



Taylor Wimpey Southern Counties

Land adjacent to Nyton Road, Eastergate

Geo-Environmental Site Assessment

Project no. 29519 R01 (00)

17/01/2017

RSK



RSK GENERAL NOTES

Project No.: 29519 R01 (00)

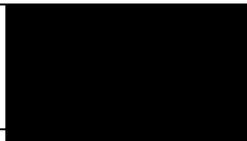
Title: Geo-Environmental Site Assessment: land adjacent to Nyton Road, Eastergate.

Client: Taylor Wimpey Southern Counties, Colvden Court, Wessex Business Park,
Colden Common, Winchester, SO1 1WP.

Date: 18th January 2018

Office: RSK: Unit 26, Abbey Park Industrial Estate, Premier Way, Romsey,
Southampton SO51 9AQ.

Status: Final

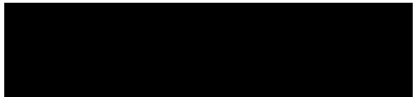
Author Joshua Laite

Signature
Date: 18/01/2018

Technical reviewer Kirsten Fairall

Signature
Date: 18/01/2018

Project manager Craig Lewis

Signature
Date: 18/01/2018

Quality reviewer Carys Baker

Signature
Date: 18/01/2018

RSK Environment Limited (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

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.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd.

CONTENTS

1	INTRODUCTION.....	1
1.1	Objective	1
1.2	Scope	1
1.3	Existing reports	2
1.4	Limitations	2
2	THE SITE	3
2.1	Site location and description	3
2.2	Proposed development	3
3	PREVIOUS REPORTS SUMMARY	4
3.1	Structural Soils (2013) Interpretive report on site investigation (ref. 727897)	4
3.2	Structural soils (2015) Ground investigation report (ref. 730794).....	7
4	CONCEPTUAL SITE MODEL	10
4.1.1	Summary of potential contaminant sources.....	10
4.1.2	Sensitive receptors	11
4.1.3	Summary of plausible pathways	11
4.1.4	Data gaps and uncertainties	11
4.1.5	Potentially complete pollutant linkages	11
5	SITE INVESTIGATION METHODOLOGY	15
5.1	Sampling strategy and methodology	15
5.1.1	Health, safety and environment considerations	15
5.1.2	Investigation locations.....	15
5.1.3	Soil sampling, in-situ testing and laboratory analysis	17
5.1.4	Groundwater monitoring and levelling	18
5.1.5	In-situ infiltration testing	18
6	GROUND CONDITIONS.....	19
6.1	Soil	19
6.1.1	Made Ground	19
6.1.2	River Terrace Deposits	20
6.1.3	Head Deposits (cohesive).....	20
6.1.4	Head Deposits (granular).....	20
6.1.5	London Clay Formation.....	20
6.1.6	Groundwater	21
6.1.7	Results of infiltration rate testing.....	22
6.1.8	Visual/olfactory evidence of soil and groundwater contamination	23
6.2	Refinement of the initial conceptual site model	23
6.2.1	Uncertainty	23
7	QUANTITATIVE RISK ASSESSMENT	24
7.1	Linkages for assessment	24
7.2	Methodology and results	24
7.2.1	Direct contact with impacted soil by future residents and adjacent site users	25
7.2.2	Inhalation exposure of future residents to contaminants in the vapour phase	25

7.2.3	Uptake of contaminants by vegetation potentially inhibiting plant growth	25
7.2.4	Impact of organic contaminants on potable water supply pipes	26
7.2.5	Leaching of contaminants to groundwater into Secondary A aquifer	26
7.3	Environmental assessment conclusions	26
8	REUSE OF MATERIALS AND WASTE	27
8.1	Reuse of suitable materials	27
8.2	Treatment to meet suitable-for-use criteria	28
8.3	Reuse of waste materials	28
8.4	Wastes for landfill disposal	28
8.4.1	Waste acceptance criteria	29
8.4.2	Waste sampling plan	29
8.4.3	Preliminary waste assessment	29
8.4.4	Asbestos within waste soils	29
8.5	Landfill tax	30
8.6	Groundwater	30
8.7	Recommendations	30
9	CONCLUSIONS AND RECOMMENDATIONS	31
9.1	Environmental	31
9.2	Reuse of materials and waste	31
	BIBLIOGRAPHY	33

TABLES

Table 1:	Site setting	3
Table 2:	Summary of historical development	5
Table 3:	Summary of contamination linkages and risks identified by Structural Soils	8
Table 4:	Potential sources and types of contamination as per Structural Soils report	10
Table 5:	Risk estimation for potentially complete pollutant linkages	12
Table 6:	Exploratory hole and monitoring well location rationale	16
Table 7:	Scheduled analysis – Soil	17
Table 8:	General succession of strata encountered	19
Table 9:	Summary of in-situ results for cohesive Head deposits	20
Table 10:	Summary of in-situ and laboratory test results for granular Head Deposits	20
Table 11:	Summary of in-situ test results for London Clay Formation	21
Table 12:	Groundwater results during investigation	21
Table 13:	Groundwater monitoring data (09/11/2017)	21
Table 14:	Groundwater monitoring data (08/12/2017)	22
Table 15:	Falling head test results	22
Table 16:	Linkages for generic quantitative risk assessment	24

FIGURES

Figure 1	Site location plan
Figure 2	Exploratory hole location plan
Figure 3	Proposed development plan

APPENDICES

Appendix A	Service constraints
Appendix B	Summary of legislation and policy relating to contaminated land
Appendix C	Risk assessment methodology
Appendix D	Exploratory hole records
Appendix E	Photographic log
Appendix F	Groundwater monitoring records
Appendix G	In-Situ Hydraulic Conductivity/Infiltration Testing
Appendix H	Laboratory certificates for soil analysis
Appendix I	Human health generic assessment criteria
Appendix J	Generic assessment criteria for phytotoxic effects
Appendix K	Generic assessment criteria for potable water supply pipes
Appendix L	Generic assessment criteria for controlled waters
Appendix M	HASWASTE Assessment

1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by Taylor Wimpey Southern Counties to carry out a geo-environmental assessment of the land adjacent to Nyton Road, Eastergate. It is understood the site is being considered for redevelopment as residential end use.

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

A summary of legislation and policy relating to contaminated land is given in **Appendix B**.

1.1 Objective

The objective of the work is to evaluate client liabilities as part of the due diligence process, including establishing ground conditions and winter groundwater levels beneath the site and further contamination assessment in the vicinity of the former nursery on-site. Site wide contamination testing was not a requirement of this report. In addition geo-technical testing was not within the remit of this report.

1.2 Scope

The scope of the investigation and layout of this report has been designed with consideration of CLR11 (Environment Agency, 2014) and BS 10175: 2013 (BSI, 2013) and guidance on land contamination reports issued by the Environment Agency (EA) (2010a). A summary of contaminated land legislation and policy is provided in **Appendix B**.

The project was carried out to an agreed brief as set out in RSK's proposal (29519 T01/rs, dated 3rd October 2017). The scope of works for the assessment included:

- An intrusive investigation was undertaken on 13th October 2017 consisting of 7 No. boreholes, falling head testing and subsequent groundwater monitoring to determine long term winter groundwater levels;
- an additional intrusive investigation was undertaken on 9th November 2017 consisting 5 No. trial pits with laboratory analysis within the vicinity of the former nursery on-site;
- development of a refined conceptual site model followed by generic quantitative risk assessment (GQRA) to assess complete pollutant linkages that may require the implementation of mitigation measures to facilitate redevelopment;
- identification of outline mitigation measures for complete pollutant linkages or recommendations for further work;
- a factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary.

1.3 Existing reports

The following reports detailing previous works at the site were made available for review:

- Structural Soils (2015) Ground Investigation Report (ref. 730794); and
- Structural Soils (2013) Interpretive Report on Site Investigation (ref. 727897).

These have been summarised in **Section 3**.

1.4 Limitations

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.

While asbestos containing materials (ACM) were not identified during the fieldworks or supporting laboratory analysis, the history of the site indicates that asbestos potentially may be present. Asbestos is often present in discrete areas, therefore it may be found during more extensive ground works.

2 THE SITE

2.1 Site location and description

The site is located directly north of Nyton Road, Eastergate, approximately 10km east of Chichester at National Grid reference SU 94177 05873 as shown on **Figure 1**.

The area around the site is generally residential to the west and south and residential / commercial / agricultural to the north and east of the site as detailed in **Table 1**.

Table 1: Site setting

To the north:	An active scrapyards / recycling centre was noted directly north east of the site. To the north, agricultural fields and sporadic residential / commercial (agricultural) properties exist.
To the east:	The A29 was noted directly east of the site, beyond residential houses are present.
To the south:	Barnett Close and Nyton Road were noted to lie directly south of the site with residential properties and Ormiston Six Villages School 150m beyond. The village of Westergate lies approximately 500m south west of the site. An Esso fuel station was noted ~30m south west of the site.
To the west:	Residential properties were noted directly west of the site with agricultural fields noted beyond.

The site covers approximately 12.15 hectares at an elevation of approximately 13 m above Ordnance Datum (AOD), the site is generally flat and comprises the following main attributes; as noted during the site walkover as shown on **Figure 2**:

- Farmer's workshop / compound comprising a one storey; double height; breeze block built with metal sheeting located in the centre of the site. Numerous agricultural vehicles in a state of disrepair and various tanks were noted to surround the workshop / compound; and
- Disused semi-derelict greenhouse / nursery in the south western portion of the site.

2.2 Proposed development

The site in question is being considered for redevelopment with 206 No. residential properties and a 60 No. bedroom nursing home. The planned layout of the site is shown on **Figure 3**.

3 PREVIOUS REPORTS SUMMARY

Pertinent information from the previous reports provided for the site is summarised in the following sub sections.

3.1 Structural Soils (2013) Interpretive report on site investigation (ref. 727897)

Structural Soils Limited were commissioned by Land Fund Limited to undertake a preliminary geo-environmental risk assessment for the site. The purpose of the work was to investigate ground conditions, assess the contamination status of the site and provide preliminary information for the design of foundations for residential use.

The findings of the Structural Soils report indicated that, based on geological maps from the British Geological Survey (BGS), the geology underlying the site is generally superficial Head Deposits (gravel, sand, silt and clay), underlain by bedrock deposits of the London Clay Formation (clay, silt and sand). Superficial River Terrace Deposits were noted to cap the north eastern and south western portions of the site.

The hydrogeological setting of the site comprises a shallow Secondary A Aquifer relating to superficial Head Deposits overlying Unproductive Strata of the London Clay Formation. The River Terrace Deposits noted to bound the north eastern and south western portions of the site are characterised by a shallow Secondary A Aquifer.

Groundwater monitoring was undertaken within BH1 and BH2 between 12th April 2013 and 30th April 2013 which indicated groundwater to be present between 1.20 – 2.24m bgl. Although Structural Soils did not comment on groundwater flow, it is considered by RSK that groundwater is flowing in a south to south westerly direction given the south to south-westerly direction of the stream directly west of the site.

According to the GroundSure report appended to the Structural Soils report the site does not lie within a currently designated groundwater Source Protection Zone (SPZ).

According to the GroundSure report appended to the Structural Soils report no surface water abstractions are located within a 250m radius of the site. However, a groundwater abstraction is located onsite and is related to spray irrigation.

The GroundSure report indicated one recorded licensed discharge consent within 250m of the site comprising sewage discharge from Blackberry Lodge, Eastergate (permit No. P12241), located 226m north of the site. The GroundSure report also indicated two recorded pollution incidents within a 250m radius of the site comprising; other pollutants 17m south west and noise pollution 144m north of the site. In addition the GroundSure report indicated two recorded incidents under Part A (2) and Part B activities 30 m south of the site associated with the Pace Petrol Filling Station, no enforcements under Part A (2) and Part B were notified.

The nearest surface water feature is Westergate Stream 12m west of the site running in a north to south direction. Westergate Stream is a tributary of the Lindsey Rife located 21m south west of the site.

With reference to the GroundSure report, no mining or quarrying activities were noted on-site. The nearest mining or quarrying activity noted is a chalk mine located 167m north of the site. No other mining or quarrying activities were noted within a 250m radius of the site.

A waste disposal site was noted to be present directly south east from the site from 1st March 1994 to present. The disposed materials comprised <10,000 tonnes of non-hazardous scrap yard waste per year from the Sussex Recovery Scrapyard adjacent to the north eastern boundary of the site. It should be noted that no known restrictions were placed on the disposed material. The nearest historic licence landfill was located approximately 575m north east of the site. The landfill was titled Eastergate Lane Landfill with waste comprising inert, commercial and household waste. Given the distance from the site these landfill are not considered by RSK represent potential risks to the site from the generation and migration of landfill gases and/or leachate. The nearest current licensed waste site is located approximately 419m north east of the site. The waste site titled Sussex Recovery with waste comprising metals.

The radon classification of the site is located within an area where between 1 - 3% of homes in the area are above the Action Level as defined by the Documents of the National Radiological Protection Board (Radon Atlas of England and Wales, NRPB-W26-2002) and that no radon protective measures are required within new dwellings at the site.

A summary of the historical development of the site and the surrounding area is detailed in **Table 2**.

Table 2: Summary of historical development

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
1859 – 1897	The site comprised four fields. A pond was noted in the north western corner of the site. The pond was no longer present following 1896.	The site was bound by fields to the north, with limited residential development to the south. Residential development was noted along Northfields Lane to the west and Eastergate Lane to the east. In addition two smithies were noted ~80m south and south west of the site.
1910 – 1912	No significant changes.	No significant changes.
1937 – 1940	Small building constructed in the south western corner of the site.	Residential development to the east and south east; Nursery 50m east; and Sports ground 50m east.
1961 – 1968	Hedge boundaries removed from field in the south western corner of the site. A small building was noted in the central / southern portion of the site.	No significant changes.
1973 – 1985	Track noted to enter the site along	Poultry house 30m north;

	the north eastern boundary, running west, stopping in the centre of the site. A large nursery was noted in the south western corner of the site.	Car breakers yard 140m north east; Allotment garden directly south east; Electricity substation 30m south east; Electricity substation 30m south; Garage 30m south; and Nursery 5m south west;
1992 – 2002	Farmhouse constructed in the north eastern corner of the site, access via the eastern boundary. An extension to the nursery in the south western portion of the site comprised one large building with two smaller out buildings.	Garage 30m south was relabelled as filling station; Pond 10m south west; Pond 15m west; and Car breakers yard 140m north east was relabelled as scrap yard.
2012	Structure in the south western corner of the site was labelled Nyton Nursery.	A tank was noted 5m south east of the site.

The Structural Soils report suggested the following sources exist on-site, Made Ground (heavy metals and PAHs) and soil surrounding the former nursery (pesticides). In addition the off-site infilled gravel workings, historical landfill and pond were deemed to be potential sources of ground gases such as carbon dioxide and methane.

Fieldwork was undertaken between 18th and 26th March 2013 and comprised 2 No. cable percussion boreholes (BH1 and BH2) and 5 No. machine dug trial pits (TP2a, TP2b, TP3 and TP5). Infiltration testing was undertaken in all trial pits. The investigation indicated Topsoil was present in all locations from ground level to depths ranging between 0.10 – 0.50m bgl. River Terrace Deposits were noted in all locations underlying the Topsoil to depths of 0.35 - 2.50m bgl. Beneath Head Deposits were noted for the full extent of TP2a (0.55m), TP2b (1.50m), TP3 (1.40m), TP4 (1.30m), TP5 (0.80m), BH1 (10.00m) and BH2 (10.00m).

A total of 7 No. soil samples were analysed for heavy metals, Poly Aromatic Hydrocarbons (PAHs) banded (>C6-C10, >C10-C25 and >C25-C40) Total Petroleum Hydrocarbons (TPHs), organic matter, soluble sulphate and pH. No testing was undertaken on soil samples within the nursery area as this was not within the remit of the investigation. No visual or olfactory evidence of contamination was noted during the investigation.

To determine if contaminants present are at concentrations deemed to pose a risk to human health, results were compared to the appropriate residential with plant uptake generic assessment criteria (GACs) at the time of reporting. Where a GAC was not present a CLEA derived soil guideline value (SGV) was used. All results were found to be below the appropriate GAC / SGV. As a result no risks to human health were identified. In addition no risk to water supply pipes, from ground gas or phytotoxic effects to plants were identified when compared to the appropriate screening value at the time of reporting. Results have been compared by RSK to the appropriate current GACs listed in **Appendices I – K**, no exceedences were noted above the relevant GACs.

No further works or recommendations were given, however investigations in the nursery area was not within the scope of this report.

3.2 **Structural soils (2015) Ground investigation report (ref. 730794)**

Structural Soils Limited were commissioned by Bellway Homes Wessex to undertake a preliminary geo-environmental risk assessment for the site. The purpose of the work was to further investigate ground conditions, provide additional information for foundation design and contamination assessment purposes.

Fieldwork was undertaken between 21st and 23rd September 2015 and comprised 2 No. cable percussion boreholes (BH01 and BH02), 4 No. dynamic sampler boreholes (WS01 – WS04) and 6 No. machine dug trial pits (TP01 – TP06). Infiltration testing was undertaken in TP01 – TP03.

The investigation indicated Topsoil was present in BH01, WS02, TP01 and TP06 from ground level to depths ranging between 0.20 – 0.25m bgl. Made Ground was noted from ground level in BH02, WS01, WS03 and WS04 to depths of 0.10 – 0.30 m bgl. River Terrace Deposits were noted in all locations underlying the Topsoil / Made Ground and was 0.30 – 1.00 m in thickness. Beneath Head Deposits were noted for the full extent of WS01 – WS04 and TP01 – TP06 and to depths of between 6.50 and 8.30 m in BH01 and BH02. The Head Deposits were underlain by soils of the London Clay Formation for the remainder of BH01 and BH02, down to the final drilled depth of 10.45 m bgl. During the investigation groundwater was encountered at depths ranging between 1.95 – 4.50 m bgl in all locations with the exception of TP03. An additional groundwater monitoring round was undertaken which observed standing groundwater levels ranging between 1.31 – 3.04 m bgl.

A total of 7 No. soil samples were analysed for heavy metals, PAHs, speciated TPHs, organic matter, asbestos presence, soluble sulphate and pH and 4. No soil samples were tested for pesticides. In addition 2 No. water samples were tested for heavy metals, PAHs, speciated TPHs, organic matter, sulphate hardness and pH. No visual or olfactory evidence of contamination was noted during the investigation.

To determine if contaminants present are at concentrations deemed to pose a risk to human health results were compared to residential with plant uptake GACs. Where a GAC was not present a CLEA derived soil guideline value (SGV) was used).

Soils sampled from WS03 at 0.05m bgl contained PAH compounds in excess of the GAC / SGV applicable at the time of reporting, summarised as follows:

- Benzo(a)anthracene concentration of 23.8mg/kg exceeded the GAC of 11mg/kg;
- Benzo(a)pyrene concentration of 25.5mg/kg exceeded the GAC of 5mg/kg;
- Benzo(a)fluoranthene concentration of 24.5mg/kg exceeded the GAC of 3.3mg/kg;
- Chrysene concentration of 25. mg/kg exceeded the GAC of 22 mg/kg; and
- Dibenzo(ah)anthracene concentration of 23.8mg/kg exceeded the GAC of 11mg/kg.

The Structural Soils report suggests elevated PAHs in WS03 at 0.05m were restricted to a gravel layer containing asphalt which was only 0.10m thick.

In addition concentrations of dichlorodiphenyldichloroethylene (p,p-DDE), dichlorodiphenyltrichloroethane (p,p-DDT), dichlorodiphenyldichloroethane (p,p-DDE) (DDD) and 1,1,1-trichloro-2-(2-chlorophenyl)-2-(4-chlorophenyl)ethane (o,p-DDT) were measured above levels of detection in soil collected from WS01 at 0.20m bgl. No applicable GAC or UK screening value was available at the time of reporting therefore screening values from the United States Environmental Protection Agency for residential end use were used to compare concentrations of p,p-DDE, p,p-DDT, p,p-TDE (DDD), measured concentrations were not found to exceed these screening values. However no readily available screening value was available for o,p-DDT at the time of reporting.

All remaining results were found to be below the appropriate GAC / SGV applicable at the time of reporting.

Generally concentrations were below the stated phytotoxic GAC with the exception of one exceedance for zinc which had a concentrations of 425mg/kg in soil collected from WS01 at 0.20m bgl as compared to the GAC of 300mg/kg. No risks to water supply pipes or groundwater were identified. However at the time of the investigation the future routes of water supply pipes was unknown, therefore the investigation may not have been fully compliant with UKWIR recommendations. Consequentially, a targeted investigation was recommended by Structural Soils once the supply pipe route had been established.

The complete contamination linkages and risks Structural Soils identified are summarised in **Table 3**.

Table 3: Summary of contamination linkages and risks identified by Structural Soils

Source - Soil	Pathway	Receptor	Probability / Consequence	Risk
Made Ground (PAH in WS03)	Ingestion / Dermal contact	Future site users	Likely / Medium	Moderate
		Maintenance workers	Low likelihood / Medium	Moderate / low
Made Ground (Zinc in WS01)	Root uptake	Plants / soft landscaping	Low likelihood / mild	Low

The following recommendations were made:

- Further pesticide testing should be conducted in the former nursery area to ascertain whether any additional elevated pesticide concentrations are present;
- The elevated PAH compounds in WS3 at 0.05m were restricted to a gravel layer containing asphalt which was only 0.10m thick. Therefore, it was recommended that this material is removed from site.

