	0.41	0.87
Toluene	130	300	680
Ethylbenzene	50	110	260
Xylene - m	59	140	327
Xylene - o	61	143	332
Xylene - p	57	133	310
Total xylene	57	133	310
Methyl tertiary-Butyl ether (MTBE)	60	110	210
1,1,1,2-Tetrachloroethane	1.20	2.78	6.46
1,1,2,2-Tetrachloroethane	1.6	3.5	7.7
1,1,1-Trichloroethane	9	18	39
1,1,2 Trichloroethane	0.8	1.6	3.5
1,1-Dichloroethene	0.32	0.57	1.16
1,2-Dichloroethane	0.007	0.011	0.019
1,2,4-Trimethylbenzene	1.8	4.3	9.7
1,3,5-Trimethylbenzene	NR	NR	NR
1,2-Dichloropropane	0.034	0.060	0.120
Carbon Tetrachloride (tetrachloromethane)	0.026	0.056	0.127
Chloroethane	11.7	15.9	25.7
Chloromethane	0.012	0.014	0.019
Cis 1,2 Dichloroethene	0.16	0.27	0.52
Dichloromethane	0.62	1.08	1.92
Tetrachloroethene (PCE)	0.31	0.70	1.60
Trans 1,2 Dichloroethene	0.28	0.50	1.02
Trichloroethene (TCE)	0.009	0.020	0.043
Vinyl Chloride (chloroethene)	0.006	0.010	0.017
Semi-Volatile Organic Compounds			
2-Chloronaphthalene	5	13	31
Acenaphthene	230	540	1,170
Acenaphthylene	180	440	970
Anthracene	2,400	5,500	10,900
Benzo(a)anthracene	7	11	13
Benzo(a)pyrene	5	5	5
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(g,h,i)perylene	310	340	350
Benzo(k)fluoranthene	77	92	100
Chrysene	15	22	27
Dibenzo(a,h)anthracene	0.24	0.28	0.30
Fluoranthene	290	560	900
Fluorene	170	410	880
Hexachloroethane	0.27	0.66	1.55
Indeno(1,2,3-cd)pyrene	13	30	71
Naphthalene	13	30	71
Phenanthrene	100	220	440
Pyrene	620	1,240	2,040
Phenol	120	210	390
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC ₅ -EC ₆	42	78	160
Aliphatic hydrocarbons >EC ₆ -EC ₈	100	230	530
Aliphatic hydrocarbons >EC ₈ -EC ₁₀	27	65	154
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	130 (48)	330 (118)	760 (283)
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	1,100 (24)	2,400 (59)	4,300 (142)
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	65,000 (8)	92,000 (21)	110,000
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	65,000 (8)	92,000 (21)	110,000
Aromatic hydrocarbons >EC ₈ -EC ₁₀	30	80	190
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	80	180	390
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	140	330	670
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	260	540	930
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	1,100	1,500	1,700
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	1,100	1,500	1,700
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC) ¹		
Notes:			
* Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.			
NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used			
EC - equivalent carbon. SAC - soil assessment criteria.			
¹ LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.			
The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.			
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.			
SAC for TPH fractions, PAHs naphthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.			
(VALUE IN BRACKETS)			
RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.			

Generic assessment criteria for human health: residential scenario without home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009⁽¹⁾. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009⁽²⁾. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)^(3,4), as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)⁽⁵⁾ used in the generation of SGVs.

C4SL were initially published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010⁽³⁾). Further C4SL were published in 2021 for vinyl chloride, tetrachloroethene (PCE) and trichloroethene (TCE). Where a C4SL has been published, the RSK GAC duplicates the C4SL using all input parameters within the SP1010 final project report⁽³⁾ and associated chemical specific reports⁽⁶⁾, and adopts them as GAC for these substances. Due to the use of decimal places rather than significant figures applied to the Contaminated Land Exposure Assessment (CLEA) tool outputs, the GAC presented may be marginally differently to the C4SL values, however any differences between the values are minimal and would not equate to an unacceptable risk.

