

HOLLINS HOUSE FARM, BURY

PHASE 2 GEO-ENVIRONMENTAL INVESTIGATION, RISK ASSESSMENT AND REMEDIATION STRATEGY

Job Number: LKC 21 1391
Date: December 2022
Client: Mr Nield



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LK Consult Document Verification			
Site Address	Hollins House Farm, 247 Hollins Lane, Bury, BL9 8AS		
Report Title	Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy		
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EXECUTIVE SUMMARY

Site Details

Site Location:	Hollins House Farm, 247 Hollins Lane, Bury, BL9 8AS. National Grid Reference 381410E 408020N.
Site Area:	1,050m ² .
Current Land Use:	Existing barn, foundation footings (associated with proposed building), cobbled area (yard / drive), grassed area (garden) and rough ground.
Proposed Development:	Planning Application 65632: Conversion of barns to residential dwellings.
Purpose of Report:	Contamination Assessment.

Preliminary Risk Assessment

History:	Site: Hollins House Farm. Surrounding Area: Residential, pond, well, embankment, bowling green, drains, allotment gardens, pond.
Geology / Hydrogeology:	Glaciofluvial Deposits (sand and gravel) / Secondary A Aquifer. Pennine Middle Coal Measures / Secondary A Aquifer.
Nearest Watercourse:	Drains adjacent to south and 30m south. Parr Brook 200m south.
Preliminary Conceptual Model:	PL1 Direct Contact (Human Health): Moderate / Low Risk. PL2 Inhalation of Vapours: Moderate / Low Risk. PL3 Gas: Moderate / Low Risk. PL4 Controlled waters: Low Risk. PL5 Water Pipelines: Moderate / Low Risk.
PL=Pollutant Linkage	
Recommendations:	Site Investigation was recommended to further assess all the above pollutant linkages.

Ground Investigation Work

Date of Investigation:	17 th November 2022.
Intrusive Investigation Work Undertaken:	10no. hand dug pits (HD101-HD106 including HD102B and HD103B-D).
Soil Sampling:	7no. samples tested for metals, speciated PAHs, pH, sulphate, asbestos and SOM.

Ground Conditions and Geotechnical Assessment

Made Ground:	HD101, HD105 and HD106 - gravelly, sandy silt with coal, brick fragments and clinker to depths of 0.45-0.85mbgl. HD102 and HD102B - terminated in made ground at 0.5-0.75mbgl. Comprised very sandy gravel with frequent cobbles including brick, concrete, breezeblock, clinker and coal (localised demolition rubble). HD103, HD103B and HD103C - terminated in the made ground at 0.1-0.2mbgl due to tree roots. Comprised gravelly sand with occasional brick fragments, clinker and rare plastic and ceramics fragments. HD103D made ground to 0.2mbgl comprising sandy gravel with frequent ash, clinker, coal and brick. HD104 (cobbled area) - very thin (0.05m) depth of sandy gravel comprising ash clinker and bricks below cobbles.
Natural:	Sand with occasional silt lenses, present from 0.15-0.8mbgl.
Groundwater:	None encountered.

Contamination Risk Assessment

Pollutant Linkage		Risk	Recommendations
1	Contaminants posing a risk to site users via dermal contact, ingestion and inhalation (of soil, dust, fibres and home-grown produce).	Moderate	- Elevated lead identified in the made ground which may pose a risk to site users in gardens / soft landscaping areas. - Recommendations: - Remediation required in gardens / soft landscaping areas. - No remediation required where buildings and hardstood ground are present.
2	Volatile contaminants posing a risk to site users via the inhalation of vapours.	Low	- No elevated volatile contaminants across the site. - Recommendations: No remediation required.
3	Gas posing a risk to buildings and site users via the migration of gas into building causing explosion and asphyxiation.	Moderate / Low	- No significant source anticipated. Low risk assumed. - Recommendation: No remediation required.
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	Low	- No significant source anticipated. - Recommendation: No remediation required.
5	Organic contaminants posing a risk to water pipes.	Low	- Although marginally elevated naphthalene identified, not present at depth where potable water pipes are anticipated to be laid. - Recommendation: Barrier piping unlikely to be required. This may need to be confirmed with UU.

Recommendations and Remedial Strategy

Pollutant Linkage	Remediation Requirements	Validation Requirements
Pollutant Linkage 1 (elevated lead)	<u>Option 1 (Source Removal)</u> Where made ground is shallow (<600mm), made ground should be removed and levels raised with suitably chemically validated subsoil and topsoil.	Inspection of ground following source removal. Chemical validation of imported soils. Document in Site Completion Report.
Remediation required in all gardens / soft landscaping areas.	<u>Option 2 (Environmental Cover System)</u> Where made ground is deep (>600mm), a 600mm environmental cover system is recommended and should comprise: - Either 100mm physical gravel break layer and at least 500mm comprising clean inert subsoil and topsoil. - Or geotextile membrane and at least 600mm comprising clean inert subsoil and topsoil.	Measure depth of environmental cover system using a staff and provide photographic evidence. Photographic evidence of the physical gravel break or geotextile layer. Chemical validation of imported soils. Document in Site Completion Report.