- At the time of the investigation the future routes of water supply pipes were unknown, therefore the investigation may not be fully compliant with UKWIR recommendations. Consequentially, it was recommended that a targeted investigation may be required at a later date once the supply pipe route has been established.
- Structural Soils did not make any recommendations regarding the phytotoxicity of zinc in soil collected from WS01 at 0.20m bgl. In RSK's opinion this doesn't warrant further consideration as the concentration of zinc in soil collected from WS01 at 0.20m bgl of 425 mg/kg is within the same order of magnitude as compared to the GAC of 300 mg/kg.

4 CONCEPTUAL SITE MODEL

The information presented in **Sections 2 and 3**, has been used by RSK to compile a conceptual site model in relation to area of the former on-site nursery. Information and conclusions drawn by RSK within **Section 4** is based upon information provided within the preceding Structural Soils reports.

The identified potential sources of contamination, associated contaminants and receptors identified as requiring further assessment following the Structural Soils report have been considered with plausible pathways that may link them. The resulting potential pollutant linkages are considered in **Section 4.1.5**. The risk classification has been estimated in accordance with information in **Appendix C**.

It should be noted that Structural Soils discounted surface water and groundwater as receptors as appropriate GACs or target Concentrations (TCs) were not exceeded.

4.1.1 Summary of potential contaminant sources

Potential sources and contaminants of concern are summarised in **Table 4**.

Table 4: Potential sources and types of contamination as per Structural Soils report

Potential sources	Contaminants of concern
On-site historical	
Historic nursery usage	Herbicides, pesticides, metals, leachable metals total organic carbon, sulphate, pH, asbestos, PAHs and TPHs,
Made Ground	TPHs and pesticides
Off-site current	
Petrol Filling Station 30m south west	Metals, leachable metals, asbestos, PAHs and TPHs,

Pesticides and herbicides associated with the nursery and localised spillages associated from machinery such as generators within the vicinity of the nursery have been identified as the only potential sources which may affect human health, which are yet to be investigated on-site.

Whilst elevated PAH compounds were detected in WS3 at 0.05m this was restricted to a gravel layer containing asphalt which was only 0.10m thick, this materials was recommended to be removed off-site by Structural Soils, therefore the source will remain until this material has been removed from site.

Structural Soils did not make any recommendations regarding the phytotoxicity of zinc in soil collected from WS01 at 0.20m bgl. In RSKs opinion no risk is present as the concentration of zinc in soil collected from WS01 at 0.20m bgl of 425mg/kg is within the same order of magnitude as compared to the GAC of 300mg/kg.

Although Structural Soils did not comment on groundwater flow, it is considered by RSK that groundwater is flowing in a south to south-westerly direction given the south to

south-westerly direction of the stream directly west of the site. As a result RSK does not consider the petrol filling station ~30m south-west of the site to be a risk to groundwater beneath the site.

4.1.2 Sensitive receptors

Sensitive receptors at this site include:

- Future site occupants
- Adjacent site users
- Vegetation
- Potable water supply pipes

Please note that construction workers have not been identified in the conceptual site model as potential receptors because risks are considered to be managed through health and safety procedures including CDM regulations.

Whilst no risks were identified to potable water supply pipes in the Structural Soils reports, it should be noted that at the time of the investigation the future routes of water supply pipes was unknown, therefore the investigation may not be fully compliant with UKWIR recommendations. Consequentially, a targeted investigation may be required at a later date once the supply pipe route has been established.

4.1.3 Summary of plausible pathways

The plausible pathways are summarised below:

- Direct contact (soil, dust and vegetable ingestion, dermal contact, dust and fibre inhalation);
- Soil gas inhalation;
- Leaching of potential contaminants of concern to underlying Secondary A Aquifer following removal of former nursery;
- Root uptake; and
- Chemical attack of infrastructure (including water supply pipes) and buildings.

4.1.4 Data gaps and uncertainties

At the time of the Structural Soils investigation a water supply pipe route had not been identified, therefore the investigation may not be fully compliant with UKWIR recommendations. Consequentially, a targeted investigation may be required at a later date once the supply pipe route has been established.

4.1.5 Potentially complete pollutant linkages

Based on the information available for review, RSK has produced an outline conceptual site model and an estimate of the risk associated with each pollutant linkage. This is summarised in **Table 5**. The risk classification has been undertaken in accordance with CIRIA C552 (Rudland et al., 2001), a summary of which is included in **Appendix C**.

Table 5: Risk estimation for potentially complete pollutant linkages

Potential Contaminant	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
Contaminants of potential concern (COPC) within soil on site from pesticide and herbicide usage within the former nursery in the south western corner of the site.	Future Site users	Direct contact, inhalation pathways	Likely	Medium	Moderate risk: Presence of COPC within soils is not confirmed, however if present, risk to human health exists in areas of soft landscaping on site.
	Adjacent site users		Low likelihood	Medium	Moderate / low risk: Presence of COPC within soils is not confirmed, however if present, risk to human health exists in areas of soft landscaping on site.
	Water supply pipes	Permeation through direct contact	Low likelihood	Minor	Very low risk: Concentrations of COPC on-site to date have not been found at concentrations considered to pose a risk to water supply pipes. However, as the proposed water supply pipe routes are unknown there remains a low likelihood that water supply pipes may be at risk from permeation of contaminants through impacted ground.
	Vegetation	Root uptake	Low likelihood	Minor	Very low risk: Presence of COPC within soils is not confirmed, however if present, vegetation may be at risk from phyto-toxicity.
Contaminants of potential concern (COPC) across site from Made Ground	Water supply pipes	Permeation through direct contact	Low likelihood	Minor	Very low risk: Concentrations of COPC on-site to date have not been found at concentrations considered to pose a risk to water supply pipes. However, as the proposed water supply pipe routes are unknown there remains a low likelihood that water supply pipes may be at risk from permeation of contaminants through impacted ground.



Potential Contaminant	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
Leaching of contaminants of potential concern (COPC) following the removal of the former nursery in the south western corner of the site.	Groundwater	Leaching	Low likelihood	Medium	Moderate / low risk: Presence of COPC within soils is not confirmed, however if present, risk to groundwater may be at risk through leaching of contaminants through impacted soil.

The potential pollutant linkages with a risk of moderate or above that may drive site investigation works are:

- Potentially a moderate risk to future and adjacent site users from ingestion of contaminated soil, dust; and inhalation of contaminated dust containing pesticides; and
- Potentially a moderate risk to groundwater following the removal of the former nursery from the leaching of contaminants.

Structural Soils did not make any recommendations regarding the phytotoxicity of zinc in soil collected from WS01 at 0.20m bgl. In RSK's opinion no risk is present as the concentration of zinc in soil collected from WS01 at 0.20m bgl of 425mg/kg is within the same order of magnitude as compared to the GAC of 300mg/kg.

Although Structural Soils did not comment on groundwater flow, it is considered by RSK that groundwater is flowing in a south to south-westerly direction given the south to south-westerly direction of the stream directly west of the site. As a result RSK does not consider the petrol filling station ~30m south-west of the site to be a risk to groundwater beneath the site.

Whilst elevated PAH compounds were detected in WS3 at 0.05m this was restricted to a gravel layer containing asphalt which was only 0.10m thick, this materials was recommended to be removed off-site by Structural Soils, therefore the source and risks identified by WDE Consulting will remain until this material has been removed from site.

5 SITE INVESTIGATION METHODOLOGY

RSK carried out intrusive investigation work to install groundwater monitoring wells and conduct borehole infiltration testing on 13th October 2017 to provide further information on the hydrogeological regime beneath the site.

An additional intrusive investigation within the former nursery was undertaken on 9th November 2017 to further investigate the potential pollutant linkages identified in the CSM.

5.1 Sampling strategy and methodology

The techniques adopted for the investigation were chosen considering the anticipated ground conditions, existing land use and the proposed development.

The investigation undertaken by Structural Soils in 2015 indicated groundwater to be present at 1.31 – 4.50m bgl.

A non-targeted investigation was considered appropriate for the wider site to provide a detailed understanding of the groundwater regime beneath the site. Seven boreholes were drilled (WS1 – WS7) using dynamic sampling techniques. Groundwater monitoring wells were subsequently installed in all locations, see **Table 6** for details.

In addition, a non-targeted investigation within the former nursery in the south western portion of the site was undertaken on 9th November 2017 comprising five hand dug pits (HDP1 – HDP5), see **Table 6** for details.

Groundwater data loggers were installed in WS1 – WS4 on 13th October 2017 to monitor winter groundwater levels. The logging regime will collect data over 6 months. Results will be submitted as an addendum to this report.

5.1.1 Health, safety and environment considerations

Prior to intrusive investigation works, reference was made to existing service drawings for the site to prevent damage to underground utilities, in addition, each of the exploratory locations were cleared and marked out by a service clearance company.

The RSK engineer carried out a scan of each exploratory hole location using a Cable Avoidance Tool (CAT) as a final check prior to commencement of drilling.

Due to the potential presence of asbestos containing materials (ACM) and asbestos fibres in Made Ground, all works were undertaken in accordance with RSK's technical procedure for asbestos in soil (TP216 revision 01, dated August 2015).

5.1.2 Investigation locations

The site work was carried out by RSK on the 13th October and comprised the activities summarised in **Table 6**, along with a justification for each exploratory hole location. Additional site works targeting the nursery in the south western portion of the site was undertaken on the 9th November and comprised 5 hand dug pits as summarised in Error! Reference source not found.**Table 6** along with a justification for each exploratory hole

location. The investigations and the soil descriptions were carried out in general accordance with BS5930: 2015 - Code of Practice for Ground Investigations. The exploratory hole logs and other site work records are presented in **Appendix D** and photographic log in **Appendix E**.

The locations of the intrusive investigations are shown in **Figure 2**. The rationale for these locations is given in **Table 6**.

Table 6: Exploratory hole and monitoring well location rationale

Investigation Type	Exploratory hole number	Response zone (m bTOC)	Rationale / Additional information
Boreholes with monitoring well installations	WS1	1.00 – 4.00	Non-targeted assessment to further assess the groundwater regime beneath the site. Groundwater monitoring well installed to target the secondary A Aquifer relating to the Head deposits. Groundwater noted at 2.50m bgl. Datalogger installed at 3.50m bgl to record groundwater level / movement.
	WS2	1.00 – 5.00	Non-targeted assessment to further assess the groundwater regime beneath the site. Groundwater monitoring well installed to target the secondary A Aquifer relating to the Head deposits. Groundwater noted at 4.00m bgl. Datalogger installed at 5.00m bgl to record groundwater level / movement.
	WS3	1.00 – 4.00	Non-targeted assessment to further assess the groundwater regime beneath the site. Groundwater monitoring well installed to target the secondary A Aquifer relating to the Head deposits. Groundwater noted at 3.70m bgl. Datalogger installed at 4.70m bgl to record groundwater level / movement.
	WS4	1.00 – 5.00	Non-targeted assessment to further assess the groundwater regime beneath the site. Groundwater monitoring well installed to target the secondary A Aquifer relating to the Head deposits. Groundwater noted at 2.80m bgl. Datalogger installed at 3.80m bgl to record groundwater level / movement.
	WS5	1.00 – 4.00	Non-targeted assessment to further assess the groundwater regime beneath the site. Groundwater monitoring well installed to target the secondary A Aquifer relating to the Head deposits. Groundwater noted at 2.50m bgl. Falling head test undertaken in clay.
	WS6	1.00 – 3.00	Non-targeted assessment to further assess the groundwater regime beneath the site. Groundwater monitoring well installed to target the secondary A Aquifer relating to the Head deposits. No groundwater noted. Falling head test undertaken in gravel.

Investigation Type	Exploratory hole number	Response zone (m bTOC)	Rationale / Additional information
	WS7	1.00 - 2.00	Non-targeted assessment to further assess the groundwater regime beneath the site. Groundwater monitoring well installed to target the secondary A Aquifer relating to the Head deposits. Groundwater noted at 1.70m bgl. Falling head test undertaken in clay.
Hand Dug Pits within the former nursery in the south western portion of the site	HDP1	N/A	Investigation locations to determine if contamination is present within the former nursery in the south western portion of the site. Non-targeted locations within this area.
	HDP2	N/A	
	HDP3	N/A	
	HDP4	N/A	
	HDP5	N/A	

The investigation points were located approximately by reference to physical features present on the site at the time of investigation.

5.1.3 Soil sampling, in-situ testing and laboratory analysis

A total of 4. No samples were scheduled for environmental analysis and are recorded together with their depths on the exploratory hole records in **Appendix D**. In addition a total of 54. No samples were taken and screened using a PID meter, results are recorded on the exploratory hole records in **Appendix D**. Samples were taken to characterise the Made Ground and natural strata encountered in the vicinity of the former nursery area. The samples were transported to the laboratory in chilled cool boxes. Laboratory chain of custody forms can be provided if required. The rationale for soil sample chemical analysis is presented in **Table 7**.

Table 7: Scheduled analysis – Soil

Exploratory hole no. and sample depth (m bgl)	Analyte	Rationale
HDP1 / 0.20	Metals, asbestos screen, PAH 16 and TPH CWG.	Investigate potential migration of contaminants associated with the former nursery.
HDP2 / 0.20	TOC, nitrogen pesticides and pesticide C suite.	
HDP3 / 0.30	Metals, asbestos screen, PAH 16, TPH CWG and leachate.	
HDP5 / 0.20	Metals, TOC, asbestos screen, nitrogen pesticides, pesticide C suite, PAH 16 and TPH CWG.	
Notes: Site wide contamination testing was not a requirement of this investigation.		

Standard penetration tests (SPTs) were carried out within cohesive deposits at regular intervals of approximately 1 m during the dynamic sampling boreholes and in accordance with part 9 of BS 1377:1990 (BSI, 1990). Cone penetration tests (CPTs) were carried out within granular deposits at regular intervals of approximately 1 m during the dynamic sampling boreholes and in accordance with part 9 of BS 1377:1990 (BSI, 1990). Test results are given on the borehole records presented in **Appendix D** and within the summary table included within that appendix. Geo-technical analysis was not a requirement of this investigation.

5.1.4 Groundwater monitoring and levelling

Depths to groundwater were recorded using an electronic dip meter on 13th October, 9th November and 8th December 2017. The monitoring results are given in **Section 6.1.6**.

Groundwater data loggers have been installed in WS1 – WS4 to monitor winter groundwater levels. The logging regime will collect data over 6 months and an updated report will be submitted once all monitoring is completed.

The groundwater monitoring data is presented in **Appendix F**.

5.1.5 In-situ infiltration testing

Falling head tests were undertaken following drilling in WS5 – WS7 to ascertain infiltration rates of soils relating to the Head Deposits. The results are presented **Section 6.1.7** and in **Appendix G**.

6 GROUND CONDITIONS

The results of the intrusive investigation undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented in **Appendix D**.

6.1 Soil

The exploratory holes revealed that the site is underlain by a variable thickness of Topsoil / Made Ground, underlain by Head Deposits with soils of the London Clay Formation occasionally encountered at depth (WS3 and WS4 only). Made Ground was encountered in WS7, HDP3 and HDP5 only. River Terrace Deposits were noted beneath the Topsoil / Made Ground in HDP1 – HDP5. This appears to conform with the stratigraphical succession described within the conceptual model. For the purpose of discussion, the ground conditions are summarised in **Table 8** and the strata discussed in subsequent subsections

Table 8: General succession of strata encountered

Strata	Exploratory holes encountered	Depth to top of stratum m bgl	Thickness (m)
Topsoil	WS1 – WS7, HDP1 – HDP2 and HDP4 – HDP5.	GL	0.20 – 0.65
Made Ground	WS7, HDP3 and HDP5.	GL - 0.40	0.25 - 0.30
River Terrace Deposits	HDP1 – HDP5	0.25	0.35 -0.75
Head Deposits (cohesive)	WS1, WS2, WS4 - WS7 and HDP5	0.25 - 0.70	0.35 – 3.30 (not proven in WS7 only)
Head Deposits (granular, gravel)	WS1, WS3 - WS6	0.55 - 1.20	0.60 – 2.35 (not proven)
Head Deposits (cohesive)	WS1 – WS5	1.90 – 2.90	0.40 – 2.15 (not proven)
Head Deposits (granular, sand)	WS1 and HDP1- HDP4	0.25 - 3.80	0.45 – 0.75 (not proven)
London Clay Formation	WS3, WS4	3.30 - 4.10	1.15 - 1.35 (not proven)

6.1.1 Made Ground

Made Ground was encountered in three locations; in WS7 it comprised a silty gravelly clay, encountered at 0.40m bgl and 0.30m in thickness. The Made Ground within the

area of the former nursery in HDP3 and HDP5 comprised a light to dark brown black clayey gravelly sand to sandy gravelly clay, encountered at ground level (GL) to a depth of 0.25m bgl.

6.1.2 River Terrace Deposits

This stratum was encountered beneath the Topsoil / Made Ground at a depth of 0.25m bgl and was between 0.35 – 0.75m in thickness.

6.1.3 Head Deposits (cohesive)

This stratum was encountered beneath the Topsoil / Made Ground comprising an initial layer of generally light to mid brown silty gravelly clay between 0.25 – 0.70m bgl and 0.35 – 3.30m in thickness.

Beyond the granular Head Deposits described in **Section 6.1.4**, an additional layer of cohesive Head Deposits was noted comprising a soft to very stiff light brown, beige mottled silty gravelly clay between 1.90 – 2.90m bgl and 0.40 – 1.90m in thickness.

A summary of the in-situ testing in this stratum is presented in **Table 9** and in **Appendix D**.

Table 9: Summary of in-situ results for cohesive Head deposits

Soil parameters	Range	Reference
SPT 'N' values	4 - 17	Appendix D
Stiffness term	Soft to very stiff	BS5930:2015

6.1.4 Head Deposits (granular)

This stratum was encountered at a depth of between 0.25 and 1.50m bgl generally below the initial layer of cohesive Head Deposits and varies between 0.40 and 1.90m in thickness. Based on the site descriptions and in-situ tests carried out, this layer can be described as a medium dense predominately granular soil.

A summary of the in-situ results in this stratum is presented in **Table 10** and in **Appendix D**.

Table 10: Summary of in-situ and laboratory test results for granular Head Deposits.

Soil parameters	Range	Reference
SPT 'N' values	12 - 27	Appendix D
Density term	Medium dense	BS5930:2015

6.1.5 London Clay Formation

Soils of the London Clay Formation was encountered in WS3 and WS4 at a depth of between 3.30 - 4.10m bgl to the full depth of the investigation locations. Based on the site descriptions and in-situ testing carried out this stratum can be described as a stiff to hard clay.

A summary of the in-situ test results in this stratum is presented in **Table 11** and in **Appendix D**.

Table 11: Summary of in-situ test results for London Clay Formation

Soil parameters	Range	Reference
SPT 'N' values	11 - 39	Appendix D
Stiffness term	Stiff to hard	BS5930:2015

6.1.6 Groundwater

Groundwater was encountered during the investigation within WS1 – WS5 and WS7 as detailed in **Table 12**.

Table 12: Groundwater results during investigation

Borehole	Stratum	Strike (m bgl)
WS1	Head Deposits (cohesive)	2.50
WS2	London Clay Formation	3.80
WS3	Head Deposits (cohesive)	3.70
WS4	Head Deposits (granular)	2.80
WS5	Head Deposits (cohesive)	2.50
WS7	Head Deposits (cohesive)	1.70

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal variations. The ongoing monitoring will provide information with respect to the groundwater conditions and establish any trends in groundwater levels.

The results of the subsequent groundwater monitoring visits conducted on 9th November 2017 and 8th December 2017 are summarised in **Table 13** and **14**.

Table 13: Groundwater monitoring data (09/11/2017)

Monitoring well	Depth to product (mb TOC)	Depth to water (mb TOC)	Product thickness (m)	Corrected depth to water (mb TOC)
WS1	N/A	2.34	N/A	2.34
WS2	N/A	2.61	N/A	2.61
WS3	N/A	3.37	N/A	3.37
WS4	N/A	2.85	N/A	2.85

Monitoring well	Depth to product (mb TOC)	Depth to water (mb TOC)	Product thickness (m)	Corrected depth to water (mb TOC)
WS5	N/A	3.06	N/A	3.06
WS6	N/A	DRY	N/A	DRY
WS7	N/A	1.62	N/A	1.62
Notes: mb TOC metres below top of casing, m ASD metres above site datum, m AOD metres above Ordnance datum, N/A not observed.				

Table 14: Groundwater monitoring data (08/12/2017)

Monitoring well	Depth to product (mb TOC)	Depth to water (mb TOC)	Product thickness (m)	Corrected depth to water (mb TOC)
WS1	N/A	2.10	N/A	2.10
WS2	N/A	2.40	N/A	2.40
WS3	N/A	3.22	N/A	3.22
WS4	N/A	2.73	N/A	2.73
WS5	N/A	2.88	N/A	2.88
WS6	N/A	DRY	N/A	DRY
WS7	N/A	1.42	N/A	1.42
Notes: mb TOC metres below top of casing, m ASD metres above site datum, m AOD metres above Ordnance datum, N/A not observed.				