For all other substances the C4SL exposure modifications relevant for residential without home-grown produce end use have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) and reducing exposure frequency for dermal contact outdoors.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015⁽⁷⁾ or by the USEPA⁽¹⁴⁾, where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the CLEA tool v1.071, supporting EA guidance^(5,8,9) and revised exposure scenarios published for the C4SL⁽³⁾. The SAC are also termed GAC.

Conceptual model

In accordance with SR3⁽⁵⁾, the residential without home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In

accordance with Box 3.1 of SR3⁽⁵⁾, the pathways considered for production of the SAC in the residential without home-grown produce scenario are

- direct soil and dust ingestion in areas of soft landscaping
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium⁽¹⁾, the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh} , are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase⁽⁹⁾. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached⁽⁹⁾. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required⁽⁹⁾:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook⁽⁹⁾, this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook⁽⁹⁾, which explains how to calculate an effective assessment criterion manually.

SR3⁽⁵⁾ states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7⁽¹⁰⁾, the EA TOX⁽¹⁾ reports, the C4SL SP1010 project report and associated chemical specific reports^(3,6), the 2015 LQM/CIEH report⁽⁷⁾ or the USEPA IRIS database⁽¹⁴⁾. Where a LLTC^(3,6) has been published for a substance, RSK has used these input parameters to derive the RSK GAC. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report⁽¹¹⁾.

For TPH, aromatic hydrocarbons C₅–C₈ were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential without home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. SR3⁽⁵⁾ notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3⁽³⁾, with a dust loading factor detailed in Section 9.3 of SR3⁽⁵⁾. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3⁽⁵⁾. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3⁽⁵⁾ input parameters for residential without home-grown produce

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3⁽⁵⁾. Modifications to the default SR3⁽⁵⁾ exposure scenarios based on the C4SL exposure scenarios⁽³⁾ are presented in Table 2 below.

The final selected GAC are presented by pathway in Table 3 and the combined GAC in Table 4.

Figure 1: Conceptual model for CLEA residential scenario without home-grown produce