Other Considerations	
Unexpected Contamination	The relevant contractors should be briefed that during development works at the site should any unusual ground conditions and / or visual or olfactory evidence of contamination (including asbestos containing material) be encountered at the site, LKC and the Local Authority should be informed, and further assessment of the material may be required. Should asbestos be identified during groundworks, precautions should be taken to ensure the safety of the construction workers and nearby land users. It would be advisable to introduce an asbestos management strategy.
Health and Safety Considerations	In working with, removing or treating any contaminating material it is important that any potential risks associated with the actual site works are mitigated by good environmental management of the site during the remedial phases. Standard health and safety precautions should be adopted by all workers involved with site enabling and construction works.

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- Appendix A: Risk Matrix
Appendix B: Profile Logs
Appendix C: Certificate of Analysis - Soil
Appendix D: Generic Assessment Criteria

1 Introduction

1.1 Background

LK Consult Ltd (LKC) has been commissioned by Mr Nield to carry out a Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy for Hollins Farm, Bury. The investigation was undertaken in support of a planning application (reference number 65632) to develop the site for residential use.

The following work has previously been undertaken:

- Preliminary Risk Assessment (PRA) report, undertaken by LKC (Ref: CL-602-LKC 12 1111-01, dated March 2013).

This investigation has been undertaken to confirm the ground conditions below the site and to allow a contamination assessment to be undertaken.

The investigation will aim to confirm the risks of the potential pollutant linkages identified in the PRA and recommend further assessment / remediation, as required.

1.2 Site Details

A summary of the site details is presented in Table 1-1. Figures 1 and 2 indicate the site location, boundary and proposed development.

The PRA was carried out for a wider area including the existing property to the east. The Phase 2 investigation focuses on the development area in the north and west (see site boundary plan).

Site Location	Hollins House Farm, 247 Hollins Lane, Bury, BL9 8AS. National Grid Reference 381410E 408020N.
Approximate Area	1,050m ² .
Topography	Approximately 100 metres Above Ordnance Datum (AOD). Site slopes down to the northeast.
Current Site Use	Existing barn, foundation footings (associated with proposed building), cobble area (yard / drive), grassed area (garden) and rough ground.
Purpose of Report	Planning.
Planning Ref.	65632
Proposed Development	Conversion of barns to residential dwellings.

Table 1-1. Summary of site details.

2 Phase 1 Preliminary Risk Assessment (PRA)

A PRA report (Ref: LKC 12 1111-01, dated March 2013) has previously been undertaken by LKC. This is reviewed below. Additional information has also been included following a recent site visit.

2.1 Historical Review

Site Features	Location	Map Dates Present	Comments
Hollins House Farm	Whole site	1848-2012	Buildings to the north and west of the site, one building in the centre of the site. A number of small buildings to the west of the site are only marked until 1992 mapping. Pump/ well marked on 1893 and 1910 mapping.
Surrounding Area Features	Distance/ Location	Map Dates Present	Comments
Residential	Adj. E & W	1848-2012	Properties to the east from 1893 mapping.
Pond	100m E	1851-1955	Potentially infilled by 1957 mapping.
Well	190m SW	1893-1957	Potentially infilled by 1963 mapping.
Embankment	10m E	1893-1994	Associated with Hollins Lane.
Bowling Green	65m N	1930-2012	Embankments marked adjacent to the north and south of the bowling green on 1957 mapping.
Drain	Adj. S	1957-1992	Running east-west parallel to the southern site boundary.
Drain	10m SE	1957-2012	
Allotment Gardens	30m NW	1957	Only annotated on this map. Residential properties on this site from 1970 mapping.
Pond	80m N	1965-1974	Potentially infilled by 1983 mapping.

Table 2-1: Summary of Historical Review.

2.2 Environmental Settings

Summary of Environmental Settings		
Geology	Superficial	Glaciofluvial Deposits (sand and gravel).
	Bedrock	Pennine Middle Coal Measures.
Hydrogeology	Aquifer Designation	Secondary A (superficial and bedrock)
	Groundwater abstractions	None within 500m.
Hydrology	Nearest surface water	Drains adjacent to south and 30m south. Parr Brook approximately 200m south.
	Surface water abstractions	None within 500m.
Landfill sites (within 250m)	Known/Registered	None within 250m.
	Potential	Well on site (located in existing cobbled drive / yard). 2 ponds (80m N and 100m E).
Radon		Probability of <1% of homes above Action Level. -No further action required.
Contemporary Trade Directory		None within 250m.

Table 2-2: Summary of Relevant Environmental Settings.

2.3 Site Reconnaissance

2013

The area of the proposed development comprised derelict farm buildings. Ground cover across the site was mainly hardwood with cobbles in the farmyard. There were some areas of soft landscaping in the northeast and south of the site.

The farmyard buildings were in a state of disrepair and were not deemed safe for access. The building to the northwest of the site was supported by scaffolding, as the south of the building had collapsed. There was an open door, to the north of the building, through which it could be seen that the building was empty. A wooden staircase could be seen to the north of this building, leading to a second floor.

No evidence of farm equipment or machinery was observed. There was evidence that a small fire had been set on the cobbles towards the north of the farmyard. Some wood was being stored in the farmyard, and a small box of rubbish. No fuel stains or leakages were noted within the farmyard. LKC saw no evidence of the well marked on historic mapping.