It is noted that a survey is planned to establish the level of each borehole relative to ordnance datum in January 2018. The findings to date reflect that the general groundwater table lies within the cohesive Head Deposits (WS1 – WS3, WS5 and WS7), with the exception of WS4 in which the groundwater table was observed within the granular Head Deposits. The results from the full six month of groundwater monitoring programme will be provided as an addendum to this report once groundwater monitoring programme has been completed.

Groundwater monitoring results to data are presented within **Appendix F**.

6.1.7 Results of infiltration rate testing

The results of the falling head tests are summarised in **Table 15** and **Appendix G**. One test was carried out per location.

Table 15: Falling head test results

Borehole/ monitoring well	Saturated geological unit	Infiltration rate (m/s)
WS5	Head Deposits	7.22×10^{-5}
WS6	Head Deposits	3.69×10^{-6}

Borehole/ monitoring well	Saturated geological unit	Infiltration rate (m/s)
WS7	Head Deposits	1.15x10 ⁻⁴

6.1.8 Visual/olfactory evidence of soil and groundwater contamination

No visual or olfactory evidence of contamination was noted throughout the investigations. However, during the walkover a small area of burnt materials was noted directly adjacent to the north western corner of the nursery.

6.2 Refinement of the initial conceptual site model

The ground conditions encountered generally concur with those anticipated by the BGS geology map. Generally the site is underlain by a variable thickness of Topsoil / Made Ground, underlain by Head Deposits with soils of the London Clay Formation encountered at depth.

No visual/olfactory evidence of significant gross contamination was encountered during the intrusive investigation and in-situ volatiles screening results using a photo-ionisation detector (PID) were not recorded above 0.2 ppmV as shown on the exploratory hole records included in **Appendix D**. To further assess the potential pollutant linkages identified in **Section 4** a selection of soil samples were submitted for laboratory testing. The results of which are included in **Appendix H**.

Based on refinement of the conceptual site model, the potential pollutant linkages that require further assessment include:

- Direct contact with and inhalation of vapours from impacted soil by future residents and adjacent site users;
- Leaching of contaminants to groundwater following the removal of the former nursery in the south western corner of the site;
- Uptake of contaminants by vegetation potentially impacting plant growth; and
- Contaminants permeating potable water supply pipes.

6.2.1 Uncertainty

At the time of the investigation the future routes of water supply pipes was unknown, therefore the investigation may not be fully compliant with UKWIR recommendations.

7 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (EA, 2004), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

7.1 Linkages for assessment

Section 4 presents the conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in **Table 16**.

Table 16: Linkages for generic quantitative risk assessment

Potentially relevant pollutant linkage	Assessment method
1. Direct contact with impacted soil by future residents and adjacent site users (in relation to Metals, TOC, asbestos screen, nitrogen pesticides, pesticide C suite, PAH 16 and TPH CWG).	Human health GAC in Appendix I for a proposed residential end use with private gardens since proposed end use includes residential gardens.
2. Inhalation of impacted soils vapours by future residents and adjacent site users	Human health GAC in Appendix I for a proposed residential end use with private gardens since proposed end use includes residential gardens.
3. Uptake of contaminants by vegetation potentially impacting plant growth	Comparison of soil data to GAC in Appendix for the potential uptake of leachable metals.
4. Contaminants permeating potable water supply pipes (in relation to TPH and pesticides)	Comparison of soil data to GAC in Appendix K for plastic water supply pipes using UKWIR (2010) guidance.
5. Leaching of contaminants to Secondary A Aquifer through impacted soil.	Human health GAC in Appendix L for a proposed residential end use with private gardens since proposed end use includes residential gardens.

7.2 Methodology and results

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

7.2.1 Direct contact with impacted soil by future residents and adjacent site users

Metals, PAH compounds, speciated TPH, BTEX, asbestos, and pesticides (with the exception of p,p-DDE, p,p-DDT and o,p-DDT) were not found to exceed the GAC associated with direct contact pathways. Concentrations of p,p-DDE (0.698mg/kg, HDP5 at 0.20m bgl), p,p-DDT (0.776mg/kg, HDP5 at 0.20m bgl) and o,p-DDT (0.209mg/kg, HDP5 at 0.20m bgl) were detected above limit of detection (LOD). However, no GAC or UK screening value is currently available therefore screening values from the United States Environmental Protection Agency (USEPA, 2017) for residential end use were used to compare concentrations of p,p-DDE, p,p-DDT and o,p-DDT. No readily available screening value for p,p-DDT or o,p-DDT was available at the time of reporting, however a screening value for DDT was available. As p,p-DDT and o,p-DDT are different isomers of DDT, concentrations of p,p-DDT and o,p-DDT have been combined to provide a representative comparison value. No exceedances of the United States Environmental Protection Agency (2017) for residential end use screening values were observed for p,p-DDE (2.00mg/kg) and DDT (1.90mg/kg).

It should be noted that the USEPA screening criteria for non-threshold substances are based on a target cancer risk of $1E^{-06}$, whereas UK derived values are based on a target cancer risk of $1E^{-05}$. As concentrations of p,p-DDE or DDT were an order of magnitude lower than the USEPA screening criteria no potentially significant risks associated with the measured concentration of contaminants in soil have been identified. It is therefore, considered that the site suitable for the proposed end use, subject to the removal of the gravel layer containing asphalt surrounding WS3 in accordance with Structural Soils recommendations.

7.2.2 Inhalation exposure of future residents to contaminants in the vapour phase

In-situ PID volatile organic compounds screening (VOCs) results were recorded during the site investigation works at a maximum concentration of 0.2 ppmV, which is marginally above the method detection limit of <0.1 ppmV. This, along with the absence of olfactory signs of contamination during the works suggests the absence of significant volatile contamination of concern.

Inhalation exposure to VOCs has been further assessed through the direct comparison of soil data with the human health GAC presented in **Appendix I** for inhalation pathways. None of the measured concentrations in soil are in excess of the GAC specific to inhalation exposure pathways.

Inhalation exposure to VOCs has been further assessed through the direct comparison of soil data with the groundwater assessment criteria (GrAC) presented in **Appendix I** for inhalation pathways. None of the measured concentrations in soil are in excess of the GAC specific to inhalation exposure pathways.

Based on the multiple lines of evidence considered above, a potential risk to future residents via inhalation of the vapours is not considered an active pollutant linkage.

7.2.3 Uptake of contaminants by vegetation potentially inhibiting plant growth

The results associated with the former nursery have been compared with the GAC presented in **Appendix J** for this linkage. The results indicate that a relevant pollutant is unlikely to exist associated with phytotoxic effects in the vicinity of the former nursery.

Structural soils observed concentrations of zinc in soil collected from WS01 at 0.20m bgl of 425mg/kg, which exceeds the applicable GAC of 300 mg/kg presented in **Appendix J** for this linkage. Structural Soils did not make any recommendations regarding the phytotoxicity of zinc in soil collected from WS01 at 0.20m bgl. In RSK's opinion no risk is present as the concentration of zinc in soil collected from WS01 at 0.20m bgl of 425mg/kg is within the same order of magnitude as compared to the GAC of 300mg/kg

7.2.4 Impact of organic contaminants on potable water supply pipes

For initial assessment purposes, the results of the investigation in the vicinity of the former nursery have been compared with the GAC presented in **Appendix K** for this linkage, which are reproduced from UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (UKWIR, 2010).

The results indicate that a relevant linkage is unlikely to exist associated with organic contaminants and therefore pollutant polyethylene (PE) and/or polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development in the vicinity of the former nursery, which concurs with Structural Soils findings for the wider site.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

7.2.5 Leaching of contaminants to groundwater into Secondary A aquifer

The metal leachate analytical results are below the appropriate GAC presented in **Appendix L**, indicating pollutant linkages associated with leaching of contaminants into the dissolved phase are incomplete. On this basis, no significant risks are considered to groundwater.

7.3 Environmental assessment conclusions

The groundwater monitoring programme is not yet completed with additional visits planned, therefore the assessment is not yet finalised. The groundwater results will be submitted as an addendum to this report.

The results of the GQRA in combination with these findings indicate that the site is suitable for the proposed residential end use with gardens, subject to the removal of the gravel layer containing asphalt within the region of WS3 in accordance with Structural Soils recommendations. However, should any unexpected contamination be identified during development then additional testing may need to be undertaken.

8 REUSE OF MATERIALS AND WASTE

8.1 Reuse of suitable materials

Under the Waste Framework Directive, naturally occurring soils are not considered waste if reused on the site of origin for the purposes of development.

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, 2011) (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. The current reuse scenarios covered by the CoP comprise

- reuse on the site of origin (with or without treatment)
- direct transfer of clean and natural soils between sites
- use in the development of land other than the site of origin following treatment at an authorised Hub site (including a fixed soil treatment facility).

The importation of Made Ground soils (irrespective of contamination status) or crushed demolition materials is not permitted currently under the CoP and requires either a standard rules environmental permit or a U1 waste exemption (see below).

In the context of excavated materials used on sites undergoing development, four factors are considered to be of particular relevance in determining if the material is a waste or when it ceases to be waste:

- the aim of the Waste Framework Directive is not undermined, i.e. if the use of the material will create an unacceptable risk of pollution of the environment or harm to human health it is likely to be waste
- the material is certain to be used
- the material is suitable for use both chemically and geotechnically
- only the required quantity of material will be used.

The CoP requires the preparation of a materials management plan (MMP) that confirms the above factors will be met. 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 and on completion a verification report produced that shows the MMP was followed and describes any changes.

The MMP establishes whether specific materials are classified as waste and how excavated materials will be treated and/or reused in line with the CoP. The MMP is likely to form part of the site waste management plan.

The site has been developed previously and the investigation has confirmed the presence of Made Ground. Therefore, before any excavation works begin on-site, an MMP will need to be prepared, reviewed by a QP; and a Declaration lodged with the EA.

As noted above, under the Waste Framework Directive naturally occurring soils are not considered waste and therefore arisings of clean natural soils, e.g. from foundation and drainage excavations, may be reused on the site. However, it is important that these soils should be stockpiled separately and not become cross-contaminated with Made Ground / contaminated soils or construction wastes.

If it were proposed to import clean and naturally occurring soils direct from another site, the receiving site's MMP would need to be updated in advance of importation.

8.2 Treatment to meet suitable-for-use criteria

Where materials do not meet the suitable for use criteria, it may be possible to treat them under an environmental permit (mobile treatment licence) to enable them to be reused on-site.

To enable the treatment options to be determined, an options appraisal and a remediation strategy document will be necessary to support discussion of the issues with regulators and third parties.

8.3 Reuse of waste materials

If material is discarded as waste then its reuse on site may still be possible. Waste soils and recycled aggregate can be reused on site under a standard rules environmental permit or a U1 waste exemption from the Environmental Permitting (England and Wales) Regulations 2010 provided that they are suitable for the proposed use, i.e. not cause harm to human health or the environment. However, it should be noted that these have strict limits on the quantity of material that can be reused.

8.4 Wastes for landfill disposal

Wastes require pre-treatment prior to disposal at landfill. Pre-treatment must be a physical, thermal, chemical or biological process (including sorting) that changes the characteristics of the waste to reduce its volume, reduce its hazardous nature, facilitate its handling and enhance its recovery.

The latest edition of the EA's 'Technical Guidance WM3' (2015), Guidance on the classification and assessment of waste, requires that within a mixed waste the separately identifiable wastes are assessed separately. Mixing of different types of hazardous waste and hazardous waste with other waste substances is prohibited under the Waste Framework Directive. Wastes that have been mixed must be separated whenever possible.

It is best practice to provide your waste carrier (or the disposal site) with details of how the waste has been treated. Your waste carrier may provide a pre-treatment confirmation form or space on the waste transfer note to detail the pre-treatment.

The classification of waste soil is a two-stage process, the first being an assessment of whether the soil is considered hazardous or not following the guidance within Technical Guidance WM3. For off-site disposal to landfill the results of Waste Acceptance Criteria (WAC) testing must then be reviewed to establish if the soil is acceptable at the relevant class of landfill or requires pre-treatment to reduce specific hazardous properties.

8.4.1 Waste acceptance criteria

All inert, stable non-reactive hazardous and hazardous wastes have limit values (waste acceptance criteria) set out in legislation that must be met before that class of landfill can accept the waste. Currently, no WAC are in place for non-hazardous waste.

Soil and other materials that are found not to be hazardous may be classified as either non-hazardous or inert. In order to determine whether they can be classed as inert the soil must be tested and found to be below the inert waste acceptance criteria.

Waste acceptance criteria testing was not carried out as the laboratory testing results confirmed soils were below recommended GACs.

8.4.2 Waste sampling plan

Technical Guidance WM3 sets out in Appendix D requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. At this stage, RSK consider that the level of soil sampling is/is not sufficient to categorise the material robustly/fully.

RSK recommends that a Sampling Plan be prepared to support any waste classifications and hazardous waste assessments, prior to development.

8.4.3 Preliminary waste assessment

Given the level of data obtained, scale of the development and heterogeneity of the site soils, the following assessment should be considered indicative and further assessment should be undertaken following the preparation of a waste sampling plan.

EnviroLab, an RSK company, has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool for potential off-site disposal of materials in the future. The HASWASTE assessment has been included in **Appendix M**.

None of the samples were classified as hazardous waste. Therefore to determine whether waste might be classified as inert or non-hazardous WAC testing will need to be undertaken.

8.4.4 Asbestos within waste soils

The latest edition of Technical Guidance WM3 requires that within a mixed waste the separately identifiable wastes be assessed separately.

For instance, where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately.

No suspected ACM were observed during the site investigation works and no ACM or asbestos fibres were detected within the soil samples submitted for laboratory analysis.

Asbestos is often present in discreet areas therefore although not encountered during investigation works to date may be present in other uninvestigated areas of the site. If encountered visible ACM should, where feasible, be separated from soils and classified as stable, non-reactive hazardous waste, which can then be disposed of within a stable non-reactive hazardous waste landfill or a special cell in a non-hazardous waste landfill.

8.5 Landfill tax

Waste producers disposing of material to landfill are required to pay landfill tax by HM Revenue and Customs.

The tax is chargeable by weight (tonnage) and two rates apply, either standard or lower rate. The lower rate only applies to those less polluting wastes as set out in the Landfill Tax (Qualifying Material) Order 2011, which include naturally occurring rock and soil, concrete, some minerals, some furnace slags and ash, and some low-activity organic compounds. Evidence confirming that the waste qualifies for the lower rate will be required, and standard rate tax will apply for the whole waste load for any loads of mixed waste.

Currently (since 1 April 2016), standard rate landfill tax is £84.40 per tonne.

The lower rate of landfill tax applicable to less polluting wastes (i.e. 'inert' wastes) remains at £2.60 per tonne.

Material disposed of at a soil treatment centre will not be subject to landfill tax.

8.6 Groundwater

When there is an intention to discard groundwater, chemical test results will indicate the appropriate disposal options. This could include disposal to treatment facility, via consent (issued by the water authority) to foul sewer or via consent (issued by the EA) to a watercourse or land.

8.7 Recommendations

RSK recommends that consideration as to how potentially waste soils will be dealt with as part of this development is given as early in the project planning process as possible. Such planning can lead to cost savings where potentially waste soils are viewed as a resource and retained on-site as part of the development. We also recommend, where off-site disposal is being considered, that appropriate facilities are identified and discussions initiated to confirm suitability of the facility to take the material. Potentially, these may include soil treatment facilities as well as landfills.

RSK can provide specialist advice to assist in this process, which can be complex and subject to regular regulatory approval.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Environmental

The investigation has revealed no exceedances of GAC and risks to future residential occupants, controlled waters, vegetation, or plastic water supply pipes.

The results of the GQRA indicate that whilst relevant pollutant linkages are present, concentrations observed are not in excess of relevant GACs / screening values therefore it is considered that the site does not pose an unacceptable risk to the identified receptors. However, this is subject to the removal of the gravel layer containing asphalt within the region of WS3 in accordance with Structural Soils recommendations.

It is considered that the site is suitable for the proposed residential development without remediation. However, ground workers should maintain a watching brief during the earthworks phase of construction. If evidence of contamination is discovered, works should stop in the affected area and advice sought from an environmental consultant.

A relevant linkage is unlikely to exist associated with organic contaminants and therefore pollutant polyethylene (PE) and/or polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development in the vicinity of the former nursery. It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) are known.

In RSK's opinion no phytotoxic risk is present to vegetation.

A potential risk to future residents via inhalation of the vapours is not considered an active pollutant linkage.

The groundwater monitoring programme is not yet completed with additional visits planned, therefore the assessment is not yet finalised. Results will be submitted as an addendum to this report.

9.2 Reuse of materials and waste

During the RSK investigation Made Ground was noted in WS7, HDP3 and HDP5 only, all remaining soils encountered were natural soils therefore the preliminary waste assessment relates to natural soils.

Should any unexpected contamination be found during site works then WAC testing may be required.

EnviroLab, an RSK company, has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool for potential off-site disposal of materials in the future. None of the samples were classified as hazardous waste. Therefore to determine whether waste might be classified as inert or non-hazardous



WAC testing will need to be undertaken. Although levels of contaminants were low, if materials are to be disposed of off site the receiving landfill should be given this report.

BIBLIOGRAPHY

AGS Interim Guidance (2013), 'Site investigation and asbestos risk assessment for the protection of site investigation and geotechnical laboratory personnel', February.

Baker, K., Hayward, H., Potter, L., Bradley, D. and McLeod, C. (2009), *CIRIA Report C682. The VOCs Handbook. Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination* (London: CIRIA).

Boyle, R. A. and Witherington, P. J. (2007), 'Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present', National House-Building Council and RSK Group.

British Geological Survey (1996), Sheet Number 317/332, Solid & Drift Edition, 1:50,000.

British Standards Institution (BSI) (1990), 'BS 1377:1990. Methods of test for soils for civil engineering purposes'.

British Standards Institution (2015), 'BS 5930:2015. Code of practice for ground investigations'.

British Standard Institution (BSI) (2015), 'BS 8485:2015. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings '.

British Standards Institution (2013), 'BS 10175:2013. Investigation of potentially contaminated sites: Code of practice'.

British Standards Institution (2013), BS8576:2013. Guidance on investigations for ground gas – permanent gases and volatile organic compounds (VOCs)

Building Research Establishment (BRE) (2001), *BRE Report 414. Protective measures for housing on gas-contaminated land* (London: BRE).

Building Research Establishment (2005), *BRE Special Digest 1: Concrete in aggressive ground* (London: BRE).

Building Research Establishment (2016) *BRE Digest 365. Soakaway design* (London: BRE).

Card, G. B. (1995), *CIRIA Report 149. Protecting development from methane* (London: CIRIA).

Chartered Institute for Environmental Health and Land Quality Management (2009), 'The LQM/CIEH Generic Assessment Criteria for Human Health', second edition.

Chartered Institute of Environmental Health (CIEH) and CL:AIRE (2008), *Guidance on Comparing Soil Contamination Data with a Critical Concentration* (London: CIEH).

CIRIA (2014). Good practice on the testing and verification of protection systems for buildings against hazardous ground gases

CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

CL:AIRE (2011), *CL:AIRE Code of Practice. The Definition of Waste: Development Industry Code of Practice, Version 2* (London: CL:AIRE).

Dangerous Substances Directive (76/464.EEC).

Department for Environment, Food and Rural Affairs (2010), *The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010* (London: HMSO).

Environment Agency (2015), 'Technical Guidance WM3. Guidance on the classification of and assessment of waste. 1st Edition.

Environment Agency (2004), *Model Procedures for the Management of Contaminated Land. Contaminated Land Report Number 11 (CLR11)*, September (Bristol: Environment Agency).

Environment Agency (2004b), 'Policy Number 199_04, dated 9 March 2004, Part IIA – Detailed Quantitative Assessment of Chronic Risks to Human Health from Contaminated Soils'.

Environment Agency (2006a), 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination'.

Environment Agency (2006b), 'The Knotweed Code of Practice – managing Japanese Knotweed on development sites'.

Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).

Environment Agency (2009a), Contaminated Land Exposure Assessment (CLEA) software, version 1.06.

Environment Agency (2009b), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2*, January (Bristol: Environment Agency).

Environment Agency (2009c), 'Science Report SC050021/benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxin like PCBs SGVs', 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs', March 2009, May 2009 and September 2009.

Environment Agency (2009d), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).

Environment Agency (2010a), 'GPLC1 – Guiding Principles of Land Contamination', 'GPLC2 – Frequently Asked Questions, Technical Information, Detailed Advice and References', and 'GPLC3 – Reporting Checklists', all March.

Environment Agency (2010b), 'Horizontal Guidance Note H1 - Environmental risk assessment for permits'.

Environment Agency (2010c), 'Status Report: Management of the London Basin Chalk Aquifer'.

Environment Agency (2011) Chemical Standards Database.

Environment Agency (no date) Freshwater environmental quality standards.

Environment Agency www.environment-agency.gov.uk/.

Environmental Permitting (England and Wales) Regulations 2010 (London: HMSO).

GroundSure (2013), Environmental Data Report (ref. EMS-197992_288787).

Hartless, R. (1991), 'BRE Report 212: Construction of new buildings on gas-contaminated land', Building Research Establishment.

Hazardous Waste Regulations 2005 (London: HMSO).

National House-Building Council (1999), 'Chapter 5.2: Suspended Ground Floors' in *NHBC Standards*, revised September 1999, effective January 2000.