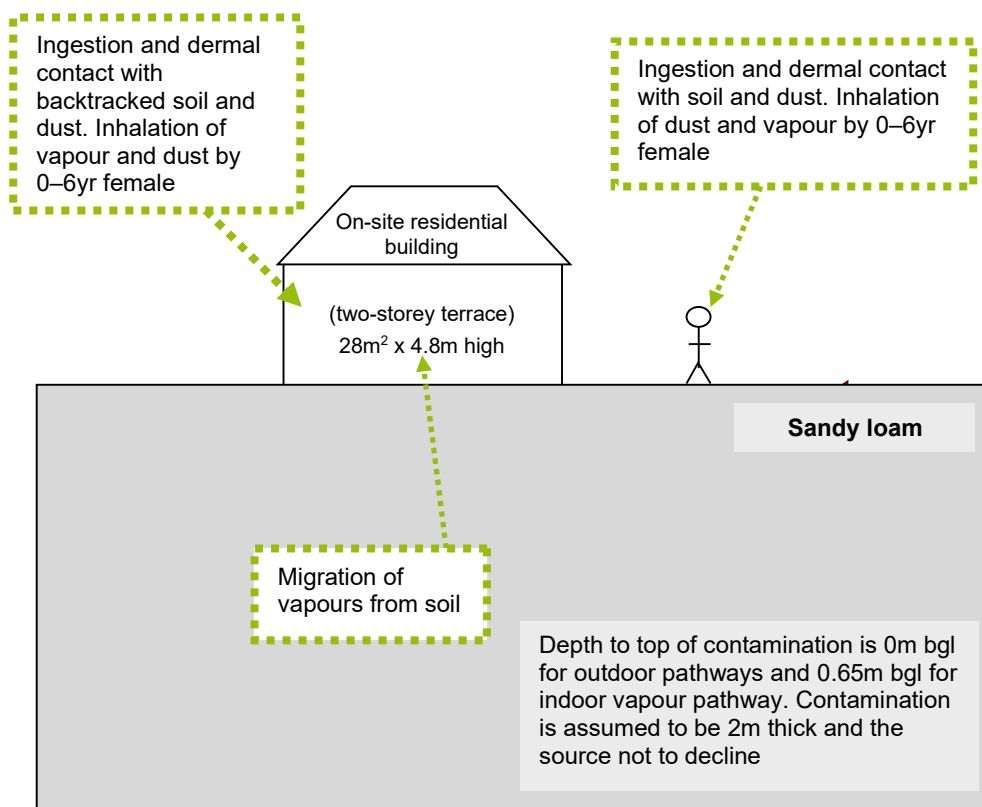


Table 1: Exposure assessment parameters for residential scenario without home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential without home-grown produce	Chosen land use
Receptor	Female child	Key generic assumption given in Box 3.1, SR3 ⁽⁵⁾
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3 ⁽⁵⁾ . Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3) ⁽⁵⁾
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3) ⁽⁵⁾
Start age class (AC)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3 ⁽⁵⁾
End AC	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents' ⁽¹³⁾
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential without home-grown produce – modified receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
Soil to skin adherence factor – (outdoor)	mg soil/cm ² skin	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010 ⁽³⁾					
Inhalation rate	m ³ day ⁻¹	5.4	8.0	8.9	10.1	10.1	10.1
Justification		Mean value USEPA, 2011 ⁽¹²⁾ ; Table 3.2, SP1010 ⁽³⁾					
Notes: For cadmium , the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TD _{loral} and TD _{linh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3 ⁽¹⁾ , Science Report SC050021/Cadmium SGV ⁽¹⁾ and the project report SP1010 ⁽³⁾ for more information.							