Anecdotal information from the tenant indicated that historically there may have been a tank towards the northeast of the site in the current garden area. Also, there used to be a culvert towards the northeast of the site, which ran into fields to the north of the site. The culvert has been gone for some time, and no evidence of the former culvert can be observed on site.

There was evidence of some made ground towards the west of the site where a section of the farmyard building had collapsed. This comprised a sandy soil with some brick fragments and occasional ash.

2022

A further site visit was undertaken in 2022. At the time of the visit, only the building (barn) in the north of the site remained and footings for the proposed new building were visible in the east.

Natural sand was visible within the existing barn and this is understood to extend across the barn (pits were undertaken for their structural engineer and sand was confirmed in all the pits).

It is understood that the possible underground tank noted in the original PRA is actually a water storage tank and not within the site boundary of the proposed development area.

Sand was present at shallow depth in the location of the foundations. The current (and proposed) garden where exposed, appeared to comprised topsoil of approx. 0.2m over sand.

There are areas where cobbles are present in the driveway and yard to the east of the development area which will remain in place post development. The former well is anticipated to be below the existing cobbles driveway / yard.

Photographs taken 1st November 2022 are provided in Table 2-3.

	
Photo 1. Existing Building with sand present at surface.	Photo 2. Small area of landscaping in the NE corner.
	
Photo 3: Current / proposed garden with exposed foundations in the background.	Photo 4: Exposed foundations with cobbled drive / yard in the background.
	
Photo 5: Exposed foundations showing natural sand at shallow depth.	Photo 6: Current / proposed garden with exposed foundations.

Table 2-3: Current site photographs.

2.4 Preliminary Contamination Conceptual Model

The preliminary contamination conceptual model (PCCM) has been updated based on additional information from the recent site visit and to be in line with LKC current risk assessment methodology using contaminant-pathway-receptor pollutant linkages based on guidance in LCRM¹.

Each pollutant linkage is described along with an assessment of the risk based upon guidance on probabilities and consequences outlined in CIRIA C552². The risk matrix is provided in Appendix A.

The PCCM is presented in Table 2-4.

Due to the minor consequence associated with the phytotoxic effect to flora (i.e. loss of plants in a landscaping scheme), the overall risk for the majority of sites will be very low to low. Where soils contain significant concentrations of heavy metals, in general there will other pollutant linkages (i.e. the risk to human health) that will trigger the requirement for remediation (e.g. a clean environmental cover system). As such the risk to flora associated with phytotoxic contaminants will not be considered further.

The risk to buildings associated with elevated sulphate will be considered as part of the geotechnical assessment and will not be included in the contamination risk assessment.

It should be noted that there may be risk from short term exposure from contaminated soil to site workers during development work. The Preliminary Contamination Conceptual Model deals with long term exposure to key receptors associated with the future use of the site. Acute risks can be easily mitigated by good environmental management of the site during site works. Standard health and safety precautions (as per HSE guidance³) should be adopted by all workers involved with site enabling and construction works. Therefore, this receptor is not considered in the contamination conceptual model.

¹ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

² CIRIA (2001). "Contaminated Land Risk Assessment: A Guide to Good Practice". C552.

³ HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land" London HMSO.

PL	Pathway	Receptor	Contaminants of Concern (CoC)	Probability	Consequence	Risk	Recommendations
1	- Dermal contact. - Inhalation of soil, fibres and dust. - Ingestion of soils, dust, home-grown produce, soil attached to home-grown produce. - Windblown dust.	- Future site users. - Offsite receptors.	- ACM. - Heavy metals. - PAHs. - Petroleum hydrocarbons. - Other inorganic and organic contaminants.	Low Likelihood (given site history, current site conditions and proposed end use)	Medium	Moderate / Low (moderate assumed until ground conditions confirmed across the site)	Intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.
2	- Inhalation of vapours. - Migration via permeable strata and preferential pathways.	- Future site users. - Offsite receptors.	- Volatile contaminants (petroleum hydrocarbons).	Low Likelihood (given site history, current site conditions and proposed end use)	Medium	Moderate / Low (low assumed as no evidence observed)	Low density intrusive investigation required, to include PID testing. Soil analysis of CoC, subject to ground conditions encountered and PID testing.
3	- Inhalation of gas. - Migration via permeable strata and preferential pathways. - Explosion in confined spaces.	- Future site users. - Buildings. - Offsite land users.	- Ground / hazardous gas (carbon dioxide, methane).	Unlikely (given age and location of potentially infilled features, not anticipated to be significant gas sources)	Severe	Moderate / Low (low assumed as no significant source anticipated)	Intrusive investigation to confirm ground conditions. If significant gas source and pathway identified, gas monitoring or gas protection measures required.
4	- Surface run-off. - Migration via permeable strata and preferential pathways. - Perched waters migration.	- Groundwater (Secondary A Aquifers). - Surface water (Adj. Drain).	- Mobile contaminants such as metals, PAHs, petroleum hydrocarbons, other organic / inorganic contaminants.	Unlikely (given limited mobile source)	Medium	Low	Low density intrusive investigation required. Groundwater sampling, subject to ground conditions encountered. Analysis of CoC.
5	- Ingestion of tainted water supply.	- Future site users. - Water pipes.	- Organic contaminants such as PAHs and petroleum hydrocarbons.	Low Likelihood (significant contamination not expected at pipeline depth)	Medium	Moderate / Low (low risk assumed given anticipated limited made ground and contamination)	Low density intrusive investigation required. Soil analysis of CoC, subject to ground conditions encountered.