Norbury, D. (2010), *Soil and Rock Description in Engineering Practice* (Caithness: Whittles).

Office of the Deputy Prime Minister (2004), *Planning Policy Statement 23: Planning and Pollution Control* (London: The Stationery Office).

Part IIA of the Environmental Protection Act (Contaminated Land Regulations (England) 2002 (London: HMSO).

Rudland, D. J., Lancefield, R. M. and Mayell, P. N. (2001), *CIRIA C552. Contaminated Land Risk Assessment: A Guide to Good Practice* (London: CIRIA).

The Building Regulations (revised December 2004) 'Approved Document C. Department of the Environment and The Welsh Office'.

The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (London: HMSO).

The Surface Waters (Dangerous Substances) (Classification) Regulations 1998 (London: HMSO).

The Water Supply (Water Quality) Regulations 1989, 2000 and 2001 (London: HMSO).

UK Water Industry Research (2010) *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (London: UKWIR).

United States Environmental Protection Agency (2017), Regional Screening Levels (RSL) Summary Table November 2017.

Water Framework Directive (2000/60/EC).

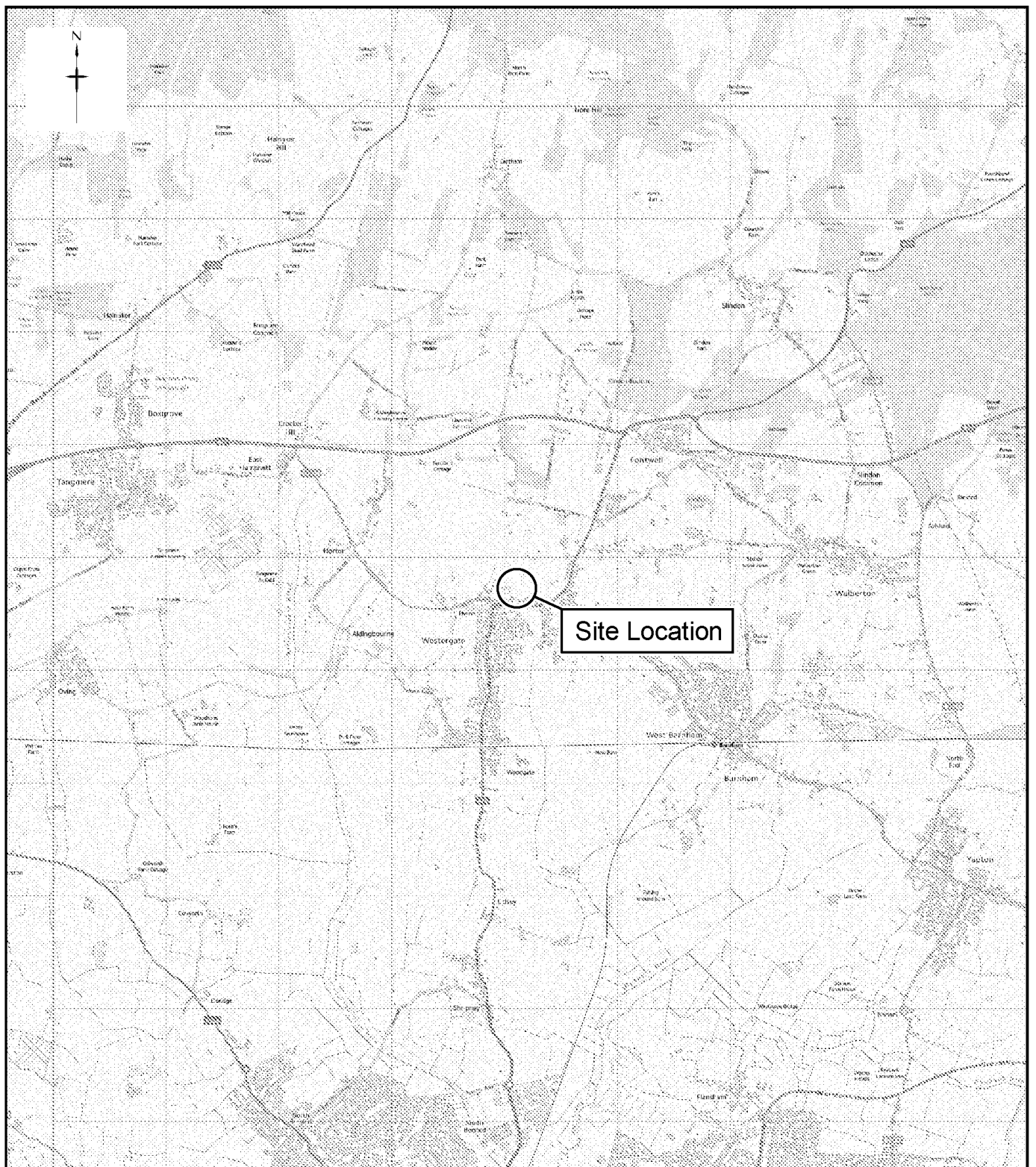
Wilson, S. A. and Card, G. B. (1999), 'Reliability and risk in gas protection design', *Ground Engineering*, February: 33–6.

Wilson, S., Oliver, S., Mallet, H., Hutchings, H. and Card, G. (2007), *CIRIA Report C665: Assessing risks posed by hazardous ground gases to buildings* (London: CIRIA).

World Health Organization (2004), *Guidelines for drinking-water quality*, 3rd edn (Geneva: WHO).

WRc plc (2002), 'Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development, R&D Technical Report P45'.

FIGURES



Contains Ordnance Survey data © Crown copyright and database right 2013



18 Frogmore Road
Henley-on-Thames
Hertfordshire
HP3 9ET
United Kingdom

Tel: +44 (0) 1492 437500
Fax: +44 (0) 1492 437530
Email: info@rsk.co.uk
Web: www.rsk.co.uk

Client

TAYLOR WIMPEY SOUTHERN COUNTIES

Project Title

EASTERGATE

Drawing Title

SITE LOCATION PLAN

Rev	Drawn	Date	Checked	Date	Approved	Date
01	ASC	19.12.17	JL	19.12.17	JL	19.12.17
Dimensions		Scale		Original Size		
m		1:50,000		A4		

Project Number

29519 - R01 (00)

Drawing File

29519 - SLP.dwg

Drawing Number

FIGURE 1



LEGEND

- Site Boundary
- Window Sample Location
- Hand Dug Pit Location
- Data Logger Location
- Falling Head Test Location

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom

Tel: +44 (0) 1442 437500
Fax: +44 (0) 1442 437550
Email: info@rsk.co.uk
Web: www.rsk.co.uk

Client

**TAYLOR WIMPEY
SOUTHERN COUNTIES**

Project Title

EASTERGATE

Drawing Title

**EXPLORATORY HOLE
LOCATION PLAN**

Drawn	Date	Checked	Date	Approved	Date
ASC	19.12.17	JL	19.12.17	JL	19.12.17

Scale	Orig Size	Dimensions
1:2000	A3	m

Project No.	Drawing File
29519 - R01 (00)	29519 (R01-00) Fig 2.dwg

Drawing No.	Rev.
FIGURE 2	P1

Scale 1 : 2,000



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 Taylor Wimpey Southern Counties (the "client") in accordance with the terms of a contract between RSK and the "client", dated 3rd October 2017. 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, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey 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. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and 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 is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the 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 soil and groundwater conditions, together with the position of any current structures and underground 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 contract 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 (boreholes, trial pits 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.

Taylor Wimpey Southern Counties
 Geo-Environmental Site Assessment: Land adjacent to Nyton Road, Eastergate.
 29519 R01 (00)

APPENDIX B

SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as ‘any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused’. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA of the EPA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by ‘priority’ and ‘priority hazardous’ substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The

1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2010 states: ‘the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.’

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a ‘Daughter’ Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Planning Policy

Contaminated land is often dealt with through planning because of land redevelopment. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF).

The new framework has only limited guidance on contaminated land, as follows:

- *“planning policies and decisions should also ensure that:*

- *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*
- *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- *adequate site investigation information, prepared by a competent person, is presented”.*

APPENDIX C

RISK ASSESSMENT METHODOLOGY

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: preliminary, generic quantitative and detailed quantitative. An outline conceptual model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (contaminant–pathway–receptor) and is used as the basis for the design of the site investigation. The outline conceptual model is updated as further information becomes available, for example as a result of the site investigation.

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- highly likely: the event appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution
- likely: it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term
- low likelihood: circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term
- unlikely: circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- severe: short term (acute) risk to human health likely to result in ‘significant harm’ as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000)
- medium: chronic damage to human health (‘significant harm’ as defined in ‘Draft Circular on Contaminated Land’, DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem
- mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services (‘significant harm’ as defined in ‘Draft Circular on Contaminated Land’, DETR 2000). Damage to sensitive buildings, structures or the environment

- minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the probability of an event occurring and its consequences have been classified, a risk category can be assigned according to the table below.

		Consequences			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high	High	Moderate	Moderate/low
	Likely	High	Moderate	Moderate/low	Low
	Low likelihood	Moderate	Moderate/low	Low	Very low
	Unlikely	Moderate/low	Low	Very low	Very low

Definitions of these risk categories are as follows together with an assessment of the further work that may be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability; urgent investigation and remediation are likely to be required.
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required. Remedial works may be necessary in the short term and are likely over the long term.
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild.
- Very low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

APPENDIX D

EXPLORATORY HOLE RECORDS



WINDOW SAMPLE LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Window Sample: WS1	
Contract Ref: 29519		Start: 13.10.17 End: 13.10.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20 0.20	1	ES PID	Tub+Jar+Vial 0.1ppm			Dark brown silty gravelly CLAY. Gravel is sub-rounded to sub-angular fine to medium flint. (TOPSOIL).	(0.40) 0.40	
							Mid brown silty gravelly CLAY. Gravel is angular to sub-angular fine to coarse flint. (HEAD DEPOSITS).	(0.80) 0.80	
	1.00 1.00	2	D PID	0.0ppm				1.20	
	1.20-1.65	1	SPT	N=24			Medium dense mid brown clayey silty angular to sub-angular fine to coarse GRAVEL of flint. (HEAD DEPOSITS).	(0.70) 1.90	
	1.50 1.50	3	D PID	0.0ppm				2.40	
	2.00-2.45	2	SPT	N=13			Stiff beige silty gravelly CLAY. Gravel is angular to sub-angular fine to medium flint. (HEAD DEPOSITS).	(0.50) 2.40	
	2.20 2.20	4	D PID	0.0ppm			Stiff light brown beige mottled silty very sandy CLAY. Sand is fine grained. (HEAD DEPOSITS).	(1.40) 3.80	
	3.00-3.45 3.00	3	SPT PID	N=14 0.0ppm				4.45	
	3.50 3.50	5	D PID	0.0ppm			Medium dense orange silty fine SAND. (HEAD DEPOSITS).	(0.65) 4.45	
	3.90 4.00-4.45 4.00	6 4	D SPT PID	N=14 0.0ppm					
							Borehole terminated at 4.45m bgl as required depth achieved.		

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)	1. Inspection pit hand dug to 1.20m depth. 2. Groundwater struck at 2.50m depth. 3. 50mm diameter standpipe piezometer (complete with upstanding protective cover) installed to 4m depth on completion. Response zone 1m to 4m. 4. Borehole terminated at 4m depth as required depth achieved.			
Method Inspection pit + Tracked window						All dimensions in metres		Scale: 1:25	
Plant Used: Premier rig			Drilled By: Bruce Hunter		Logged By: JLaite		Checked By: AGS		



WINDOW SAMPLE LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Window Sample: WS2	
Contract Ref: 29519		Start: 13.10.17 End: 13.10.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 2

Progress		Samples / Tests			Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20 0.20	1	ES PID	Tub+jar+Vial 0.2ppm			Dark brown silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. (TOPSOIL).	0.20	
	0.50	2	D				Mid to light brown silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. (HEAD DEPOSITS).	(0.40) 0.60	
	0.80 0.80	3	D PID	0.0ppm			Mid brown silty very gravelly CLAY. Gravel is angular to sub-angular fine to coarse flint. (HEAD DEPOSITS).	(0.50) 1.10	
	1.20-1.65	1	SPT	N=15			Stiff light brown silty very gravelly CLAY. Gravel is angular to sub-angular fine to coarse flint. (HEAD DEPOSITS).	(0.90) 2.00	
	1.50 1.50	4	D PID	0.0ppm			Stiff mid brown silty gravelly CLAY. Gravel is angular to sub-rounded fine to medium flint. (HEAD DEPOSITS).	(0.40) 2.40	
	2.00-2.45	2	SPT	N=12			Stiff light brown beige silty gravelly CLAY. Gravel is angular to sub-angular fine flint. (HEAD DEPOSITS).	(0.70) 3.10	
	2.20 2.20	5	D PID	0.0ppm			Stiff light brown beige mottled sandy gravelly CLAY. Sand is fine grained. Gravel is sub-angular to sub-rounded fine flint. (HEAD DEPOSITS).	(0.40) 3.50	
	3.00-3.45 3.00	3	SPT PID	N=15 0.0ppm			Stiff light brown mottled greyish silty sandy CLAY. Sand is fine grained. (LONDON CLAY FORMATION).	(1.95)	
	3.40 3.40	6	D PID	0.0ppm					
	3.80	7	D						
	4.00-4.45 4.00	4	SPT PID	N=10 0.0ppm					

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)	1. Inspection pit hand dug to 1.20m depth. 2. Groundwater struck at 3.80m depth. 3. 50mm diameter standpipe piezometer (complete with upstanding protective cover) installed to 5m depth on completion. Response zone 1m to 5m. 4. Borehole terminated at 5m depth as required depth achieved.			
Method Inspection pit + Tracked window						All dimensions in metres		Scale: 1:25	
Plant Used: Premier rig			Drilled By: Bruce Hunter		Logged By: JLaite		Checked By:		



WINDOW SAMPLE LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Window Sample: WS2	
Contract Ref: 29519		Start: 13.10.17 End: 13.10.17	Ground Level: ---	Co-ordinates: ---	Sheet: 2 of 2

Progress	Samples / Tests				Water	Backfill & Instru- mentation	Description of Strata	Depth (Thick- ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	4.50		PID	0.0ppm			Stiff light brown mottled greyish silty sandy CLAY. Sand is fine grained. (LONDON CLAY FORMATION). <i>(stratum copied from 3.50m from previous sheet)</i>		
	5.00-5.45 5.00	5	SPT PID	N=10 0.0ppm				5.45	
							Borehole terminated ta 5.45m bgl as required depth achieved.		

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)				
						All dimensions in metres		Scale:	1:25
Method	Inspection pit + Tracked window		Plant Used:	Premier rig		Drilled By:	Bruce Hunter	Logged By:	JLaite
Used:						Checked By:			



WINDOW SAMPLE LOG

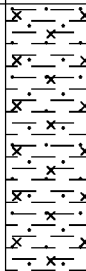
Contract: Eastergate			Client: Taylor Wimpey Southern Counties		Window Sample: WS3
Contract Ref: 29519	Start: 13.10.17 End: 13.10.17	Ground Level: ---	Co-ordinates: ---		Sheet: 1 of 2

Progress		Samples / Tests			Water Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.20 0.20	1	ES PID	Tub+Jar+Vial 0.1ppm		Mid brown silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. (TOPSOIL).	(0.65)	
							0.65	
	0.80 0.80	2	D PID	0.0ppm		Mid brown silty very clayey angular to sub-angular fine to medium GRAVEL of flint. (HEAD DEPOSITS).	(0.55)	
							1.20	
	1.20-1.65	1	SPT	N=27		Medium dense light brown beige slightly clayey sandy very silty angular to sub-angular fine to medium GRAVEL of flint. (HEAD DEPOSITS).	(0.60)	
	1.50 1.50	3	D PID	0.0ppm			1.80	
	2.00-2.45 2.00	2	SPT PID	N=20 0.0ppm		Medium dense mid to light brown silty very clayey angular to sub-angular fine to medium GRAVEL of flint. (HEAD DEPOSITS).	(1.10)	
	2.50 2.50	4	D PID	0.0ppm			2.90	
	3.00-3.45 3.00	3	SPT PID	N=17 0.0ppm		Very stiff beige silty gravelly CLAY. Gravel is angular to sub-angular fine to medium flint. (HEAD DEPOSITS).	(1.20)	
	3.50 3.50	5	D PID	0.0ppm			4.10	
	4.00-4.45 4.00	4	SPT PID	N=12 0.0ppm		Stiff light brown silty sandy CLAY. Sand is fine grained. (LONDON CLAY FORMATION).		

Drilling Progress and Water Observations						General Remarks			
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)				
						1. Inspection pit hand dug to 1.20m depth. 2. Groundwater struck at 3.70m depth. 3. 50mm diameter standpipe piezometer (complete with upstanding protective cover) installed to 5m depth on completion. Response zone 1m to 5m. 4. Borehole terminated at 5m depth as required depth achieved.			
						All dimensions in metres	Scale: 1:25		
Method Used	Inspection pit + Tracked window		Plant Used:	Premier rig		Drilled By: Bruce Hunter	Logged By: JLaite	Checked By:	



Contract:		Client:		Window Sample:
Eastergate		Taylor Wimpey Southern Counties		WS3
Contract Ref:	Start: 13.10.17	Ground Level:	Co-ordinates:	Sheet:
29519	End: 13.10.17	---	---	2 of 2

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	4.50 4.50	6	D PID	0.0ppm			Stiff light brown silty sandy CLAY. Sand is fine grained. (LONDON CLAY FORMATION). <i>(stratum copied from 4. 10m from previous sheet)</i>	(1.35)	
	5.00-5.45 5.00	5	SPT PID	N=39 0.0ppm			Borehole terminated at 5.45m bgl as required depth achieved.	5.45	

Drilling Progress and Water Observations						General Remarks
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)	
All dimensions in metres						Scale: 1:25
Method Used: Inspection pit + Tracked window		Plant Used: Premier rig		Drilled By: Bruce Hunter	Logged By: JLaite	Checked By: AGS



WINDOW SAMPLE LOG

Contract: Eastergate			Client: Taylor Wimpey Southern Counties		Window Sample: WS4
Contract Ref: 29519	Start: 13.10.17 End: 13.10.17	Ground Level: ---	Co-ordinates: ---		Sheet: 1 of 1

Progress	Samples / Tests				Water Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.20 0.20	1	ES PID	Tub+Jar+Vial 0.0ppm		Dark brown silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. (TOPSOIL).	(0.60) 0.60	
	0.80 0.80	2	D PID	0.0ppm		Mid brown orangey silty gravelly CLAY. Gravel is sub-rounded fine flint. (HEAD DEPOSITS).	(0.60) 1.20	
	1.20-1.65	1	SPT	N=12		Medium dense mid brown silty clayey angular to sub-angular fine to coarse GRAVEL of flint. (HEAD DEPOSITS).	1.20	
	1.50 1.50	3	D PID	0.0ppm			(1.00) 2.20	
	2.00-2.45 2.00	2	SPT PID	N=12 0.0ppm		Stiff beige very silty gravelly CLAY. Gravel is angular to sub-rounded fine to coarse flint. (HEAD DEPOSITS).	2.20	
	2.40 2.40	4	D PID	0.0ppm			(0.40) 2.60	
	2.70	5	D			Medium dense light brown mottled light grey silty clayey angular to sub-rounded fine to coarse GRAVEL of flint. (HEAD DEPOSITS).	(0.70) 3.30	
	3.00-3.45 3.00	3	SPT PID	N=14 0.0ppm			3.30	
	3.30	6	D			Stiff light brown mottled light grey silty slightly sandy CLAY. Sand is fine grained. (LONDON CLAY FORMATION).	(1.15) 4.45	
	3.50		PID	0.0ppm			4.45	
	4.00-4.45 4.00	4	SPT PID	N=11 0.0ppm		Borehole terminated at 4.45m bgl as required depth achieved.		

Drilling Progress and Water Observations						General Remarks				
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)					
						1. Inspection pit hand dug to 1.20m depth. 2. Groundwater struck at 2.80m depth. 3. 50mm diameter standpipe piezometer (complete with upstanding protective cover) installed to 4m depth on completion. Response zone 1m to 4m. 4. Borehole terminated at 4m depth as required depth achieved.				
						All dimensions in metres		Scale: 1:25		
Method Used	Inspection pit + Tracked window			Plant Used:	Premier rig		Drilled By: Bruce Hunter	Logged By: JLaite	Checked By:	



WINDOW SAMPLE LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Window Sample: WS5	
Contract Ref: 29519		Start: 13.10.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1
End: 13.10.17					

Progress	Samples / Tests				Water Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results				
	0.20 0.20	1	ES PID	Tub+Jar+Vial 0.1ppm		Mid brown silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to coarse flint. (TOPSOIL).	(0.40)	
						Light brown silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. (HEAD DEPOSITS).	0.40	
	0.70 0.70	2	D PID	0.0ppm		Medium dense mid to dark brown silty very clayey angular to sub-angular fine to coarse GRAVEL of flint. (HEAD DEPOSITS).	0.80	
	1.20-1.65	1	SPT	N=15			(1.50)	
	1.50 1.50	3	D PID	0.0ppm				
	2.00-2.45 2.00	2	SPT PID	N=17 0.0ppm			2.30	
	2.50 2.50	4	D PID	0.0ppm		Stiff becoming stiff beige silty gravelly CLAY. Gravel is sub-angular fine to coarse flint. (HEAD DEPOSITS).		
	3.00-3.45 3.00	3	SPT PID	N=14 0.0ppm			(2.15)	
							4.45	
						Borehole terminated at 4.45m as required depth achieved.		