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE



Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR
Barium	(b)	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR
Beryllium		1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR
Boron		1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR
Cadmium	(a)	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR
Chromium (III) - trivalent	(c)	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR
Copper		1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR
Lead	(a)	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR
Elemental Mercury (Hg ⁰)	(d)	NR	2.41E-01	NR	4.31E+00	NR	5.74E-01	NR	1.07E+01	NR	1.25E+00	NR	2.58E+01
Inorganic Mercury (Hg ²⁺)		5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR
Methyl Mercury (Hg ⁴⁺)		1.80E+01	1.87E+01	9.16E+00	7.33E+01	1.80E+01	3.62E+01	1.20E+01	1.42E+02	1.80E+01	7.68E+01	1.46E+01	3.04E+02
Nickel	(d)	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR
Selenium	(b)	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR
Vanadium		1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR
Zinc	(b)	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR
Cyanide (free)		4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR
Volatile Organic Compounds													
Benzene	(a)	7.36E+01	9.01E-01	8.90E-01	1.22E+03	7.36E+01	1.68E+00	1.64E+00	2.26E+03	7.36E+01	3.48E+00	3.33E+00	4.71E+03
Toluene		2.87E+04	9.08E+02	8.80E+02	8.69E+02	2.87E+04	2.00E+03	1.87E+03	1.92E+03	2.87E+04	4.55E+03	3.93E+03	4.36E+03
Ethylbenzene		1.29E+04	8.34E+01	8.29E+01	5.18E+02	1.29E+04	1.96E+02	1.93E+02	1.22E+03	1.29E+04	4.58E+02	4.42E+02	2.84E+03
Xylene - m		2.32E+04	8.25E+01	8.22E+01	6.25E+02	2.32E+04	1.95E+02	1.93E+02	1.47E+03	2.32E+04	4.56E+02	4.47E+02	3.46E+03
Xylene - o		2.32E+04	8.87E+01	8.83E+01	4.78E+02	2.32E+04	2.08E+02	2.06E+02	1.12E+03	2.32E+04	4.86E+02	4.76E+02	2.62E+03
Xylene - p		2.32E+04	7.93E+01	7.90E+01	5.76E+02	2.32E+04	1.86E+02	1.85E+02	1.35E+03	2.32E+04	4.36E+02	4.28E+02	3.17E+03
Total xylene		2.32E+04	7.93E+01	7.90E+01	6.25E+02	2.32E+04	1.86E+02	1.85E+02	1.47E+03	2.32E+04	4.36E+02	4.28E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		3.87E+04	1.04E+02	1.04E+02	2.04E+04	3.87E+04	1.69E+02	1.69E+02	3.31E+04	3.87E+04	3.21E+02	3.19E+02	6.27E+04
Trichloroethene (TCE)		9.73E-03	3.61E-02	NR	1.54E+03	2.04E-02	7.57E-02	NR	3.22E+03	4.52E-02	1.68E-01	NR	7.14E+03
Tetrachloroethene (PCE)		1.80E+03	3.19E-01	3.19E-01	4.24E+02	1.80E+03	7.15E-01	7.15E-01	9.51E+02	1.80E+03	1.64E+00	1.64E+00	2.18E+03
1,1,1-Trichloroethane		7.74E+04	9.01E+00	9.01E+00	1.43E+03	7.74E+04	1.84E+01	1.84E+01	2.92E+03	7.74E+04	4.04E+01	4.04E+01	6.39E+03
1,1,1,2 Tetrachloroethane		7.34E+02	1.54E+00	1.53E+00	2.60E+03	7.34E+02	3.56E+00	3.55E+00	6.02E+03	7.34E+02	8.29E+00	8.20E+00	1.40E+04
1,1,2,2-Tetrachloroethane		7.34E+02	3.92E+00	3.90E+00	2.67E+03	7.34E+02	8.04E+00	7.95E+00	5.46E+03	7.34E+02	1.76E+01	1.72E+01	1.20E+04
Carbon Tetrachloride		5.15E+02	2.58E-02	2.58E-02	1.52E+03	5.15E+02	5.65E-02	5.64E-02	3.32E+03	5.15E+02	1.28E-01	1.28E-01	7.54E+03
1,2-Dichloroethane		1.55E+01	9.20E-03	9.20E-03	3.41E+03	1.55E+01	1.33E-02	1.33E-02	4.91E+03	1.55E+01	2.28E-02	2.27E-02	8.43E+03
Vinyl Chloride (chloroethene)		4.85E+00	1.47E-02	1.47E-02	1.36E+03	4.85E+00	1.90E-02	1.90E-02	1.76E+03	4.85E+00	2.91E-02	2.89E-02	2.69E+03
1,2,4-Trimethylbenzene		NR	5.58E+00	NR	4.74E+02	NR	1.29E+01	NR	1.16E+03	NR	2.69E+01	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		7.64E+03	4.86E+04	6.60E+03	5.70E+01	7.64E+03	1.18E+05	7.17E+03	1.41E+02	7.64E+03	2.68E+05	7.43E+03	3.36E+02
Acenaphthylene		7.65E+03	4.59E+04	6.55E+03	8.61E+01	7.65E+03	1.11E+05	7.15E+03	2.12E+02	7.65E+03	2.53E+05	7.42E+03	5.06E+02
Anthracene		3.82E+04	1.53E+05	3.06E+04	1.17E+00	3.82E+04	3.77E+05	3.47E+04	2.91E+00	3.82E+04	8.76E+05	3.66E+04	6.96E+00
Benzo(a)anthracene		1.98E+01	2.47E+01	1.10E+01	1.71E+00	1.98E+01	4.37E+01	1.36E+01	4.28E+00	1.98E+01	6.26E+01	1.50E+01	1.03E+01
Benzo(a)pyrene	(a)	5.34E+00	3.51E+01	NR	9.11E-01	5.34E+00	3.77E+01	NR	2.28E+00	5.34E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		4.97E+00	1.93E+01	3.95E+00	1.22E+00	4.97E+00	2.13E+01	4.03E+00	3.04E+00	4.97E+00	2.22E+01	4.06E+00	7.29E+00
Benzo(g,h,i)perylene		4.38E+02	1.87E+03	3.55E+02	1.54E-02	4.38E+02	1.94E+03	3.58E+02	3.85E-02	4.38E+02	1.97E+03	3.59E+02	9.23E-02
Benzo(k)fluoranthene		1.31E+02	5.41E+02	1.06E+02	6.87E-01	1.31E+02	5.76E+02	1.07E+02	1.72E+00	1.31E+02	5.91E+02	1.07E+02	4.12E+00
Chrvsene		3.95E+01	1.19E+02	2.97E+01	4.40E-01	3.95E+01	1.49E+02	3.12E+01	1.10E+00	3.95E+01	1.66E+02	3.19E+01	2.64E+00