Table 2-4. Preliminary Contamination Conceptual Model.

3 Ground Investigation

3.1 Site Investigation Design and Methodology

In order to assess the ground conditions at the site and to investigate the potential pollutant linkages identified in the preliminary contamination conceptual model an intrusive investigation was undertaken.

The investigation was carried out on 17th November 2022 and comprised the following:

- 10no. hand dug pits (using hand auger / spade) excavated to 0.1-1.2mbgl (ref. HD101-HD106 including HD102B and HD103B-D).

HD102 was repositioned (HD102B) due to collapsing of the pit. HD103 was repositioned (HD103B-D) due to tree roots.

All site investigation locations are shown in Figure 3. The locations were chosen to allow good coverage across the site as well as target proposed soft landscaping / garden areas.

All profile logs are provided in Appendix B and are in line with BS14688-1⁴ and BS5930⁵.

3.2 Sampling Protocol

Standard sampling protocol and preservation of samples was undertaken as described in the EA guidance on site investigation⁶.

Soil was collected for onsite testing. A plastic zip bag was half filled with soil allowing a suitably sized headspace. The bag was sealed and stored for at least 20 minutes before being tested for total volatile organic compounds (TVOCs) using a photoionisation detector (PID). The on-site monitoring was carried out in line CIRIA C665⁷ to aid in screening samples for volatile analysis.

Soil samples of approximately 500g were recovered in amber jars, amber vials for volatile analysis and plastic tubs. All the samples were labelled and stored in cool boxes prior to being collected by courier at the end of the day for delivery to the Chemtest laboratory in Newmarket for chemical testing. If collection was not possible the same day then samples were stored in the sample storage fridge at the LK Group offices below 4°C. Samples were tracked using appropriate Chain of Custody forms provided by Chemtest.

Many of the contamination tests are UKAS or MCERTS accredited and further details are given in the Certificate of Analysis presented in Appendix C. Table 3-1 shows the soil testing undertaken.

⁴ British Standards (2002) Geotechnical investigation and testing – Identification and Classification of Soil. Part 1: Identification and description. BS EN ISO 14688-1:2002.

⁵ British Standard (2015). "Code of Practice for Ground Investigations". BS5930:2015.

⁶ EA (2000). "Technical Aspects of Site Investigation. Volumes 1 & 2 Text Supplements Research and Development Technical Report." P5-065/Tr.

⁷ CIRIA (2007). "Assessing Risks Posed by Hazardous Ground Gases to Buildings." CIRIA C665.

Contaminants	No. Samples	Justification
Metals / metalloids, pH, water soluble sulphate, speciated PAHs, SOM, asbestos screen.	7	A basic suite with a broad selection of contaminants tested on samples across the site where no significant evidence of contamination was identified (with the exception of ash, clinker and coal) and no TVOCs identified from the PID tests.

Table 3-1. Summary of soil sample testing undertaken.

Notes:

If asbestos present during screen identification and quantification will be undertaken.

Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc and boron; PAH=polycyclic aromatic hydrocarbons; SOM=Soil Organic Matter.

4 Ground Conditions

A summary section of the logs is provided in Plate 4-1.

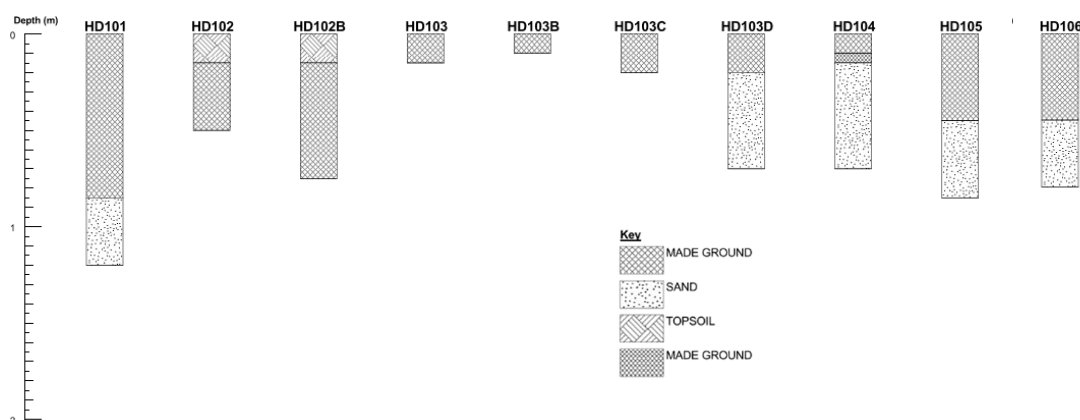


Plate 4-1: Summary of ground conditions.

Additional information on ground conditions:

Topsoil / Made Ground

Topsoil and made ground were recorded to depths of 0.15-0.85mbgl.

The made ground in HD101, HD105 and HD106 comprised gravelly, sandy silt with coal, brick fragments and clinker to depths of 0.45-0.85mbgl.