Drilling Progress and Water Observations						General Remarks					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)						
						1. Inspection pit hand dug to 1.20m depth. 2. Groundwater struck at 2.50m depth. 3. 50mm diameter standpipe piezometer (complete with upstanding protective cover) installed to 3m depth on completion. Response zone 1m to 3m. 4. Borehole terminated at 3m depth as required depth achieved.					
						All dimensions in metres	Scale: 1:25				
Method	Inspection pit + Tracked window		Plant Used:	Premier rig		Drilled By:	Bruce Hunter	Logged By:	JLaite	Checked By:	



WINDOW SAMPLE LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Window Sample: WS6	
Contract Ref: 29519		Start: 13.10.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1
End: 13.10.17					

Progress		Samples / Tests			Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20 0.20	1	ES PID	Tub+Jar+Vial 0.2ppm			Mid brown silty gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium flint. (TOPSOIL).	(0.40) 0.40	
	0.50	2	D				Light brown silty slightly sandy gravelly CLAY. Sand is fine grained. Gravel is sub-angular to sub-rounded fine to medium flint. (HEAD DEPOSITS). Gravel content increasing with depth.	(0.70)	
	0.90 0.90	3	D PID	0.0ppm				1.10	
	1.20-1.65 1.30	1 4	SPT D	N=16			Medium dense mid brown silty very clayey angular to sub-angular fine to medium GRAVEL of flint. (HEAD DEPOSITS).	(0.50)	
	1.50		PID	0.0ppm				1.60	
	1.80	5	D				Medium dense light brown beige sandy very clayey angular to sub-angular fine to medium GRAVEL of flint. (HEAD DEPOSITS).	(0.50)	
	2.00-2.45 2.00	2	SPT PID	N=20 0.0ppm				2.10	
	2.50 2.50	6	D PID	0.0ppm			Medium dense mid brown silty clayey angular to sub-angular fine to coarse GRAVEL of flint. (HEAD DEPOSITS).	(1.35)	
	3.00-3.45 3.00	3	SPT PID	N=11 0.0ppm				3.45	
							Borehole terminated at 3.45m bgl as required depth achieved.		

Drilling Progress and Water Observations						General Remarks	
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)		
						1. Inspection pit hand dug to 1.20m depth. 2. No groundwater encountered. 3. 50mm diameter standpipe piezometer (complete with upstanding protective cover) installed to 3m depth on completion. Response zone 1m to 3m. 4. Borehole terminated at 3m depth as required depth achieved.	
						All dimensions in metres	Scale: 1:25
Method	Inspection pit + Tracked window		Plant Used:	Premier rig		Drilled By: Bruce Hunter	Logged By: JLaite
						Checked By:	



WINDOW SAMPLE LOG

Contract: Eastergate			Client: Taylor Wimpey Southern Counties		Window Sample: WS7
Contract Ref: 29519	Start: 13.10.17 End: 13.10.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1	

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.10 0.10	1	ES PID	Tub+Jar+Vial 0.0ppm			Mid to dark brown silty gravelly CLAY. Gravel is angular to sub-angular fine to medium flint. (TOPSOIL).	(0.40) 0.40	
	0.50	2	D				MADE GROUND: Mid brown silty gravelly CLAY. Gravel is angular to sub-angular fine to coarse flint and brick.	(0.30) 0.70	
	1.00		PID	0.0ppm			Firm becoming soft mid brown mottled greyish silty very gravelly CLAY. Gravel is angular to sub-angular fine to coarse flint. (HEAD DEPOSITS).	(1.75)	
	1.20-1.65	1	SPT	N=9					
	1.50 1.50	3	D PID	0.0ppm					
	2.00-2.45 2.00	2	SPT PID	N=4 0.0ppm				2.45	
							Borehole terminated at 2.45m bgl as required depth achieved.		

Drilling Progress and Water Observations						General Remarks
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)	
						1. Inspection pit hand dug to 1.20m depth. 2. groundwater struck at 1.70m bgl. 3. 50mm diameter standpipe piezometer (complete with upstanding protective cover) installed to 2m depth on completion. Response zone 1m to 2m. 4. Borehole terminated at 2m depth as required depth achieved.
All dimensions in metres						Scale: 1:25
Method Used: Inspection pit + Tracked window	Plant Used: Premier rig		Drilled By: Bruce Hunter		Logged By: JLaite	Checked By: 



HAND AUGER LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Position: HDP1
Contract Ref: 29519	Date: 9.11.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.20	1	ES	Tub+Jar+Vial			Light brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse sub-rounded to angular flint. (TOPSOIL).	0.25	
0.20		PID	0.0ppm			Orangey brown clayey silty fine to medium SAND. (RIVER TERRACE DEPOSITS).	0.40	
0.30	2	D				Orangey brown clayey silty gravelly fine to medium SAND with low cobble content. Gravel is fine to coarse sub-rounded to sub-angular flint. (RIVER TERRACE DEPOSITS).	(0.60)	
							1.00	
1.00		PID	0.0ppm			Hand dug pit terminated at 1.00m bgl as required depth achieved.		

General Remarks

1. CAT scanned prior to excavation.
2. Pit remained stable.
3. No groundwater encountered.
4. Backfilled with arisings.

All dimensions in metres

Scale:

1:25

Method **Inspection pit +
Hand dug**

Plant
Used:

Hand tools

Logged
By:

JLaite

Checked
By:





Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.20 0.20	1	ES PID	Tub+Jar+Vial 0.1ppm			Light brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse sub-roundned to angular flint. (TOPSOIL).	0.25	
							Slightly clayey gravelly fine to medium SAND with medium to high cobble content. Gravel is fine to coarse angular to sub-rounded flint. (RIVER TERRACE DEPOSITS).	(0.45)
0.70		PID	0.0ppm			Hand Dug Pit terminated at 0.70m bgl due to high cobble content.	0.70	

1. CAT scanned prior to excavation.
2. Pit remained stable.
3. No groundwater encountered.
4. Backfilled with arisings.

Scale: 1:25





HAND AUGER LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Position: HDP3
Contract Ref: 29519	Date: 9.11.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.20	1	ES	Tub+Jar+Vial 0.2ppm			MADE GROUND: Light brown clayey gravelly fine to medium SAND. Gravel is sub-rounded to angular fine to coarse flint brick and tile.	0.25	
0.20		PID				Orangey brown clayey gravelly fine to medium SAND with medium cobble content. Gravel is sub-rounded to angular fine to coarse flint. (RIVER TERRACE DEPOSITS).	(0.75)	
0.30	2	D						
1.00		PID	0.0ppm			Hand Dug Pit terminated at 1.00m bgl as required depth achieved.	1.00	

General Remarks

1. CAT scanned prior to excavation.
2. Pit remained stable.
3. No groundwater encountered.
4. Backfilled with arisings.

All dimensions in metres

Scale:

1:25

Method Inspection pit + Hand excavation	Plant Used: Hand tools	Logged By: JLaite	Checked By:	
--	-------------------------------	--------------------------	-------------	--



HAND AUGER LOG

Contract: Eastergate		Client: Taylor Wimpey Southern Counties		Position: HDP4
Contract Ref: 29519	Date: 9.11.17	Ground Level: ---	Co-ordinates: ---	Sheet: 1 of 1

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.20 0.20	1	ES PID	Tub+Jar+Vial 0.1ppm			Light brown clayey gravelly fine to medium SAND. Gravel is sub-rounded to angular fine to coarse flint. (TOPSOIL).	0.25	
0.40 0.40	2	D PID	0.0ppm			Orangey brown clayey gravelly fine to medium SAND with medium cobble content. Gravel is sub-rounded to angular fine to coarse flint. (RIVER TERRACE DEPOSITS).	(0.55) 0.80	
						Hand Dug Pit terminated at 0.80m bgl as required depth achieved.		

General Remarks

1. CAT scanned prior to excavation.
2. Pit remained stable.
3. No groundwater encountered.
4. Backfilled with arisings.

All dimensions in metres

Scale:

1:25

Method Inspection pit + Hand excavation	Plant Used: Hand tools	Logged By: JLaite	Checked By:	
--	-------------------------------	--------------------------	-------------	--



Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.20 0.20	1	ES PID	Tub+Jar+Vial 0.1ppm			MADE GROUND: Dark brown black sandy gravelly CLAY. Sand is fine to medium grained. Gravel is fine to coarse sub-rounded to angular flint. (REWORKED TOPSOIL).	0.25	
0.40 0.40	2	D PID	0.0ppm			Orangey brown sandy very gravelly CLAY with medium cobble content. Sand is fine to medium grained. Gravel is fine to coarse sub-rounded to angular flint. (RIVER TERRACE DEPOSITS).	(0.35)	
						Hand Dug Pit terminated at 0.60m bgl due to high cobble content.	0.60	

1. CAT scanned prior to excavation.
2. Pit remained stable.
3. No groundwater encountered.
4. Backfilled with arisings.

Scale: 1:25

Checked
By:



APPENDIX E

SITE PHOTOGRAPHS AND WALKOVER

CHECKLIST

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

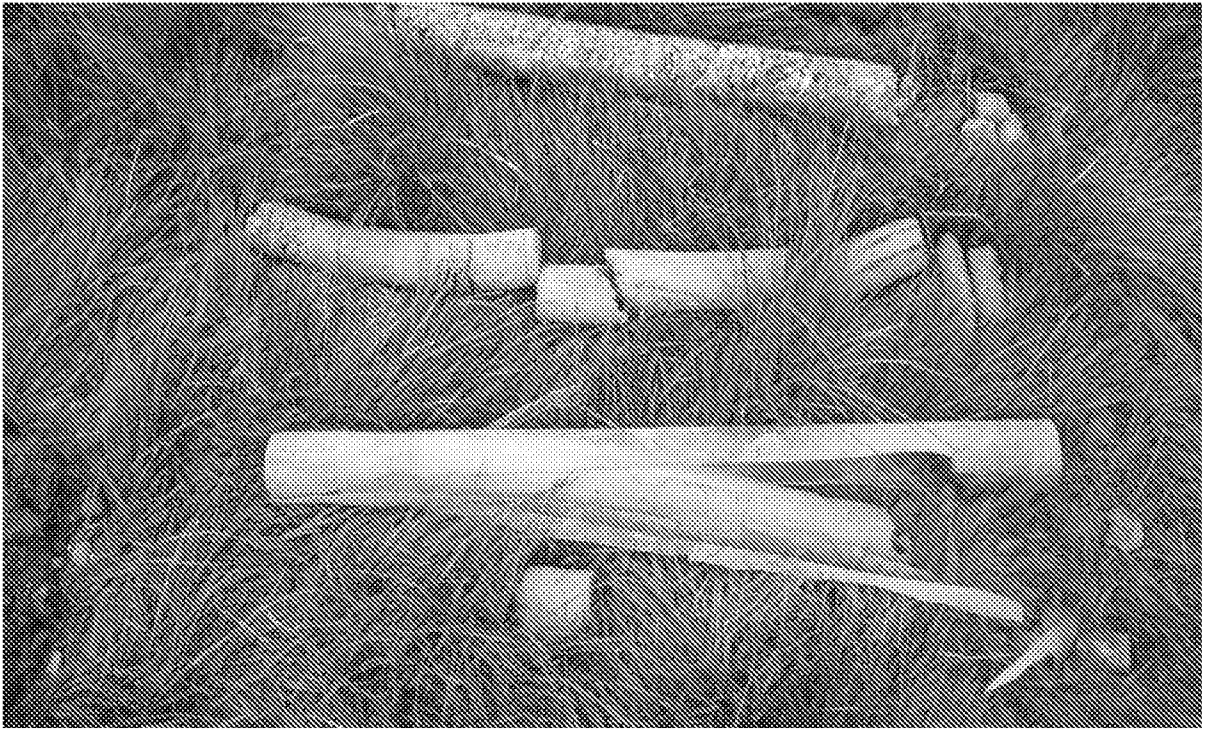
Photo No. 1	
Date: 13/10/2017	
WS1 soil cores.	

Photo No. 2	
Date: 13/10/2017	
WS2 soil cores.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 3	
Date: 13/10/2017	
WS3 soil cores.	

Photo No. 4	
Date: 13/10/2017	
WS4 soil cores.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 5	
Date: 13/10/2017	
WS5 soil cores.	

Photo No. 6	
Date: 13/10/2017	
WS6 soil cores.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 7	
Date: 13/10/2017	
WS7 soil cores.	

Photo No. 8	
Date: 09/11/2017	
View of HDP1.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 9	
Date: 09/11/2017	
HDP1 arising.	

Photo No. 10	
Date: 09/11/2017	
View of HDP2.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 11	
Date: 09/11/2017	
HDP2 arisings.	

Photo No. 12	
Date: 09/11/2017	
HDP2 arisings, coarse cobbles scaled to pencil.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 13	
Date: 09/11/2017	
View of HDP3.	

Photo No. 14	
Date: 09/11/2017	
Arising from HDP3.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 15	
Date: 09/11/2017	
View of HDP4.	

Photo No. 16	
Date: 09/11/2017	
Arising from HDP4.	

PHOTOGRAPHIC LOG

Site Location: Nyton Road, Eastergate.

Photo No. 17	
Date: 09/11/2017	
View of HDP5.	

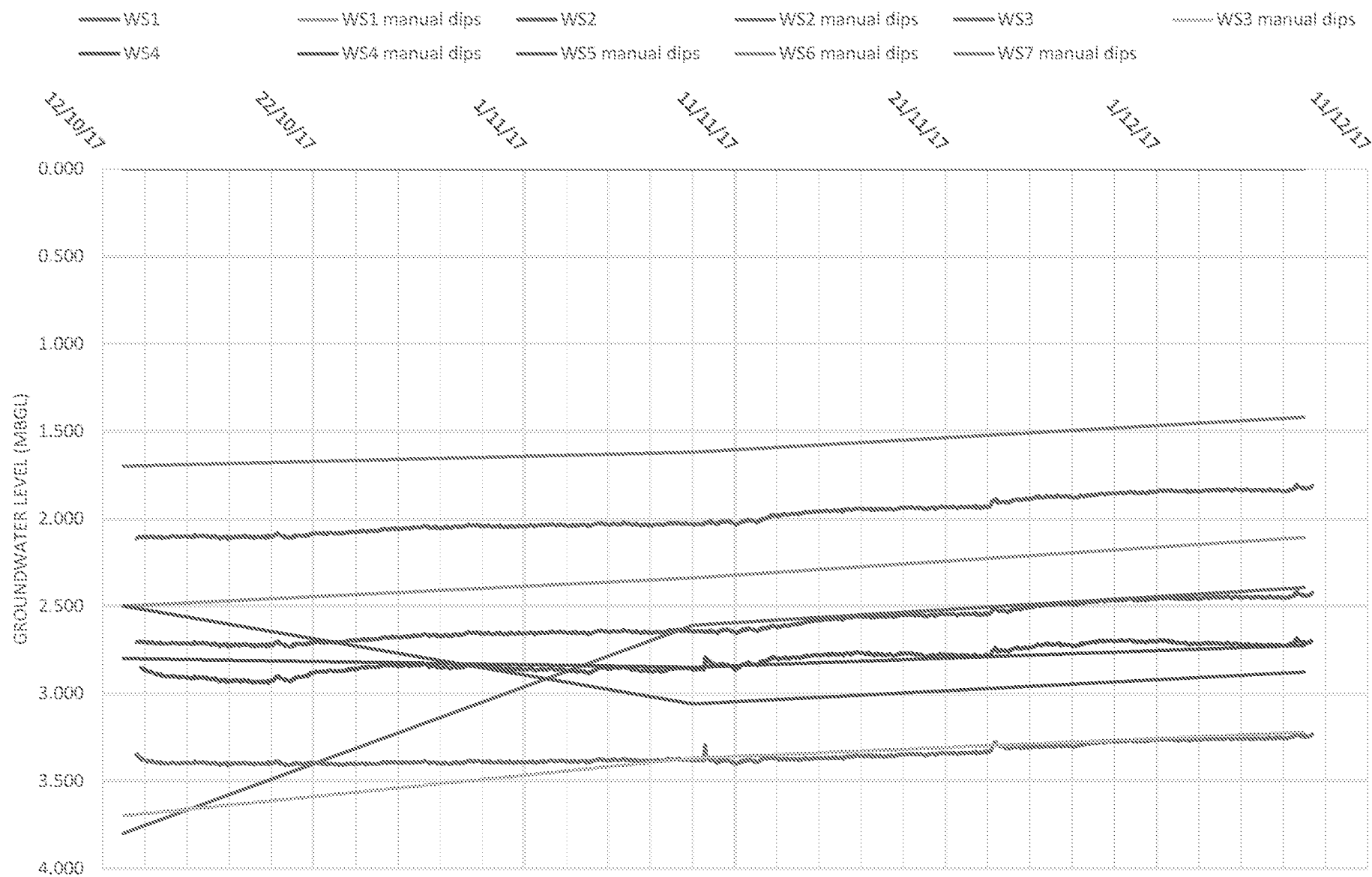
Photo No. 18	
Date: 09/11/2017	
Arising from HDP5.	



APPENDIX F

GROUNDWATER MONITORING RECORDS

COMPOSITE GROUNDWATER LEVELS (mbgl)



APPENDIX G

LABORATORY CERTIFICATES FOR SOIL ANALYSIS

Borehole Soakaway - Falling Head Test

Based on Roads in Hertfordshire A Design Guide

Location	Eastergate	Diameter of casing (m)	0.05
Client	Taylor Wimpey (Southern Counties)	Diameter of test zone (m)	0.05
Soakaway	WS5	Casing depth (m)	1
Date	13-Oct-17	Depth to base of hole (m)	4
Operator		Job Number	29519

[illegible]

Results

t_h (mins)	1.50	Comments:
H_p (m)	1.56	
Infiltration Rate (l/m²/min)	4.33	
Infiltration Rate (m/s)	7.22E-05	

Based on Roads in Hertfordshire A Design Guide

Time (Minutes)	Water level (mbgl)	Head (m)
0.00	0.00	3.00
1.00	0.34	2.66
1.25	0.40	2.60
1.50	0.50	2.50
1.75	0.54	2.46
2.00	0.59	2.41
2.25	0.63	2.37
2.50	0.66	2.34
2.75	0.71	2.29
3.00	0.78	2.22
3.25	0.83	2.17
3.50	0.86	2.14
3.75	0.92	2.08
4.00	0.94	2.06
4.50	1.01	1.99
5.00	1.08	1.92
5.50	1.16	1.84
6.00	1.23	1.77
6.50	1.25	1.75
7.00	1.27	1.73
7.50	1.31	1.69
8.00	1.35	1.65
9.00	1.42	1.58
10.00	1.46	1.54
11.00	1.50	1.50
12.00	1.55	1.45
13.00	1.61	1.39
14.00	1.65	1.35
15.00	1.71	1.29
16.00	1.77	1.23
17.00	1.80	1.20
18.00	1.84	1.16
19.00	1.87	1.13
20.00	1.91	1.09
25.00	2.06	0.94
30.00	2.20	0.80
35.00	2.31	0.69
40.00	2.41	0.59
45.00	2.49	0.51
50.00	2.56	0.44
60.00	2.66	0.34
90.00	2.85	0.15

The graph displays the relationship between head and time during a falling head test. The data points are plotted as black dots, and a smooth curve is fitted through them. The head drops sharply from 3.00 m at time 0 to about 1.75 m by 10 minutes, after which the rate of decrease slows down significantly.

Time (Minutes)	Head (m)
0	3.00
1	2.66
2	2.41
3	2.22
4	2.06
5	1.92
6	1.84
7	1.77
8	1.73
9	1.69
10	1.65
15	1.29
20	1.09
25	0.94
30	0.80
35	0.69
40	0.59
45	0.51
50	0.44
60	0.34
90	0.15

t_h (mins)	50.00	Comments:
H_p (m)	1.77	
Infiltration Rate (l/m²/min)	0.22	
Infiltration Rate (m/s)	3.69E-06	

Borehole Soakaway - Falling Head Test

Based on Roads in Hertfordshire A Design Guide

Location	Eastergate	Diameter of casing (m)	0.05
Client	Taylor Wimpey (Southern Counties)	Diameter of test zone (m)	0.05
Soakaway	WS7	Casing depth (m)	1
Date	13-Oct-17	Depth to base of hole (m)	2.2
Operator		Job Number	29519

[illegible]

Results

t_h (mins)	1.75	Comments:
H_p (m)	1.16	
Infiltration Rate (l/m²/min)	6.90	
Infiltration Rate (m/s)	1.15E-04	

APPENDIX I

HUMAN HEALTH GENERIC ASSESSMENT

CRITERIA

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 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⁾). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report⁽³⁾ and associated appendices⁽⁶⁾, and adopts them as GAC for these six substances.

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 Contaminated Land Exposure Assessment (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⁽¹¹⁾ 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 C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report⁽³⁾ and associated appendices⁽⁶⁾, and has adopted them as GAC for these six substances. Toxicological and specific chemical parameters for aromatic hydrocarbon C₈–C₉ (styrene), 1,2,4-trimethylbenzene 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 and toluene, which are modelled separately. The aromatic C₈–C₉ hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for aromatic C₈–C₉ have been taken from styrene.