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE



Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Dibenzo(a,h)anthracene		3.95E-01	1.45E+00	3.10E-01	3.93E-03	3.95E-01	1.64E+00	3.18E-01	9.82E-03	3.95E-01	1.74E+00	3.22E-01	2.36E-02
Fluoranthene		1.59E+03	3.83E+04	1.53E+03	1.89E+01	1.59E+03	8.87E+04	1.56E+03	4.73E+01	1.59E+03	1.83E+05	1.58E+03	1.13E+02
Fluorene		5.09E+03	6.20E+03	2.80E+03	3.09E+01	5.09E+03	1.53E+04	3.82E+03	7.65E+01	5.09E+03	3.62E+04	4.47E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		5.65E+01	2.12E+02	4.46E+01	6.13E-02	5.65E+01	2.38E+02	4.56E+01	1.53E-01	5.65E+01	2.50E+02	4.60E+01	3.68E-01
Naphthalene		2.50E+03	2.33E+01	2.31E+01	7.64E+01	2.50E+03	5.58E+01	5.46E+01	1.83E+02	2.50E+03	1.31E+02	1.25E+02	4.32E+02
Phenanthrene		1.58E+03	7.17E+03	1.30E+03	3.60E+01	1.58E+03	1.76E+04	1.45E+03	8.96E+01	1.58E+03	4.07E+04	1.52E+03	2.14E+02
Pyrene		3.82E+03	8.79E+04	3.66E+03	2.20E+00	3.82E+03	2.04E+05	3.75E+03	5.49E+00	3.82E+03	4.23E+05	3.79E+03	1.32E+01
Phenol		6.48E+04	4.58E+02	4.55E+02	2.42E+04	6.48E+04	6.95E+02	6.88E+02	3.81E+04	6.48E+04	1.19E+03	1.17E+03	7.03E+04
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC ₅ -EC ₆		3.23E+05	4.24E+01	4.24E+01	3.04E+02	3.23E+05	7.79E+01	7.79E+01	5.58E+02	3.23E+05	1.61E+02	1.61E+02	1.15E+03
Aliphatic hydrocarbons >EC ₆ -EC ₈		3.23E+05	1.04E+02	1.04E+02	1.44E+02	3.23E+05	2.31E+02	2.31E+02	3.22E+02	3.23E+05	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons >EC ₈ -EC ₁₀		6.45E+03	2.68E+01	2.68E+01	7.77E+01	6.45E+03	6.55E+01	6.53E+01	1.90E+02	6.45E+03	1.56E+02	1.55E+02	4.51E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂		6.45E+03	1.33E+02	1.32E+02	4.75E+01	6.45E+03	3.31E+02	3.27E+02	1.18E+02	6.45E+03	7.93E+02	7.67E+02	2.83E+02
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆		6.45E+03	1.11E+03	1.06E+03	2.37E+01	6.45E+03	2.78E+03	2.42E+03	5.91E+01	6.45E+03	6.67E+03	4.37E+03	1.42E+02
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC ₈ -EC ₁₀		2.58E+03	4.74E+01	4.72E+01	6.13E+02	2.58E+03	1.16E+02	1.15E+02	1.50E+03	2.58E+03	2.77E+02	2.69E+02	3.58E+03
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂		2.58E+03	2.58E+02	2.52E+02	3.64E+02	2.58E+03	6.39E+02	5.94E+02	8.99E+02	2.58E+03	1.52E+03	1.24E+03	2.15E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆		2.58E+03	2.85E+03	1.80E+03	1.69E+02	2.58E+03	7.07E+03	2.30E+03	4.19E+02	2.58E+03	1.68E+04	2.48E+03	1.00E+03
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	(b)	1.86E+03	NR	NR	5.37E+01	1.90E+03	NR	NR	1.34E+02	1.92E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GRAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

	Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.
	Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.
	Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs naphthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for boron and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE



Table 4
Human health generic assessment criteria for residential without home-grown produce