In the location of HD102 and HD102B, the pits were terminated in the made ground due to collapsing of the pit at 0.5-0.75mbgl. The made ground in this area comprised very sandy gravel with frequent cobbles including brick, concrete, breezeblock, clinker and coal. The made ground was typical of demolition rubble and is assumed to be relatively localised.

In HD103, HD103B and HD103C, the pits were terminated in the made ground at 0.1-0.2mbgl due to tree roots. The ground generally comprised gravelly sand with occasional brick fragments, clinker and rare plastic and ceramics fragments. HD103D extended through the made ground and encountered natural at 0.2mbgl. The made ground in HD103D comprised sandy gravel with frequent ash, clinker, coal and brick.

In HD104 was located in the area of the cobbles and comprised cobbles to 0.10mbgl and a sandy gravel comprising ash, clinker and bricks to 0.15mbgl.

Natural Strata

Natural strata comprised fine to coarse SAND with occasional silt lenses, present from depths of 0.15-0.85mbgl.

Contamination

With the exception of the anthropogenic material encountered in the made ground (as described above), no further contamination was identified.

There was no visual / olfactory evidence of hydrocarbons or volatile contaminants in any locations. The PID recorded a maximum of 0.1ppm TVOC in the samples.

Groundwater

No groundwater was encountered during the investigation.

5 Generic Risk Assessment

5.1 Introduction

Current good practice requires that the findings from a site investigation should be evaluated on a site-specific basis, using a risk-based approach. Risk assessment involves identification and evaluation of the hazards presented by the concentrations of contaminants measured followed by an evaluation of the risks which are associated with these hazards (LCRM⁸). Information gathered from the risk assessment has been collated in the revised contamination conceptual model in Section 5.6.

5.2 Soil Risk Assessment

5.2.1 Methodology

With regards to the soil risk assessment LKC will use the following hierarchy:

- Category 4 Screening Levels (C4SLs).
- LQM Suitable 4 Use Levels (S4ULs).
- ATRISK Soil Screening Values (SSVs) and CL:AIRE Generic Assessment Criteria (GACs).

C4SLs were published in 2013^{9,10}. The change to the contaminated land guidance has changed the evaluation of risk from 'minimal' (referred to as Health Criteria values (HCVs))¹¹ used to generate Soil Guideline Values (SGVs) to 'low' (referred to as Lowest Level of Toxicological Concern (LLTCs)). The policy companion document and supporting letter by Defra, dated 3rd September 2014, states that C4SLs '*could be used under the planning regime, as well as within Part 2A*'. Based on these comments LKC considers the justifications and assumptions used to generate 'low' risk are suitable for the planning regime.

Where no C4SLs have been generated LKC will use the LQM S4ULs¹². Similar assumptions and land uses to C4SLs have been used. However, toxicological information has been based on 'minimal risk' as per previous guidelines and assumptions^{13,14,15,16}.

If contaminants are not present as C4SLs and S4ULs then LKC will use ATRISK SSVs or CL:AIRE GACs¹⁷. These follow the 'minimal' risk principle and more stringent exposure parameters and will be conservative.

LKC consider the main risk drivers for PAHs are benzo(a)pyrene (B(a)P) and naphthalene. This is due to B(a)P possibly being a carcinogen and most toxic of the

⁸ Land Contamination Risk Management (LCRM) <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

⁹ Defra (2014). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Policy Companion Document."

¹⁰ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

¹¹ EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

¹² LQM (2014). "The LQM/CIEH S4ULs for Human Health Risk Assessment."

¹³ EA (2008). "Updated Technical Background to the CLEA Model." Science Report – SC050021/SR3.

¹⁴ EA (2008). "Human Health Toxicological Assessment of Contaminants in Soils." Science Report – SC050021/SR2.

¹⁵ EA (2008). "A Review of Body Weight and Height Data used within the Contaminated Land Exposure Assessment Model (CLEA)." Project SC050021/Technical Review 1.

¹⁶ EA (2009). "Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values." Science report SC050021/SR7.

¹⁷ CL:AIRE (2009). "The Soil Generic Assessment Criteria for Human Health Risk Assessment."

PAHs^{18,19} and naphthalene the most volatile and soluble²⁰. The new C4SLs indicate B(a)P as a surrogate marker for carcinogenic PAHs, if it falls within appropriate limits, since the risk from other non-carcinogenic PAHs are considered negligible²¹. For B(a)P to be used as a surrogate marker it should follow the profile described by the HPA (2008)²² and CL:AIRE (2013). Naphthalene will be treated separately using the LQM S4ULs.

The proposed development is for residential use with garden, therefore the assessment criteria for residential with home-grown produce has been used.

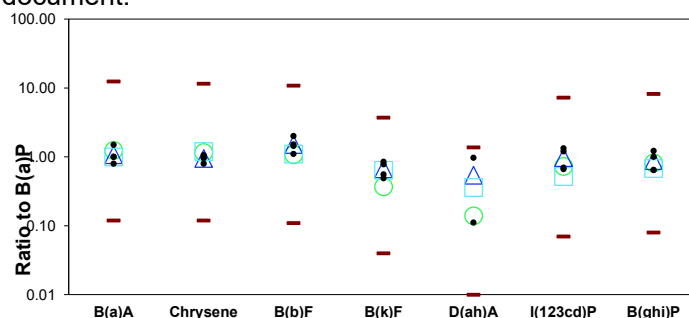
All criteria have been generated using the CLEA V1.06 model²³ based either on 1%, 2.5% and 6% Soil Organic matter (SOM). Results will be compared to the nearest appropriate SOM.