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

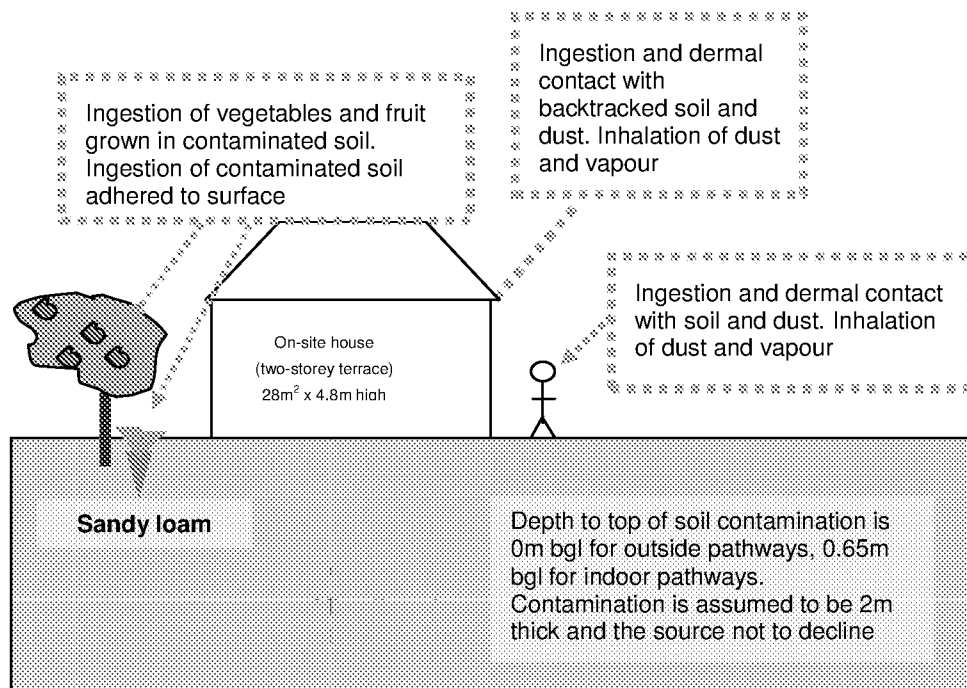


Table 1: Exposure assessment parameters for residential scenario with home-grown produce – inputs for CLEA model

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 and 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.							

References

1. Environment Agency (2009), 'Science Reports SC050021 - SGV and TOX reports for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'; 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'. Available at: <https://www.gov.uk/government/publications/contaminants-in-soil-updated-collation-of-toxicological-data-and-intake-values-for-humans> and <https://www.gov.uk/government/publications/land-contamination-soil-guideline-values-sgvs> (accessed 4 February 2015)
2. Nathanial, C. P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A. G., Ogden, R. C. and Scott, D. (2009), *LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment*, second edition (Nottingham: Land Quality Press).
3. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010.
4. Department for Environment, Food and Rural Affairs (Defra) (2014), 'SP1010: Development of Category 4 Screening Levels for assessment of land affected by contamination – Policy Companion Document', Revision 2.
5. Environment Agency (2009), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).
6. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Appendices C to H). DEFRA research project SP1010'.
7. Nathanial, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathanial, J. F. (2015), *The LQM/CIEH S4ULs for Human Health Risk Assessment* (Nottingham: Land Quality Press).
8. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2* (Bristol: Environment Agency).
9. Environment Agency (2009), *Science Report – SC050021/SR4 CLEA Software (version 1.05) Handbook* (Bristol: Environment Agency).
10. Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).
11. CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).
12. USEPA (2011), *Exposure factors handbook*, EPA/600/R-090/052F (Washington, DC: Office of Research and Development).
13. Environment Agency (2009), 'Changes made to the CLEA framework documents after the three-month evaluation period in 2008', released January 2009.
14. USEPA (2010). Hydrogen cyanide and cyanide salts. Integrated Risk Information Systems (IRIS) Chemical Assessment Summary. September 2010. <https://www.epa.gov/iris> (accessed 9 December 2015)

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	9.25E-02	NR	NR	3.71E-01	4.29E-02	NR	NR	3.71E-01	4.29E-02	NR	NR
Cadmium	(a)	2.30E-01	4.69E-02	2.21E-01	NR	2.30E-01	4.69E-02	2.21E-01	NR	2.30E-01	4.69E-02	2.21E-01	NR
Chromium (III) - trivalent	(c)	1.84E-04	8.07E-03	NR	NR	1.84E-04	8.07E-03	NR	NR	1.84E-04	8.07E-03	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.89E-01	2.06E-01	NR	NR	5.89E-01	2.06E-01	NR	NR	5.89E-01	2.06E-01	NR	NR
Copper		2.70E-03	1.41E-04	2.47E-03	NR	2.70E-03	1.41E-04	2.47E-03	NR	2.70E-03	1.41E-04	2.47E-03	NR
Lead	(a)	2.61E-02	NR	NR	NR	2.61E-02	NR	NR	NR	2.61E-02	NR	NR	NR
Elemental Mercury (Hg ⁰)	(d)	NR	2.23E-01	NR	4.31E+00	NR	3.60E-01	NR	1.07E+01	NR	1.22E-00	NR	2.58E+01
Inorganic Mercury (Hg ²⁺)		3.95E-01	3.69E-03	3.21E-01	NR	3.95E-01	3.69E-03	3.21E-01	NR	3.95E-01	3.69E-03	3.21E-01	NR
Methyl Mercury (Hg ^{Me})		1.26E-01	1.87E-01	7.52E-00	7.33E+01	1.26E-01	2.62E-01	2.29E-00	1.42E+02	1.26E-01	2.62E-01	1.90E-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)	2.59E-02	NR	NR	NR	2.59E-02	NR	NR	NR	2.59E-02	NR	NR	NR
Zinc	(b)	3.86E-03	3.82E-07	NR	NR	3.86E-03	3.82E-07	NR	NR	3.86E-03	3.82E-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)	2.82E-01	5.01E-01	2.73E-01	1.22E-03	5.33E-01	1.85E-00	4.05E-01	2.26E+03	1.18E+00	3.48E-00	8.72E-01	4.71E+03
Toluene		1.53E-00	9.08E-02	1.31E-00	8.69E-02	3.48E-02	2.00E+03	2.97E-00	1.92E+03	7.95E-00	4.55E+03	6.77E-02	4.36E+03
Ethylbenzene		1.10E-02	6.34E-01	4.74E-01	5.18E-02	2.61E-02	1.99E-02	1.12E-02	1.22E+03	6.00E-02	4.39E-02	2.60E-02	2.84E+03
Xylene - m		2.10E-02	8.25E-01	5.95E-01	6.25E-02	5.01E-02	1.93E-02	1.40E-02	1.47E+03	1.15E+00	4.59E-02	3.27E-02	3.46E+03
Xylene - o		1.90E-00	6.67E-01	6.07E-01	4.78E-02	4.58E-00	2.08E+00	1.43E-02	1.12E+03	1.05E+00	4.89E-00	3.32E-00	2.62E+03
Xylene - p		1.86E-01	7.99E-01	5.66E-01	5.76E-02	4.70E-02	1.98E+00	1.25E-02	1.35E+03	1.09E-03	4.89E-02	3.10E-02	3.17E+03
Total xylene		1.32E-02	7.98E-01	5.65E-01	6.25E-02	4.56E-02	1.86E-02	1.39E-02	1.47E+03	1.09E+00	4.90E-02	3.10E-02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		1.54E-00	1.04E-02	6.32E-01	2.04E+04	2.37E-02	1.69E-02	1.69E-02	3.31E+04	6.09E-02	3.21E-00	2.10E-00	6.27E+04
Trichloroethene		2.63E-01	1.72E-02	1.69E-02	1.54E+03	6.26E-01	3.99E-02	3.40E-00	3.22E+03	1.41E+00	7.95E-02	7.95E-02	7.14E+03
Tetrachloroethene		4.69E-00	1.73E-01	1.79E-01	4.24E+02	1.04E-01	4.02E-01	3.94E-01	9.51E+02	2.36E-01	9.21E-01	9.04E-01	2.18E+03
1,1,1-Trichloroethene		3.39E-02	9.01E-00	6.73E+00	1.43E+03	7.26E-02	1.94E+01	1.20E+01	2.92E+03	1.62E-00	4.04E-01	2.94E-01	6.39E+03
1,1,1,2-Tetrachloroethene		5.39E-00	1.34E-00	1.20E+00	2.60E+03	1.27E-01	3.56E+00	2.78E+00	6.02E+03	2.93E-01	8.29E-00	6.40E+00	1.40E+04
1,1,2,2-Tetrachloroethene		2.31E-00	3.32E-00	1.84E+00	2.67E+03	6.19E-00	3.04E+00	3.47E+00	5.46E+03	1.26E-01	1.79E-01	1.87E-00	1.20E+04
Carbon Tetrachloride		3.10E-00	2.69E-02	2.37E-02	1.52E+03	7.11E-00	5.65E-02	5.62E-02	3.32E+03	1.32E-01	1.28E-01	1.27E-01	7.54E+03
1,2-Dichloroethene		3.17E-02	5.80E-03	7.13E-03	3.41E+03	5.73E-02	1.39E-02	1.00E-02	4.91E+03	1.09E-01	2.28E-02	1.98E-02	8.43E+03
Vinyl Chloride		3.28E-03	7.78E-04	6.43E-04	1.36E+03	6.67E-03	1.09E-03	8.73E-04	1.76E+03	1.25E-02	1.34E-03	1.96E-03	2.69E+03
1,2,4-Trimethylbenzene		NR	1.76E+00	NR	4.74E-02	NR	4.26E+00	NR	1.16E+03	NR	3.72E+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
Semi-Volatile Organic Compounds													
Acenaphthene		2.27E-02	4.86E-04	2.25E-02	5.70E+01	5.41E-02	1.18E+00	5.38E-02	1.41E+02	1.18E+00	2.68E-00	1.17E+00	3.36E+02
Acenaphthylene		1.85E-02	4.59E-04	1.84E-02	8.61E+01	4.42E-02	1.11E+00	4.40E-02	2.12E+02	9.78E-02	2.53E-00	9.74E-02	5.06E+02
Anthracene		2.43E-03	1.53E-05	2.39E-03	1.17E+00	5.53E-03	3.77E+00	5.45E-03	2.91E+00	1.10E+04	8.76E-00	1.09E-00	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	1.89E-01	6.29E-01	1.33E-01	1.03E+01
Benzo[a]pyrene	(a)	4.96E+00	3.51E-01	NR	9.11E+01	4.98E+00	3.77E-01	NR	2.28E+00	4.36E+00	3.89E+01	NR	5.46E+00
Benzo[b]fluoranthene		2.96E-00	1.93E-01	2.35E+00	1.22E+00	3.89E+00	2.13E-01	3.29E+00	3.04E+00	4.42E+00	2.23E-01	2.69E+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+00	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	9.82E-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	2.87E-01	2.64E+00
Dibenzo[a,h]anthracene		2.30E-01	1.45E+00	2.41E-01	3.93E-03	3.43E-01	1.64E+00	2.84E-01	9.82E-03	5.63E-01	1.74E+00	3.04E-01	2.36E-02
Fluoranthene		2.87E-02	3.89E-04	2.85E-02	1.89E+01	5.69E-03	8.67E+04	5.60E-02	4.73E+01	9.00E-02	1.83E+00	6.99E-00	1.13E+02
Fluorene		1.77E-02	6.20E-03	1.72E-02	3.09E+01	4.13E-02	1.55E+04	4.07E-02	7.65E+01	8.86E-02	3.62E-04	6.77E-00	1.83E+02
Indeno(1,2,3-cd)pyrene		3.09E-01	2.12E-02	2.70E+01	6.13E-02	4.82E-01	2.38E-02	3.99E-01	1.53E-01	4.92E-01	2.50E-02	4.11E-01	3.68E-01
Naphthalene		2.79E-01	2.93E-01	1.27E+01	7.64E-01	6.66E-01	5.68E+01	3.04E-01	1.83E+02	1.53E-00	1.31E-02	7.06E-01	4.32E+02
Phenanthrene		3.85E-01	7.17E-03	8.72E-01	3.60E+01	2.24E-02	1.78E+04	2.22E-02	8.96E+01	4.48E-00	4.07E-04	4.43E-02	2.14E+02
Pyrene		6.25E-02	6.79E-04	6.20E-02	2.20E+00	1.25E-03	2.04E+00	1.24E-03	5.49E+00	2.05E-00	4.23E-00	2.04E-00	1.32E+01
Phenol		1.66E-00	4.36E-02	1.36E-02	2.42E+04	2.95E-02	8.96E-02	8.96E-02	3.81E+04	5.36E-02	1.19E-00	2.93E-00	7.03E+04

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	
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons <EC ₉ -EC ₉		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 ₁₀ -EC ₈		1.49E+04	1.04E+02	1.03E+02	1.44E+02	3.43E+04	2.91E+02	2.91E+02	3.22E+02	7.11E+04	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons >EC ₈ -EC ₁₀		1.61E+03	2.89E+01	2.87E+01	7.77E+01	2.91E+03	8.92E+01	8.91E+01	1.90E+02	4.26E+03	1.56E+02	1.54E+02	4.51E+02
Aliphatic hydrocarbons >EC ₁₃ -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 ₁₃		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 ₁₉ -EC ₂₂	(b)	6.48E+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 ₂₉ -EC ₃₄	(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 ₉ -EC ₁₄ (styrene)		1.66E+03	5.32E+02	1.06E+01	6.26E+02	2.53E+03	1.29E+03	2.48E+01	1.44E+03	1.31E+04	2.79E+03	5.09E+01	3.35E+03
Aromatic hydrocarbons >EC ₂₇ -EC ₁₀		5.79E+03	4.74E+01	3.45E+01	6.13E+02	1.35E+02	1.16E+02	8.78E+01	1.50E+03	3.07E+02	2.77E+02	1.34E+02	3.58E+02
Aromatic hydrocarbons >EC ₁₆ -EC ₁₂		8.29E+03	2.36E+02	7.82E+01	3.64E+02	1.96E+02	8.39E+02	1.79E+02	8.99E+02	4.25E+02	1.52E+02	5.91E+02	2.15E+03
Aromatic hydrocarbons >EC ₁₀ -EC ₁₆		1.47E+02	2.85E+02	1.49E+02	1.69E+02	1.38E+02	7.07E+03	3.32E+02	4.19E+02	8.41E+02	1.68E+04	8.74E+02	1.00E+03
Aromatic hydrocarbons >EC ₁₈ -EC ₂₁	(b)	2.83E+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 ₂₃ -EC ₃₅	(b)	1.09E+02	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC ₃₆ -EC ₄₄	(b)	1.09E+02	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 dependent 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 Q4SL toxicology data.													
(b) SAC for 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
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
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
Trichloroethene	0.02	0.03	0.08
Tetrachloroethene	0.2	0.4	0.9
1,1,1-Trichloroethane	9	18	39
1,1,1,2 Tetrachloroethane	1.2	2.8	6.5
1,1,2,2-Tetrachloroethane	1.6	3.5	7.7
Carbon Tetrachloride	0.026	0.056	0.127
1,2-Dichloroethane	0.007	0.011	0.019
Vinyl Chloride	0.0006	0.0009	0.0014
1,2,4-Trimethylbenzene	1.8	4.3	9.7
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
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
Indeno(1,2,3-cd)pyrene	27	36	41
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 ₈	42	78	160
Aliphatic hydrocarbons >EC ₈ -EC ₉	100	230	530
Aliphatic hydrocarbons >EC ₉ -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 ₉ (styrene)	11	25	57
Aromatic hydrocarbons >EC ₉ -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	No asbestos detected with ID or <0.001% dry weight ¹		
Notes:			
1/ 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 J

GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

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 amended 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 amended 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.				

APPENDIX K

GENERIC ASSESSMENT CRITERIA FOR

POTABLE WATER SUPPLY PIPES

GENERIC ASSESSMENT CRITERIA FOR POTABLE WATER SUPPLY PIPES

A range of pipe materials is available and careful selection, design and installation is required to ensure that water supply pipes are satisfactorily installed and meet the requirements of the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations. The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supply company has a statutory duty to enforce the regulations.

Contaminants in the ground can pose a risk to human health by permeating potable water supply pipes. To fulfil their statutory obligation, UK water supply companies require robust evidence from developers to demonstrate either that the ground in which new plastic supply pipes will be laid is free from specific contaminants, or that the proposed remedial strategy will mitigate any existing risk. If these requirements cannot be demonstrated to the satisfaction of the relevant water company, it becomes necessary to specify an alternative pipe material on the whole development or in specific zones.

In 2010, UK Water Industry Research (UKWIR) published *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (Report Ref. No. 10/WM/03/21). This report reviewed previously published industry guidelines and threshold concentrations adopted by individual water supply companies.

The focus of the UKWIR research project was to develop clear and concise procedures, which provide consistency in the pipe selection decision process. It was intended to provide guidance that can be used to ensure compliance with current regulations and to prevent water supply pipe failing prematurely due to the presence of contamination.

The report concluded that in most circumstances only organic contaminants pose a potential risk to plastic pipe materials and Table 3.1 of the report provides threshold concentrations for polyethylene (PE) and polyvinyl chloride (PVC) pipes for the organic contaminants of concern. The report also makes recommendations for the procedures to be adopted in the design of site investigations and sampling strategies, and the assessment of data, to ensure that the ground through which water supply pipes will be laid is adequately characterised.

Risks to water supply pipes have therefore been assessed against the threshold concentrations for PE and PVC pipe specified in Table 3.1 of Report 10/WM/03/21, which have been adopted as the GAC for this linkage and are reproduced in Table A3 below.

Since water supply pipes are typically laid at a minimum depth of 0.75 m below finished ground levels, sample results from depths between 0.5 m and 1.5 m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used, providing the stratum is the same as that in which water supply pipes are likely to be located. The report specifies that sampling should characterise the ground conditions to a minimum of 0.5 m below the proposed depth of the pipe.

It should be noted that the assessment provided in this report is a guide and the method of assessment and recommendations should be checked with the relevant water supply company.

Table A3: Generic assessment criteria for water supply pipes

		Pipe material	
		GAC (mg/kg)	
	Parameter group	PE	PVC
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC (Not including compounds within group 1a)	0.5	0.125
1a	BTEX + MTBE	0.1	0.03
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C ₅ –C ₁₀) (Not including compounds within group 2e and 2f)	2	1.4
2e	Phenols	2	0.4
2f	Cresols and chlorinated phenols	2	0.04
3	Mineral oil C ₁₁ –C ₂₀	10	Suitable
4	Mineral oil C ₂₁ –C ₄₀	500	Suitable
5	Corrosive (conductivity, redox and pH)	Suitable	Suitable
Specific suite identified as relevant following site investigation			
2a	Ethers	0.5	1
2b	Nitrobenzene	0.5	0.4
2c	Ketones	0.5	0.02
2d	Aldehydes	0.5	0.02
6	Amines	Not suitable	Suitable
Notes: where indicated as 'suitable', the material is considered resistant to permeation or degradation and no threshold concentration has been specified by UKWIRL.			

APPENDIX L

GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

Protection of the water environment

The water environment in the United Kingdom is protected under a number of regulatory regimes. The relevant environmental regulator is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past.

The term 'controlled waters' refers to coastal waters, inland freshwaters and groundwater. The EU Water Framework Directive (WFD) (2000/60/EC) is implemented via domestic regulations and guidance, covering aspects of groundwater and surface water protection as well as drinking water supply policy. Domestic legislation and guidance will vary across the United Kingdom. Therefore, the relevant legislation for England, Wales, Northern Ireland and Scotland should be reviewed, alongside guidance provided by the Environment Agency (EA), Natural Resource Wales (NRW), the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA), as appropriate.

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out within "The Environment Agency's approach to groundwater protection", version 1.0 (March 2017)⁽¹⁾ and the associated guidance "Land contamination groundwater compliance points: quantitative risk assessments (March 2017)^(1a) that have replaced the previous guidance document "Groundwater Principles and Practice (GP3)". When assessing risks to groundwater, the following need to be considered:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to:
 - **prevent** the input of **hazardous** substances into groundwater (see description of hazardous substances below)
 - **limit** the entry of other (non-hazardous) pollutants into groundwater to avoid pollution, deterioration in the status of groundwater bodies and to prevent sustained, upward trends in pollutant concentrations in groundwater.
- Where pollutants have already entered groundwater, the priority is to take all necessary and reasonable measures to:
 - **minimise** further entry of "contaminants" where there is a defined source
 - **limit the pollution** of groundwater or any effect on the status of the groundwater body from the future expansion of the 'plume', if necessary, by actively reducing its extent.

Within the context of groundwater risk assessments on sites affected by land contamination, "reasonable" means feasible without involving disproportionate costs. What costs are "disproportionate" depends on site-specific circumstances, which may include:

- Considerations of technical feasibility such as identified by the remedial options appraisal, this may be due to the distribution or nature of the contamination and the available remedial methods to treat the identified contamination;
- Sustainability considerations.