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	40	40	40
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	11,000	11,000	11,000
Cadmium	149	149	149
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	7,100	7,100	7,100
Lead	310	310	310
Elemental Mercury (Hg ⁰)	0.2	0.6	1.2
Inorganic Mercury (Hg ²⁺)	56	56	56
Methyl Mercury (Hg ⁴⁺)	9	12	15
Nickel	180	180	180
Selenium	430	430	430
Vanadium	1,200	1,200	1,200
Zinc	40,000	40,000	40,000
Cyanide (free)	40	40	40
Volatile Organic Compounds			
Benzene	0.9	1.6	3.3
Toluene	900 (869)	1,900	3,900
Ethylbenzene	80	190	440
Xylene - m	80	190	450
Xylene - o	90	210	480
Xylene - p	80	180	430
Total xylene	80	180	430
Methyl tertiary-Butyl ether (MTBE)	100	170	320
Trichloroethene (TCE)	0.010	0.020	0.045
Tetrachloroethene (PCE)	0.32	0.71	1.64
1,1,1-Trichloroethane	9.0	18.4	40.4
1,1,1,2 Tetrachloroethane	1.5	3.5	8.2
1,1,2,2-Tetrachloroethane	3.9	8.0	17.2
Carbon Tetrachloride	0.026	0.056	0.128
1,2-Dichloroethane	0.009	0.013	0.023
Vinyl Chloride (chloroethene)	0.015	0.019	0.029
1,2,4-Trimethylbenzene	5.6	12.9	26.9
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	6,600 (57)	7,200	7,400
Acenaphthylene	6,600 (86)	7,200	7,400
Anthracene	31,000 (1.17)	35,000	37,000
Benzo(a)anthracene	11.0	13.6	15.0
Benzo(a)pyrene	5.3	5.3	5.3
Benzo(b)fluoranthene	4.0	4.0	4.1
Benzo(g,h,i)perylene	355	358	359
Benzo(k)fluoranthene	106	107	107
Chrysene	30	31	32
Dibenzo(a,h)anthracene	0.31	0.32	0.32
Fluoranthene	1,500	1,600	1,600
Fluorene	2,800 (31)	3,800 (77)	4,500 (183)
Indeno(1,2,3-cd)pyrene	45	46	46
Naphthalene	23	55	125
Phenanthrene	1,300 (36)	1,450	1,520
Pyrene	3,700	3,800	3,800
Phenol	440*	688	1,170
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC ₅ -EC ₆	42	78	161
Aliphatic hydrocarbons >EC ₆ -EC ₈	100	230	530
Aliphatic hydrocarbons >EC ₈ -EC ₁₀	27	65	155
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	130 (48)	330 (118)	770 (283)
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	1,100 (24)	2,400 (59)	4,400 (142)
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	65,000 (8)	92,000 (21)	111,000
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	65,000 (8)	92,000 (21)	111,000
Aromatic hydrocarbons >EC ₈ -EC ₁₀	47	115	269
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	300	600	1,200
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	1,800 (169)	2,300 (419)	2,500
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	1,900	1,900	1,900
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	1,900	1,900	1,900
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	1,900	1,900	1,900
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC) ¹		
Notes: ^: Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data. NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used EC - equivalent carbon. SAC - soil assessment criteria. ¹ LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry. The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994. SAC for TPH fractions, PAHs naphthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3. (VALUE IN BRACKETS) RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.			

APPENDIX D

PHYTOTOXIC GAC

GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) dated 1986, has been transposed into UK law by Statutory Instrument No. 1263, The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as ammended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land (however the status of this document is unclear as it is on the archive section of the Defra website).

The directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to “**prevent harmful effects on soil, vegetation, animals and man**”. To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. Treated sludge is defined as having undergone “biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use”. To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge.

The specified limits of concentrations of selected elements in soil are presented in Table 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK regulations. However since they were ammended following recommendations from the Independent Scientific Committee in 1993. (MAFF/DOE 1993). The GAC are presented in Table 1.

Table 1: Generic assessment criteria

Determinant	Generic assessment criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110
Lead	300	300	300	300
Cadmium	3	3	3	3
Mercury	1	1	1	1
Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP.				