A summary of the generic assessment criteria is provided in Appendix D. ATRISK SSVs and CL:AIRE GACs were not required for this dataset and have not been included.

B(a)P as Surrogate Marker

Based on the above assumption for PAHs, LKC undertook an assessment of the data for the site with regards to using B(a)P as a surrogate marker for carcinogenic PAHs as per HPA and CL:AIRE guidelines. The primary toxicological study related to Culp *et al.*²⁴, which was based on coal tar mixtures (>80,000mg/kg of total PAHs) fed in food to mice over a two-year carcinogenicity study.

Graph 5-1 summarises the study site data with respect to how the ratios of carcinogenic PAHs relate to B(a)P, within the confidence limits provided in the HPA document.



Graph 5-1: The ratio of PAH to B(a)P in soil for all available data at the site based on 7 samples (where values were >LOD to allow the calculation of a ratio).

Notes:

B(a)P=Benzo(a)pyrene; D(ah)A=Dibenzo(ah)anthracene; B(a)A=Benzo(a)anthracene; B(b)F=Benzo(b)fluoranthene; B(k)F=Benzo(k)fluoranthene; I(123cd)P=Indeno(123cd)pyrene; B(ghi)P=Benzo(ghi)perylene
●=Ratio to B(a)P for all data; ○=Mean ratio to B(a)P for Culp data; △=Mean ratio to B(a)P from all data at the site
□=Mean ratio to B(a)P for UK data presented by HPA; ■=Upper and Lower limits (order of magnitude from Culp data)

¹⁸ EA (2002). "Contaminants in Soils: Collation of Toxicological Data and Intake Values for Humans. Benzo[a]pyrene." R&D Publication TOX2.

¹⁹ USEPA (1984). "Health Effects Assessment of Polycyclic Aromatic Hydrocarbons (PAHs). EPA 540/1-86-013."

²⁰ EA (2003). "Review of the Fate and Transport of Selected Contaminants in the Soil Environment." Draft technical report P5-079/TR1.

²¹ CL:AIRE (2013). "SP1010: Development of Category 4 Screening Levels and Assessment of Land Affected by Contamination – Final project Report."

²² HPA (2010). "HPA Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)." Version 3.

²³ EA (2008). "CLEA Software (Version 1.05) Handbook." Science Report – SC050021/SR4.

²⁴ Culp, S; Gaylor, D; Sheldon, W; Goldstein, L and Beland, F (1998). "A Comparison of Tumours Induced by Coal Tar and Benzo-a-pyrene in a 2-Year Bioassay." Carcinogenesis. Vol 19, no. 1, pp. 117-124.

All the data points that could be used to calculate ratios fall inside the upper or lower limits.

Based on this distribution of data LKC considers B(a)P can be used as a surrogate marker for carcinogenic PAHs and the C4SL criteria is suitable for this dataset.

5.2.2 Soil Results Comparison against Assessment Criteria

All analysis sheets are presented in Appendix C. Elevated results are presented in Table 5-1.

Contaminant	Units	No. of samples	Elevated Results	Sample Location	Criteria	Source of Criteria
Lead	mg/kg	7	230	HD101 0.0-0.85m	200	C4SL
			500	HD103D 0.0-0.2m		
			490	HD104 0.1-0.15m		

Table 5-1: Summary of elevated and pertinent analytical results.

No asbestos was identified in any soil samples analysed.

5.2.3 Direct Contact Risk – Pollutant Linkage 1

Elevated lead has been identified in 3 of 7 samples analysed. The contamination is within made ground and is assumed to be associated with ash and clinker noted in the strata.

At the concentrations identified, the lead is considered to pose a potential risk to future site users (residents) where made ground may be exposed / in contact with home-grown produce (gardens / soft landscaping areas). The principal pathways are the ingestion pathways (soil, dust and home-grown produce) and dermal contact.

The probability of lead contamination affecting site users is likely. With a medium consequence, the risk is considered to be moderate and remediation is recommended.

Where there are buildings and hard landscaping, there will be no pollutant linkage and no remediation is required.

5.2.4 Risk from Inhalation of Vapours – Pollutant Linkage 2

No visual / olfactory evidence of volatile contaminants was identified during the investigation. The PID did not detect any TVOCs. Confirmatory soil analysis did not detect any VOCs / SVOCs above detection limits.

LKC therefore consider the probability of volatile contaminants affecting site users as unlikely. The consequence is expected to be medium, giving a low risk and no remediation is required with respect to pollutant linkage 2.

5.3 Gas Risk Assessment

Gas monitoring was not carried out as part of this assessment. The PRA identified a low risk and recommended further assessment if a significant depth of organic / putrescible material was identified.

No organic / putrescible material was encountered on site. Made ground was generally less than 1m comprising reworked natural ground with some anthropogenic material (generally demolition materials).

Where footings had been excavated for the proposed building, minimal made ground was present and natural strata was noted at the ground surface in the current building.