DEFINITIONS AND SUBSTANCE CLASSIFICATIONS

Risks to surface waters:

When assessing risks to surface waters, the following list of definitions should be understood:

Priority substances (PS) are harmful substances originally identified under the Water Framework Directive (WFD) 2000/60/EC as substances 'presenting a significant risk to or via the aquatic environment' at a European level. Member States are required to incorporate the identified **PS** into their country-wide monitoring programmes. There are currently 33 **PS** defined within the Priority Substances Directive (2013/39/EU; Annex 1), with a further 12 additional substances due to come into force from 22 December 2018. Directive 2013/39/EU has been transposed into domestic legislation for England and Wales by The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Under the umbrella of **PS**, there is a sub-set of substances identified as being "hazardous", and these are referred to as **Priority hazardous substances (PHS)**. The list of **PHS** is defined at EU level within the Priority Substances Directive (2013/39/EU). The WFD defines hazardous substances as 'substances (or groups of substances) that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances that give rise to an equivalent level of concern'. There are currently 15 **PHS**, with a further 6 additional substances due to come into force from 22 December 2018.

There is also another group of substances defined at EU level and which are referred to as **other pollutants (OP)** in Directive 2013/39/EU. These are additional substances which although not **priority substances**, have EQS which are identical to those laid down in the legislation which applied prior to 13 January 2009 (Directive 2008/105/EU). The **OP** are listed along with the **priority substance (PS)** within the Priority Substances Directive (2013/39/EU) and their associated EQS are also listed therein. There are 6 **OP** defined within the Priority Substances Directive (2013/39/EU).

In addition to the EU level substances, there are also a group of pollutants defined at a Member State level, referred to as **Specific pollutants (SP)**. These substances are pollutants which are released in significant quantities into water bodies in each of the individual European Member States. Under the WFD, Member States are required to set their own EQS for these substances. An indicative list of **SP** is given in Annex VIII of the WFD. Many of the substances categorised as **SP** in the UK were formerly List 2 substances under the old Groundwater Directive (80/68/EEC). The **SP** are defined within Part 2 (Table 1) of The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Risks to groundwater:

When assessing risks to groundwater, the following definitions should be understood:

Under the requirements of the Groundwater Daughter Directive (2006/118/EU), the UK has published a list of substances it considers to be **hazardous substances** with respect to groundwater. In their advisory capacity to the government, this list has been derived by the UK Joint Agencies Groundwater Directive Advisory Group (JAGDAG), of which the Environment Agency is a member. The JAGDAG list of **hazardous substances** was published in January 2017 and the Environment Agency will use the updated list of hazardous substances from this date for all new activities that may lead to the discharge of hazardous substances to groundwater. The list is extensive and can be found in full at:

<https://www.wtduk.org/sites/default/files/Media/170116%20Substance%20Determinationsfinal.pdf>

Selecting the appropriate assessment criteria

When assessing the risks to controlled waters, various assessment criteria apply, depending on the nature of the assessment and the conceptual site model.

Where a surface water body is involved, then Environmental Quality Standards (EQS) are the relevant assessment criteria as they are designed to be protective of surface water ecology.

Where a public water supply or a Principal aquifer is involved, then the standards defined in The Water Supply (Water Quality) Regulations⁽²⁾ are the primary source of assessment criteria. The Private Water Supplies Regulations⁽³⁾ may also be applicable in some cases. For instances where there are no UK assessment criteria, then the World Health Organisation (WHO) drinking water guidelines⁽⁴⁾ may be used.

This appendix presents the generic assessment criteria (GAC) that RSK considers suitable for assessing risks to controlled waters for our most commonly encountered determinants. A full list of EQS for England and Wales are included in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

The RSK GAC for controlled waters are presented in **Table 1** and **Table 2**. In line with the Environment Agency's Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The appropriate target concentrations should be selected with consideration to:

- the site conceptual model (i.e. the receptor at potential risk);
- whether the substance is already present in groundwater at the site;
- whether or not the substance is classified as a priority hazardous substance under the Priority Substances Directive (2013/39/EC) (see above), or as a hazardous substance according to the current list of JAGDAG determinations⁽⁵⁾; and
- background concentrations in the aquifer (if applicable).

It is important to remember that the WFD and Environment Agency guidance^(1 & 1a) support a sustainable, risk-based approach be applied to groundwater contamination. Exceedance of any target concentration does not necessarily imply that an unacceptable risk exists or that remediation is inevitably required.

Target concentrations shaded in green are <u>statutory values</u>	Target concentrations shaded in orange are <u>non-statutory values</u>
---	--

Note: Units µg/l throughout (unless otherwise stated)

Table 1: Target concentrations for controlled waters (excluding TPH CWG fractions)

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁵⁾	Surface water receptors ⁽⁵⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transifional (estuaries) and coastal waters
Metals & other inorganics						
Hazardous substance	Specific pollutant	Arsenic	-	10 ⁽²⁾	50 ^(6a)	25 ^(6a)
Non-hazardous pollutant	Priority substance	Cadmium	0.1 ⁽⁷⁾	5 ⁽²⁾	≤0.08, 0.08, 0.09, 0.15, 0.25 ^(6b)	0.2 ^(6a)
(Not determined)	-	Chromium (total)	-	50 ⁽²⁾	Sum values for chromium III and VI	
(None	Specific pollutant	Chromium (III)	-	Use value for total chromium	4.7 ^(6a)	-
Hazardous substance	Specific pollutant	Chromium (VI)			3.4 ^(6a)	0.6 ^(6a)

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
(Not determined)	Specific pollutant	Copper	-	2,000 ⁽²⁾	1 bioavailable ^(6a)	3.76 dissolved, where DOC ≤1mg/l ^(6a)
						3.76µg/l + (2.677µg/l x ((DOC/2) – 0.5µg/l)) dissolved, where DOC >1mg/l ^(6a)
Hazardous substance	Priority substance	Lead	-	10 ⁽²⁾	1.2 bioavailable ^(6a)	1.3 ^(6a)
Hazardous substance	Priority hazardous substance	Mercury	0.01 ⁽⁷⁾	1 ⁽²⁾	0.07 ^(6c)	0.07 ^(6c)
Non-hazardous pollutant	Priority substance	Nickel	-	20 ⁽²⁾	4.0 bioavailable ^(6a)	8.6 ^(6a)
Non-hazardous pollutant	-	Selenium	-	10 ⁽²⁾	-	-
Non-hazardous pollutant	Specific pollutant	Zinc	-	3,000 ⁽⁸⁾	10.9 bioavailable ^(6a)	6.8 dissolved ^(6a)
None	Specific pollutant	Iron	-	200 ⁽²⁾	1000 ^{(6a)*1}	1000 ^{(6a))*1}
None	Specific pollutant	Manganese	-	50 ⁽²⁾ (0.05mg/l)	123 bioavailable ^(6a) (0.123mg/l)	-
(Not determined)	-	Aluminium	-	200 ⁽²⁾	-	-

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Priority hazardous substance	Tributyltin compounds (Tributyltin-cation)	0.001 ⁽⁷⁾	-	0.0002 ^(6a)	0.0002 ^(6a)
(Not determined)	-	Sodium	-	200,000 ⁽²⁾ (200 mg/l)	-	-
Non-hazardous pollutant	Specific pollutant	Cyanide (Hydrogen cyanide)	-	50 ⁽²⁾ (0.05 mg/l)	1 ^(6a) (0.001 mg/l)	1 ^(6a) (0.001 mg/l)
Non-hazardous pollutant	-	Total ammonia [§] (ammonium (as NH ₄ ⁺) plus ammonia (NH ₃))	-	500 ⁽²⁾ (0.5 mg/l)	300 ^(6f) (0.3 mg/l)	-
Non-hazardous pollutant	Specific pollutant	Ammonia un-ionised (NH ₃)	-	-	-	21 ^(6a) (0.021 mg/l)
Non-hazardous pollutant	Specific pollutant	Chlorine	-	-	2 ^(6a) (0.002 mg/l)	10 ^(6d) (0.01 mg/l)
(Not determined)	-	Chloride	-	250,000 ⁽²⁾ (250 mg/l)	-	-
(Not determined)	-	Sulphate	-	250,000 ⁽²⁾ (250 mg/l)	-	-
(Not determined)	-	Nitrate (as NO ₃)	-	50,000 ⁽²⁾ (50 mg/l)	-	-
(Not determined)	-	Nitrite (as NO ₂)	-	500 ⁽²⁾ (0.5 mg/l)	10 ⁽⁹⁾ (0.01 mg/l)	-
Volatile organic compounds (VOC)						

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Non-hazardous pollutant	Other pollutant	Tetrachloroethene (tetrachloroethylene)	0.1 ⁽⁷⁾	10 ⁽²⁾	10 ^(6a)	10 ^(6a)
Hazardous substance	Other pollutant	Trichloroethene (trichloroethylene)	0.1 ⁽⁷⁾	10 ⁽²⁾	10 ^(6a)	10 ^(6a)
None	Specific pollutant	Tetrachloroethane	-	-	140 ^(6a)	-
Hazardous substance	Other pollutant	Carbon tetrachloride (tetrachloromethane)	0.1 ⁽⁷⁾	3.0 ⁽²⁾	12 ^(6a)	12 ^(6a)
Non-hazardous pollutant	Priority substance	1,2-Dichloroethane	1.0 ⁽⁷⁾	3.0 ⁽²⁾	10 ^(6a)	10 ^(6a)
Hazardous substance	-	Vinyl chloride (chloroethene)	-	0.5 ⁽²⁾	-	-
Non-hazardous pollutant	Priority substance	Dichloromethane	-	20 ⁽⁴⁾	20 ^(6a)	20 ^(6a)
Non-hazardous pollutant	Priority substance	Trichlorobenzenes	0.01 ⁽⁷⁾	-	0.4 ^(6a)	0.4 ^(6a)
(Not determined)	-	Trihalomethanes	-	100 ^(2a)	-	-
Hazardous substance	Priority substance	Trichloromethane (Chloroform)	0.1 ⁽⁷⁾	(see “Trihalomethanes” above)	2.5 ^(6a)	2.5 ^(6a)
Non-hazardous pollutant	Priority hazardous substance	Di(2-ethylhexyl) phthalate (bis(2-ethylhexyl) phthalate, DEHP)	-	8 ⁽⁴⁾	1.3 ^(6a)	1.3 ^(6a)

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
None	Specific pollutant	Benzyl butyl phthalate	-	-	7.5 ^(6a)	0.75 ^(6e)
Hazardous substance	Priority hazardous substance	Hexachlorobutadiene	0.005 ⁽⁷⁾	0.6 ⁽⁴⁾	0.6 ^(6c)	0.6 ^(6c)
Semi-volatile organic compounds (SVOC)						
(Not determined)	-	Acenaphthylene (C12-C16)	-	-	5.8 ⁽¹⁰⁾	
Hazardous substance	Priority hazardous substance	Anthracene (C16-C35)	-	-	0.1 ^(6a)	0.1 ^(6a)
Non-hazardous pollutant	Priority substance	Naphthalene (C10-C12)	-	-	2 ^(6a)	2 ^(6a)
Hazardous substance	Priority substance	Fluoranthene (C16-C35)	-	-	0.0063 ^(6a)	0.0063 ^(6a)
Hazardous substance(s)	Priority hazardous substance(s)	Benzo(a)pyrene (C16-C35)	-	0.01 ⁽²⁾	0.00017 ^(6a)	0.00017 ^(6a)
		Benzo(b)fluoranthene (C16-C35)	-	0.1 ⁽²⁾ sum of the concentration of the four specified compounds	No EQS for these substances. B(a)P should be used as the indicator compound instead.	
		Benzo(k)fluoranthene (C16-C35)	-			

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
		Benzo(g,h,i)perylene (C16-C35)	-			
		Indeno(1,2,3-cd) pyrene (C16-C35)	-			
Non-hazardous pollutant	Specific pollutant	Phenol		-	7.7 ^(6a)	7.7 ^(6a)
Hazardous substance	Specific pollutant	2,4-Dichlorophenol	0.1 ⁽⁷⁾	-	4.2 ^(6a)	0.42 ^(6a)
Hazardous substance	Priority substance	Pentachloro-phenol (PCP)	0.1 ⁽⁷⁾	9 ⁽⁴⁾	0.4 ^(6a)	0.4 ^(6a)
Petroleum hydrocarbons						
Hazardous substance	-	Total petroleum hydrocarbons	-	See Table 2 for individual (non-statutory) TPH CWG fractions with respect to drinking water receptors	See individual risk driving compounds (i.e. BTEX and PAH) for specific EQS	
Hazardous substance	Priority substance	Benzene	1 ⁽⁷⁾	1 ⁽²⁾	10 ^(6a)	8 ^(6a)
Hazardous substance	Specific pollutant	Toluene	4 ⁽⁷⁾	700 ⁽⁴⁾	74 ^(6a)	74 ^(6a)
Hazardous substance	-	Ethylbenzene	-	300 ⁽⁴⁾	-	-
(Not determined)	-	Xylenes	3 ⁽⁷⁾	500 ⁽⁴⁾	30 ⁽¹¹⁾	-

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Non-hazardous pollutant	-	Methyl tertiary butyl ether (MTBE)	-	15 ⁽¹²⁾	-	
Pesticides, fungicides, insecticides and herbicides						
Hazardous substance(s)	Other pollutant (Cyclodiene pesticides)	Aldrin	0.003 ⁽⁷⁾	0.03 ⁽²⁾	0.01 ^(6a)	0.005 ^(6a)
		Dieldrin	0.003 ⁽⁷⁾	0.03 ⁽²⁾		
		Endrin	0.003 ⁽⁷⁾	0.1 ^(2b)		
		Isodrin* ²	0.003 ⁽⁷⁾	0.1 ^(2b)		
Hazardous substance	Other pollutant	DDT (total)	0.002 ⁽⁷⁾	1 ⁽⁴⁾	0.025 ^(6a)	0.025 ^(6a)
(Not determined) – assume to be Hazardous Substance	-	Total pesticides	-	0.5 ⁽²⁾	-	-
(Not determined) - assume to be Hazardous Substance	-	Other individual pesticides	-	0.1 ⁽²⁾		

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Specific pollutant	Carbendazim	-	-	0.15 ^(6a)	-
Hazardous substance	Specific pollutant	Chlorothalonil	-	-	0.035 ^(6a)	-
Hazardous substance	Specific pollutant (until 22/12/18, after which it becomes a Priority substance)	Cypermethrin	-	-	0.0001 ^(6a) From 22/12/18: 8.0E-5 ^(6a)	0.0001 ^(6a) From 22/12/18: 8.0E-6 ^(6a)
Hazardous substance	Specific pollutant	Dimethoate	0.01 ⁽⁷⁾	-	0.48 ^(6a)	0.48 ^(6a)
(Not determined)	Specific pollutant	Glyphosate	-	-	196 ^(6a)	196 ^(6a)
Hazardous substance	Specific pollutant	Linuron	-	-	0.5 ^(6a)	0.5 ^(6a)
Non-hazardous pollutant	Specific pollutant	Mecoprop	0.04 ⁽⁷⁾	-	18 ^(6a)	18 ^(6a)
Non-hazardous pollutant	Specific pollutant	Methiocarb	-	-	0.01 ^(6a)	-
Non-hazardous pollutant	Specific pollutant	Pendimethalin	-	20 ⁽⁴⁾	0.3 ^(6a)	-

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Specific pollutant	Permethrin	0.001 ⁽⁷⁾	-	0.001 ^(6a)	0.0002 ^(6a)
Hazardous substance	Priority substance	Alachlor	-	20 ⁽⁴⁾	0.3 ^(6a)	0.3 ^(6a)
Hazardous substance	Priority substance	Atrazine	0.03 ⁽⁷⁾	100 ⁽⁴⁾	0.6 ^(6a)	0.6 ^(6a)
Hazardous substance	Priority substance	Diuron	-	-	0.2 ^(6a)	0.2 ^(6a)
Hazardous substance	Priority hazardous substance	Endosulphan	0.005 ⁽⁷⁾	-	0.005 ^(6a)	0.0005 ^(6a)
Non-hazardous pollutant	Priority substance	Isoproturon	-	9 ⁽⁴⁾	0.3 ^(6a)	0.3 ^(6a)
Hazardous substance	Priority substance	Simazine	0.03 ⁽⁷⁾	2 ⁽⁴⁾	1 ^(6a)	1 ^(6a)
Hazardous substance	Priority hazardous substance	Trifluralin	0.01 ⁽⁷⁾	20 ⁽⁴⁾	0.03 ^(6a)	0.03 ^(6a)
(Not determined)	From 22/12/18: Priority substance	Dichlorovos	-	-	From 22/12/18: 6.0E-4 ^(6a)	From 22/12/18: 6.0E-5 ^(6a)
Hazardous substance	From 22/12/18: Priority substance	Heptachlor and heptachlor epoxide	-	0.03 ⁽²⁾	From 22/12/18: 2.0E-7 ^(6a)	From 22/12/18: 1.0E-08 ^(6a)
Miscellaneous						

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors ⁽⁶⁾	Surface water receptors ⁽⁶⁾		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
None	Specific pollutant	Triclosan (antibacterial agent)	-	-	0.1 ^(6a)	0.1 ^(6a)
Hazardous substance	From 22/12/18: Priority hazardous substance	Perfluoro-octane sulfonic acid (and its derivatives) (PFOS)	-	-	From 22/12/18: 6.5E-4 ^(6a)	From 22/12/18: 1.3E-4 ^(6a)
Hazardous substance	From 22/12/18: Priority hazardous substance	Hexabromo cyclododecane (HBCDD)	-	-	From 22/12/18: 0.0016 ^(6a)	From 22/12/18: 0.0016 ^(6a)

Notes:

⁽¹⁾ A target concentration is not available.

⁽⁶⁾ Please note that total ammonia (NH₄⁺ and NH₃) is equivalent to ammoniacal nitrogen in laboratory reports.

⁽¹⁾ Please note that although iron is listed in the 2015 Direction as 1,000 µg/l, the EQS remains at 1mg/l in Scotland and it is assumed this is an error and should read either 1,000 or 1000µg/l.

⁽²⁾ Please note that although Isodrin is not listed in name within the group of 'Cyclodiene pesticides' in Table 1 of Schedule 3 Part 3 of the 2015 Direction⁽⁶⁾, the CAS number for Isodrin (465-73-6) is listed and therefore it is assumed that it has been missed off the named list of substances.

⁽³⁾ Total petroleum hydrocarbons is used for consistency, but is an analytical method-defined measurement for a mixture of hydrocarbons subject to environmental analysis⁽¹⁾.

"Bioavailable" in relation to copper, zinc, nickel and manganese (but not lead) is the generic EQSbioavailable^(6a) derived from the Metal Bioavailability Assessment Tool (M-BAT) developed by the Water Framework Directive UK Technical Advisory Group (WFD TAG). Exceedance of this value should prompt a site-specific assessment using the M-BAT with pH, DOC and Ca to derive a site-specific EQS termed the PNEC_{unresolved}.
<http://www.wfd.uk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat>.

For zinc, if there is an exceedance of the EQSbioavailable in an initial GQRA, Tier 2 required that the EQS for zinc should also have the ambient background concentration of zinc added as well.

Table 2: World Health Organization (WHO) guide values for TPH CWG fractions in drinking water⁽¹³⁾ (as referenced in CL:AIRE, 2017⁽¹¹⁾)

TPH CWG fraction	WHO guide value for drinking water ⁽¹³⁾ (µg/l)
Aliphatic fractions:	
Aliphatic EC5-EC6	15,000
Aliphatic >EC6-EC8	15,000
Aliphatic >EC8-EC10	300
Aliphatic >EC10-EC12	300
Aliphatic >EC12-EC16	300
Aliphatic >EC16-EC21	-
Aliphatic >EC21-EC35	-
Aromatic fractions:	
Aromatic EC5-EC6	10 (benzene)
Aromatic >EC6-EC8	700 (toluene)
Aromatic >EC8-EC10	300 (ethyl benzene) 500 (xylenes)
Aromatic >EC10-EC12	90
Aromatic >EC12-EC16	90
Aromatic >EC16-EC21	90
Aromatic >EC21-EC35	90
Reference: World Health Organisation (WHO), 2008. Petroleum products in drinking-water. Background document for development of WHO guidelines for drinking water quality. WHO/SDE/WSH/05.08/123. World Health Organisation, Geneva ⁽¹³⁾ .	

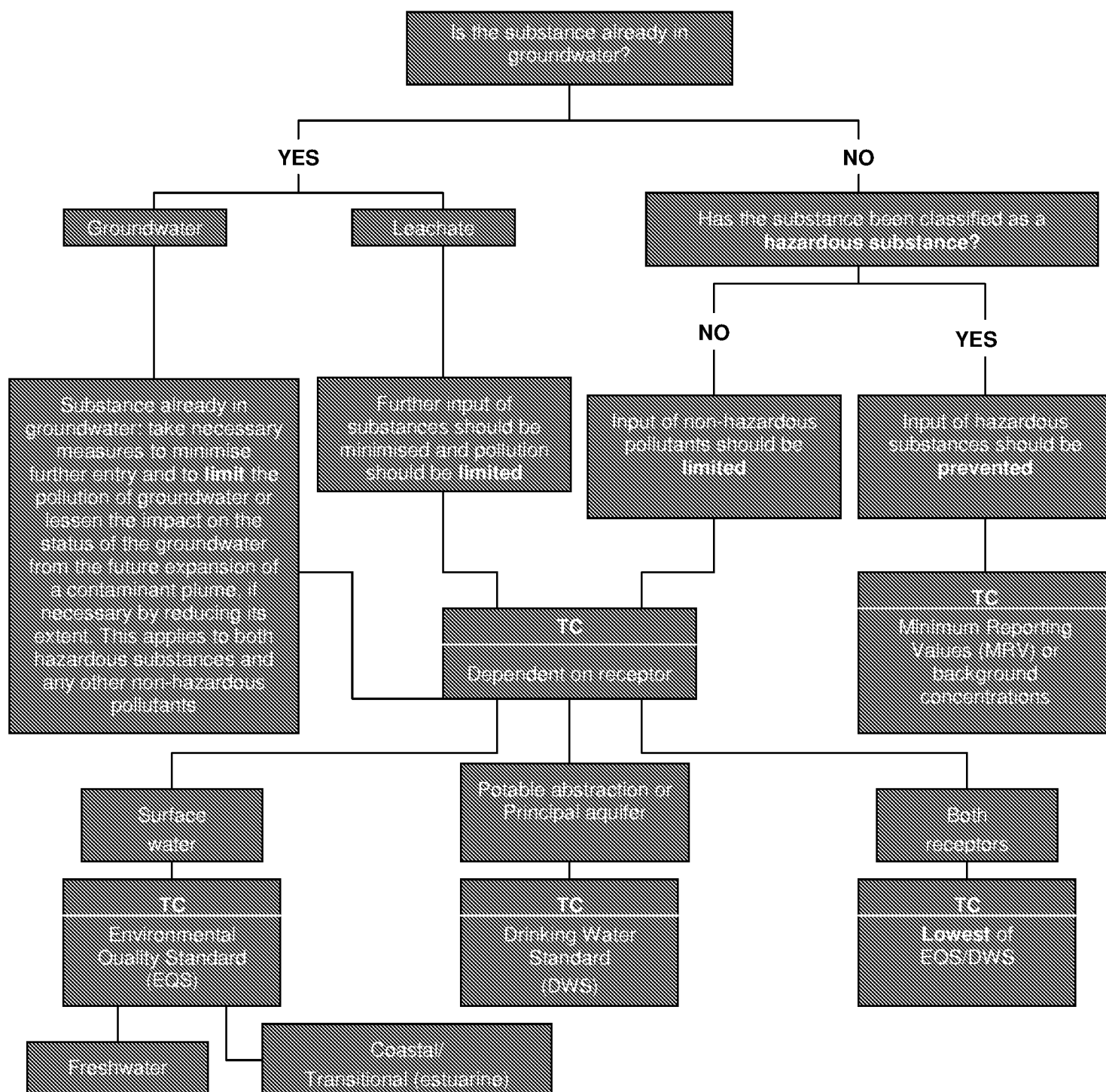
References

1. Environment Agency (2017), 'The Environment Agency's approach to groundwater protection', version 1.0, March 2017 (formerly contained within GP3) [accessed 29 March 2017].
<https://www.gov.uk/government/collections/groundwater-protection>
- 1a. Environment Agency (2017), 'Land contamination groundwater compliance points: quantitative risk assessments', March 2017 (formerly contained within GP3) [accessed 29 March 2017].
<https://www.gov.uk/government/collections/groundwater-protection>
2. The Water Supply (Water Quality) Regulations 2016 (SI 2016/619)
 - 2a. Sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane
 - 2b. Standard applies to individual pesticides except aldrin, dieldrin, heptachlor and heptachlor epoxide, for which a separate standard is defined.
3. The Private Water Supplies (England) Regulations 2016. SI 2016 / 618
4. WHO (2011), *Guidelines for drinking-water quality*, 4th edn
5. JAGDAG hazard substance determinations: This list contains substances that are determined to be hazardous substances or non-hazardous pollutants for the purposes of the groundwater directive 2006/118/EC. The absence of an assessment or substance from the list means an assessment has not been done yet and is presented as 'Not yet determined'; if a substance has been assessed but does not fall into either category it is presented as 'None'. For further details on how substances are assessed, see the Joint Agencies Groundwater Directive Advisory Group (JAGDAG) 'Methodology for the determination of hazardous substances in groundwater for the purposes of the groundwater directive 2006/118/EC' which is available from the JAGDAG website. The methodology is a UK –wide framework that sets criteria for how to assess whether a substance is a hazardous substances in groundwater. The list of substances can be found at:
<https://www.wfd.uk.org/sites/default/files/Media/170116%20Substance%20Determinationsfinal.pdf>
6. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
 - 6a. The EQS for these substances are based on a "long term mean" or an "annual average (AA)" EQS.
 - 6b. For cadmium and its compounds the EQS values vary depending on the hardness of the water as specified in five class categories (Class 1: < 40 mg CaCO₃/l, Class 2: 40 to < 50 mg CaCO₃/l, Class 3: 50 to < 100 mg CaCO₃/l, Class 4: 100 to < 200 mg CaCO₃/l and Class 5: ≥ 200 mg CaCO₃/l).
 - 6c. The EQS for Mercury and hexachlorobutadiene are based on a "maximum acceptable concentration (MAC)" EQS in absence of an "annual average (AA)" EQS.
 - 6d. The EQS for chlorine in saltwater is based on the 95th percentile concentration of total residual oxidant, which refers to the sum of all oxidising agents existing in water, expressed as available chlorine.
 - 6e. The recommended saltwater standard is derived using a safety factor of 100. Where the standard is failed, it is recommended that supporting evidence of ecological damage should be obtained before committing to expensive action.
 - 6f. EQS for total ammonia is as per Schedule 3, Part 1, Table 7 of of the above directions. EQS applies to river types 1, 2 and 4 and 6 (namely upland and low alkalinity). The EQS for a lowland and high alkalinity rivers (types 3, 5 and 7) is 600µg/l (0.6mg/l).

Additional information on the Metal Bioavailability Assessment Tool (M-BAT) is available at <http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat>

7. Minimum reporting values listed at <https://www.gov.uk/government/publications/values-for-groundwater-risk-assessments/hazardous-substances-to-groundwater-minimum-reporting-values> (updated 13 January 2017; accessed 29 March 2017). Note target concentration for xylenes is 3 µg/l each for o-xylene and m/p xylene as it may not be possible to separate m- and p-xylene; 135 tcb, 124 tcb, 123 tcb each to 0.01 µg/l)
8. The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (as amended). SI 1996 / 3001
9. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive) (78/659/EEC)
10. WRc plc (2002), R&D Technical Report P45.
11. CL:AIRE, 2017. Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies. V1.1.
12. Drinking Water Inspectorate (London, UK). Environmental Information Request on MTBE in drinking water. Ref. DWI 1/10/18; dated 28 November 2006. Value is based on the odour threshold for MTBE, which is lower than a health-based guideline value
13. World Health Organisation (WHO), 2008. Petroleum products in drinking-water. Background document for development of WHO guidelines for drinking water quality. WHO/SDE/WSH/05.08/123. World Health Organisation, Geneva. [accessed 29 March 2017] http://www.who.int/water_sanitation_health/dwg/chemicals/petroleumproducts_2add_june2008.pdf

FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS



TC = Target concentration

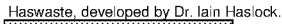
When leachate is being assessed the 'compliance point' is the groundwater body. Therefore dilution within the groundwater body may be applied with caution before comparing with the TC.

When directly assessing a receptor, e.g., a river, the appropriate TC should be selected.



APPENDIX M

HASWASTE ASSESSMENT



TP/WS/BH
Depth (m)
Envirolab reference

HOP1	HOP2	HOP3	HOP5					
0.20	0.20	0.30	0.20					

% Moisture											
pH (soil)		7.17		7.53		8.12					
pH (leachate)											
Arsenic	mg/kg	5	3	3							
Cadmium	mg/kg	1.0	0.6	0.6							
Copper	mg/kg	14	7	11							
CrVI or Chromium	mg/kg	27	18	20							
Lead	mg/kg	56	41	101							
Mercury	mg/kg	0.17	0.17	0.17							
Nickel	mg/kg	18	12	11							
Selenium	mg/kg	1	1	1							
Zinc	mg/kg	120	51	119							

Barium		mgl:kq								
Beryllium		mgl:kq								
Vanadium		mgl:kq								
Cobalt	ugbeed v5.06	mgl:kq								
Manganese	ugbeed v5.06	mgl:kq								
Molybdenum		mgl:kq								
Antimony		mgl:kq								
Aluminium		mgl:kq								
Bismuth		mgl:kq								
CrIII		mgl:kq								
Iron	ugbeed v5.06	mgl:kq								
Strontium		mgl:kq								
Tellurium		mgl:kq								
Thallium		mgl:kq								
Titanium		mgl:kq								
Tungsten		mgl:kq								
Ammoniacal N ws Boron		mgl:kq mgl:kq								

PAH (Input Total PAH OR individual PAH results)									
Acenaphthene	mg/kg	0.01	0.01	0.01					
Acenaphthylene	mg/kg	0.01	0.01	0.01					
Anthracene	mg/kg	0.02	0.02	0.02					
Benzo(a)anthracene	mg/kg	0.09	0.04	0.09					
Benzo(a)pyrene	mg/kg	0.10	0.04	0.11					
Benzo(b)fluoranthene	mg/kg	0.13	0.07	0.17					
Benzo(ghi)perylene	mg/kg	0.07	0.05	0.10					
Benzo(k)fluoranthene	mg/kg	0.07	0.07	0.07					
Chrysene	mg/kg	0.10	0.06	0.11					
Dibenzo(ah)anthracene	mg/kg	0.04	0.04	0.04					
Fluoranthene	mg/kg	0.18	0.08	0.14					
Fluorene	mg/kg	0.01	0.01	0.01					
Indeno(123cd)pyrene	mg/kg	0.08	0.04	0.11					
Naphthalene	mg/kg	0.03	0.03	0.03					
Phenanthrene	mg/kg	0.05	0.03	0.03					
Pyrene	mg/kg	0.16	0.07	0.12					
Coronene	mg/kg	0.96	0.26	0.96					
Total PAHs (16 or 17)	mg/kg								

TPH									
Petrol	mg/kg	0.03		0.03	0.03				
Diesel	mg/kg	0.3		0.3	0.3				
Lube Oil	mg/kg	0.1		0.1	0.1				

Crude Oil									
White Spirit / Kerosene	mg/kg								
Creosote	mg/kg								
Unknown TPH with ID	mg/kg								
Unknown TPHCWG	mg/kg								
Total Sulphide	mg/kg								
Complex Cyanide	mg/kg								
Free (or Total) Cyanide	mg/kg								
Thiocyanate	mg/kg								
Elemental/Free Sulphur	mg/kg								

Phenols Input Total Phenols HPLC OR individual Phenol results.									
Phenol	mg/g								
Cresols	mg/g								
Xylenols	mg/g								
Resorcinol	mg/g								
Phenols Total by HPLC	mg/g								

BTEX Input Total BTEX OR individual BTEX results.									
Benzene	mg/kg	0.01	0.01	0.01					
Toluene	mg/kg	0.01	0.01	0.01					
Ethylbenzene	mg/kg	0.01	0.01	0.01					
Xylenes	mg/kg	0.01	0.01	0.01					
Total BTEX	mg/kg	0.01	0.01	0.01					

[illegible]

PBBs (POPs)									
Hexabromobiphenyl (Total or PBB153; 2,2',4,4',5,5'- if only available)	mg/kg								



Haswaste, developed by Dr. Iain Haslock.

29519 - Eastergate

TP/WS/BH

Depth (m)

Envirolab reference

HQF1	HQF2	HQF3	HQF4					
0.20	0.20	0.30	0.20					

POPs Dioxins and Furans Input Total Dioxins and Furans

OR individual Dioxin and Furan results.

2,3,7,8-TeCDD	mg/kg							
1,2,3,7,8-PeCDD	mg/kg							
1,2,3,4,7,8-HxCDD	mg/kg							
1,2,3,6,7,8-HxCDD	mg/kg							
1,2,3,7,8,9-HxCDD	mg/kg							
1,2,3,4,6,7,8-HpCDD	mg/kg							
OCDD	mg/kg							
2,3,7,8-TeCDF	mg/kg							
1,2,3,7,8-PeCDF	mg/kg							
2,3,4,7,8-PeCDF	mg/kg							
1,2,3,4,7,8-HxCDF	mg/kg							
1,2,3,6,7,8-HxCDF	mg/kg							
2,3,4,6,7,8-HxCDF	mg/kg							
1,2,3,7,8,9-HxCDF	mg/kg							
1,2,3,4,6,7,8-HpCDF	mg/kg							
1,2,3,4,7,8,9-HpCDF	mg/kg							
OCDF	mg/kg							
Total Dioxins and Furans	mg/kg							

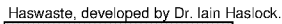
Some Pesticides (POPs unless otherwise stated)

Aldrin	mg/kg		0.050000		0.050000			
α Hexachlorocyclohexane (alpha-HCH) (leave empty if total HCH results used)	mg/kg		0.050000		0.050000			
β Hexachlorocyclohexane (beta-HCH) (leave empty if total HCH results used)	mg/kg		0.050000		0.050000			
α Cis-Chlordane (alpha) OR Total Chlordane	mg/kg		0.050000		0.050000			
δ Hexachlorocyclohexane (delta-HCH) (leave empty if total HCH results used)	mg/kg		0.050000		0.050000			
Dieldrin	mg/kg	revised v5.4ei	0.050000		0.050000			
Endrin	mg/kg		0.050000		0.050000			
γ Hexachlorocyclohexane (gamma-HCH) (lindane) OR Total HCH	mg/kg	updated v5.4ei	0.050000		0.050000			
Heptachlor	mg/kg		0.050000		0.050000			
Hexachlorobenzene	mg/kg		0.050000		0.050000			
o,p'-DDT (leave empty if total DDT results used)	mg/kg		0.050000		0.209000			
p,p'-DDT OR Total DDT	mg/kg	revised v5.4ei	0.050000		0.776000			
γ Trans-Chlordane (gamma) (leave empty if total Chlordane results used)	mg/kg		0.050000		0.050000			
Chlordecone (kepone)	mg/kg							
Pentachlorobenzene	mg/kg							
Mirex	mg/kg							
Toxaphene (camphechlor)	mg/kg							

Tin

Tin (leave empty if Organotin and Tin excl Organotin results used)

Organotin								
Dibutyltin; DiBT	mg/kg							
Tributyltin; TriBT	mg/kg							
Triphenyltin; TriPT	mg/kg							
Tetrabutyltin; TeBT	mg/kg							
Tin excluding Organotin								
Tin excl Organotin	mg/kg							



TP/WS/BH
Depth (m)
Envirolab reference

Asbestos % Composition in Soil (Matrix Loose Fibres or Microscopic Identifiable Pieces only)	see "Carc HP7 % Asbestos in Soil (Fibres)" below
Carcinogenic HP7 % Asbestos in Soil (fibres or micro pieces)	20.1%

Asbestos Identifiable Pieces visible with the naked eye detected in the Soil (enter Y or N)	Y
---	---

HQP1	HQP2	HQP3	HQP5					
0.20	0.20	0.30	0.20					

N	N	N	N					
---	---	---	---	--	--	--	--	--

[illegible]

If Asbestos in Soil above is ">", but Asbestos % above is "<0.1%", the soil is Non Hazardous Waste. You can only use Asbestos % results where loose fibres or micro pieces are only present. You cannot use Asbestos % results when visual identifiable pieces are present.

--	--	--	--	--	--	--	--	--

If visual identifiable pieces of asbestos are present, **you cannot use Asbestos % results** and the whole soil sample is Hazardous Waste HP5 and HP7 Construction material containing Asbestos 17 06 05. Therefore, if Asbestos in Soil above is "Y", the Asbestos % above is "<0.1%", but the Asbestos Identifiable Pieces visible with the naked eye is "Z", the soil is Hazardous Waste.

Identifiable Pieces are Cement, Fragments, Board, Rope etc. ie anything ACM that is not Loose Fibres.

All visual asbestos pieces need to be removed leaving only fibres (or micro pieces) with an Asbestos % Composition in Soil result of <0.1% for the soil to become non-hazardous waste.

Hazardous Property	Thresholds	Cut Off Value
Corrosive HP8	≥5%	<1%
Irritant HP4	≥10%	<1%
Irritant HP4	≥20%	<1%
Specific Target Organ Toxicity HP5	≥1%	
Specific Target Organ Toxicity HP5	≥20%	
Specific Target Organ Toxicity HP5	≥1%	
Specific Target Organ Toxicity HP5	≥10%	
Aspiration Toxicity HP5	≥1%	
Acute Toxicity HP6	≥0.1%	<0.1%
Acute Toxicity HP6	≥0.2%	<0.1%
Acute Toxicity HP6	≥5%	<0.1%
Acute Toxicity HP6	≥25%	<1%
Acute Toxicity HP6	≥0.2%	<0.1%
Acute Toxicity HP6	≥0.2%	<0.1%
Acute Toxicity HP6	≥15%	<0.1%
Acute Toxicity HP6	≥5%	<1%
Acute Toxicity HP6	≥0.1%	<0.1%
Acute Toxicity HP6	≥0.5%	<0.1%
Acute Toxicity HP6	≥3.5%	<0.1%
Acute Toxicity HP6	≥22.5%	<1%
Carcinogenic HP7	≥0.1%	
Carcinogenic HP7	≥1%	
Carcinogenic HP7 Unknown TPH with ID	≥1.0000000%	
Carcinogenic HP7 b(a)p marker test (Unknown TPH with ID only)	≥0.01%	
pH Corrosive HP8 pH (soil or leachate)	4.0-11.5	
pH Corrosive HP8 pH (soil or leachate)	14-22	
Toxic for Reproduction HP10	≥0.5%	
Toxic for Reproduction HP10	≥5%	
Mutagenic HP11	≥0.1%	
Mutagenic HP11 Unknown TPH with ID	≥1.0000000%	
Mutagenic HP11 b(a)p marker test (Unknown TPH with ID only)	≥0.01%	
Mutagenic HP11	≥1%	
Produces Toxic Gases HP12 Sulphide	≥1.4000000%	
Produces Toxic Gases HP12 Cyanide	≥1.2000000%	
Produces Toxic Gases HP12 Thiocyanate	≥0.0000000%	
HP13 Sensitising	≥10%	

	0.00584	0.00000	0.00385	0.00424	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00224	0.00000	0.00119	0.00164	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00528	0.00001	0.00327	0.00353	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00518	0.00001	0.00346	0.00384	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00560	0.00001	0.00410	0.01010	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00005	0.00000	0.00005	0.00005	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00068	0.00001	0.00041	0.00042	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00533	0.00005	0.00360	0.00411	0.00000	0.00000	0.00000	0.00000	0.00000
	0.01095	0.00002	0.00739	0.01366	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00002	0.00001	0.00002	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00518	0.00001	0.00346	0.00385	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00002	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00010	0.00003	0.00006	0.00009	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00530	0.00000	0.00353	0.00392	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00014	0.00000	0.00014	0.00014	0.00000	0.00000	0.00000	0.00000	0.00000
	0.01085	0.00001	0.00735	0.01360	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00560	0.00001	0.00410	0.01010	0.00000	0.00000	0.00000	0.00000	0.00000
	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000
	0.00003	0.00001	0.00003	0.07760	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	7.17	0.00	7.53	8.12	0.00	0.00	0.00	0.00	0.00
	7.17	0.00	7.53	8.12	0.00	0.00	0.00	0.00	0.00
	0.00560	0.00000	0.00410	0.01010	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00518	0.00000	0.00346	0.00384	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00518	0.00000	0.00346	0.00384	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	0.00364	0.00000	0.00242	0.00222	0.00000	0.00000	0.00000	0.00000	0.00000
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.00518	0.00000	0.00346	0.00384	0.00000	0.00000	0.00000	0.00000	0.00000

Ecotoxic HP14	21.5	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.12810	0.00030	0.07129	0.13261	0.00000	0.00000	0.00000	0.00000	0.00000
Ecotoxic HP14	23.5	<0.1%	0.03203	0.00008	0.01782	0.03315	0.00000	0.00000	0.00000	0.00000	0.00000
Ecotoxic HP14	22.5	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.03206	0.00008	0.01785	0.03318	0.00000	0.00000	0.00000	0.00000	0.00000

Table 3.1 of the CLP, CL Inventory, ATPs, IARC, Concawe, MSDSs, REACH + Pesticide Properties databases. Worst case REACH + MSDS's used for "" STOT + Acute Toxicity.



Haswaste, developed by Dr. Iain Haslock.

29519 - Eastergate

TP/WS/BH

Depth (m)

Envirolab reference

Ecotoxic HP14 individual substance specific thresholds (Benzo(a)anthracene, Dibenzo(a,h)anthracene (or Total PAH if only used), Sn, TriPT)	20.00000%
Ecotoxic HP14 individual substance specific thresholds (Cd, Cr+Cr6, DDT, TriBT)	20.00000%
Persistent Organic Pollutant (PCB, PBB or POP Pesticides)	50.00000%
Persistent Organic Pollutant (Total Dioxins+Furans)	40.000000000%
Persistent Organic Pollutant (Individual Dioxins+Furans)	40.000000000%

HQF1 0.20	HQF2 0.20	HQF3 0.30	HQF5 0.20					
--------------	--------------	--------------	--------------	--	--	--	--	--

0.000009	0.000000	0.000004	0.000009	0.000000	0.000000	0.000000	0.000000	0.000000
0.00000	0.00001	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000000	0.00000500	0.00000000	0.00007760	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000

If other contaminants need adding to Haswaste, please contact Envirolab.