There was localised deeper made ground in the proposed garden area; however, this is not considered to be significant source given the composition of made ground and the limited source.

A well was noted within the site boundary on historical maps. This is thought to be within the current driveway / cobbled area. The well has not been shown on historical mapping since 1910; therefore, it is assumed that any infilling will be over 100 years ago. Given the relatively limited source expected from the well and the age of any infilling, the well is not expected to be a significant source of gas.

Two former ponds were noted within 250m of the site (80m north and 100m east). Given the size of the features, the distance from site and age of infilling (at least 40 years ago) these are not considered to be a significant source.

There is not considered to be a significant source of onsite or offsite gas. Therefore, LKC considers the probability of gas posing a risk to site users as unlikely. The consequence is severe, which gives a moderate / low risk. LKC considers there to be a low risk and no further action is required with respect to pollutant linkage 3.

5.4 Controlled Water Assessment

The PRA identified a low risk with respect to controlled waters as no significant source of mobile contamination was anticipated.

No evidence of significant mobile contamination was identified on the site. Although metals and PAHs were identified above limits of detection within the soils, the source is anticipated to be localised / minimal ash and clinker noted within the made ground. Contamination associated with ash and clinker is not anticipated to be mobile due to the residual crystalline nature of the matrix.

The site investigation did not identify any significant sources of likely mobile contamination within the soils. This confirms an unlikely probability of onsite contamination affecting controlled waters. With a medium consequence the risk is anticipated to be low and no remediation is required.

5.5 Potable Water Supply

Soil results were compared to United Utilities (UU) guidelines for the selection of potable water pipes in land potentially affected by contamination²⁵. Only contaminants of concern, based on the preliminary conceptual model and ground conditions encountered, were analysed. The following contaminants were not considered to be a risk and therefore not included in the analysis suites: speciated petroleum hydrocarbons, chlorinated compounds, BTEX compounds, phenols, cresols, ethers, nitrobenzene, ketones, aldehydes and amines.

Although naphthalene was marginally elevated (max. 0.64mg/kg) compared to the VOC threshold values (0.5mg/kg), the values are assumed to be associated with shallow ashy made ground deposits. Any proposed potable water pipes are expected

²⁵ UU(2011). "United Utilities Water Supplementary Guidance for the Selection of Water Pipes in Land Potentially Affected by Contamination."

to be laid within the natural strata below (typical pipework depths are 0.75mbgl to 1.35mbgl).

The probability of organic contaminants affecting potable water pipes is considered to be unlikely. Given the consequence is medium, the risk (pollutant linkage 5) is anticipated to be low and no remediation (i.e. barrier pipe) is likely to be required.

This may need to be confirmed with UU. UU may require a Potable Waters Risk Assessment to be carried out prior to the connection of any new water supply. This should be carried out once details of the pipeline location and depths are known.

5.6 Revised Contamination Conceptual Model

The preliminary contamination conceptual model (Table 2-3) has been revised following the risk assessments undertaken in Sections 5.1-5.5. The revised contamination conceptual model follows the same methodology and guidance used in the preliminary contamination conceptual model. The risk matrix is provided in Appendix A.

The revised contamination conceptual model is presented in Table 5-2.

Where a very low risk is identified, no specific remediation is required.

Where a low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where a moderate/low risk is identified, an assessment will be undertaken to establish what category the pollutant linkage will fall into.

Where a moderate or higher risk is identified, remediation or further investigation work is recommended.

Further details of the remedial proposals and a remedial option appraisal are given in Section 7.

PL	Pathway	Receptor	Contaminant	Probability	Consequence	Risk	Assessment and Recommendation
1	-Dermal contact. -Inhalation of soil, fibres and dust. -Ingestion of soils, dust, home-grown produce, soil attached to home-grown produce. -Windblown dust.	-Future site users. -Offsite receptors.	-Lead	Likely	Medium	Moderate	-Elevated lead identified in the made ground which may pose a risk to site users in gardens / soft landscaping areas. -Recommendations: -Remediation required in gardens / soft landscaping areas. -No remediation required where buildings and hardstood ground are present.
2	-Inhalation of vapours. -Migration via permeable strata and preferential pathways.	-Future site users. -Offsite receptors.	-No volatile contaminants identified.	Unlikely	Medium	Low	-No elevated volatile contaminants across the site. -Recommendations: No remediation required.
3	-Inhalation of gas. -Migration via permeable strata and preferential pathways. -Explosion in confined spaces.	-Future site users. -Buildings. -Offsite land users.	-No significant landfill / ground gas (carbon dioxide and methane)	Unlikely	Severe	Moderate / Low	-No significant source anticipated. Low risk assumed. -Recommendation: No remediation required.
4	-Surface run-off. -Migration via permeable strata and preferential pathways. -Perched waters migration.	-Groundwater (Secondary A Aquifers). -Surface water (Adj. Drain).	-No significant mobile contamination.	Unlikely	Medium	Low	-No significant source anticipated. -Recommendation: No remediation required.
5	-Ingestion of tainted water supply.	-Future site users. -Water pipes.	-No significant organic contamination at pipeline depth.	Unlikely	Medium	Low	-Although marginally elevated naphthalene identified, not present at depth where potable water pipes are anticipated to be laid. -Recommendation: Barrier piping unlikely to be required. However, this may need to be confirmed with UU.

Table 5-2: Revised Contamination Conceptual Model.

6 Conclusions

Investigation work has been carried out to confirm the contamination risk at the site and assess the requirement for remedial work.

Based on the findings of the investigation and contamination risk assessments, a revised contamination conceptual model has been produced which is summarised in Table 6-1 below (more detailed model provided in Section 5).

Pollutant Linkage		Risk	Recommendations
1	Contaminants posing a risk to site users via dermal contact, ingestion and inhalation (of soil, dust, fibres and home-grown produce).	Moderate	- Elevated lead identified in the made ground which may pose a risk to site users in gardens / soft landscaping areas. Recommendations: - Remediation required in gardens / soft landscaping areas. - No remediation required where buildings and hardstood ground are present.
2	Volatile contaminants posing a risk to site users via the inhalation of vapours.	Low	- No elevated volatile contaminants across the site. Recommendations: No remediation required.
3	Gas posing a risk to buildings and site users via the migration of gas into building causing explosion and asphyxiation.	Moderate / Low	- No significant source anticipated. Low risk assumed. Recommendation: No remediation required.
4	Mobile contamination posing a risk to controlled waters via the migration through permeable strata.	Low	- No significant source anticipated. Recommendation: No remediation required.
5	Organic contaminants posing a risk to water pipes.	Low	- Although marginally elevated naphthalene identified, not present at depth where potable water pipes are anticipated to be laid. Recommendation: Barrier piping unlikely to be required. However, this may need to be confirmed with UU.

Table 6-1: Summary Risk Table.

Remedial recommendations are presented in Section 7.

7 Recommendations and Remedial Strategy

The recommendations provided below are considered appropriate for the site based on the site investigation work undertaken. LKC should stress that no remediation, enabling works or designing works should take place until Regulatory approval has been obtained.

7.1 Remediation and Validation Recommendations

7.1.1 Environmental Cover System (Pollutant Linkage 1)

Due to elevated lead concentrations, remediation is required to break Pollutant Linkage 1. As the made ground is relatively shallow two remedial options are given:

Option 1 – Source Removal

Where made ground is shallow (i.e. less than 600mm), it is recommended that made ground is removed and levels are raised (as required) with suitably chemically validated subsoil and topsoil.

The following validation work should be undertaken to ensure the remediation has been appropriately carried out includes:

- Inspection of ground following removal of made ground including photographic evidence.
- Chemical validation of imported soils (see 7.1.2).
- Waste tickets to be provided showing made ground removed from site to an appropriate facility.

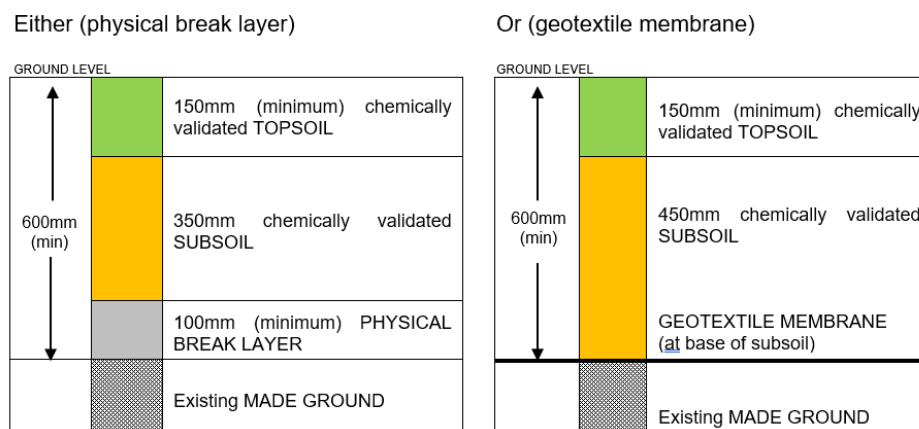
Option 2 – Environmental Cover System

Where made ground is deep (i.e. more than 600mm), it is unlikely to be viable to remove the contaminated soils. Therefore, an environmental cover system is recommended.

The environmental cover system should be 600mm depth comprising:

- Either 100mm physical gravel break layer (MOT type 1 material, 20-30mm, minimal fines) and at least 500mm comprising clean inert subsoil and topsoil (with sufficient topsoil for a growing medium).
- Or geotextile membrane and at least 600mm comprising clean inert subsoil and topsoil (with sufficient topsoil for a growing medium).

A diagram of a typical environmental cover system is shown below:



The subsoil layer can be replaced by additional topsoil.

It is assumed that some of the made ground will need to be removed to accommodate the environmental cover system, subject to finish levels.

Validation work to ensure the remediation has been appropriately carried out includes:

- Measuring depth of environmental cover system using a staff and providing photographic evidence.
- Photographic evidence of the granular physical break or geotextile layer will also be collected.
- Chemical validation of imported soils (see below).
- Waste tickets to be provided showing made ground removed from site to an appropriate facility.

7.1.2 Chemical Validation of Imported Soils

Chemical validation of all imported soils to be used on site in gardens and soft landscaping areas should be undertaken. Imported soils should be accompanied by a certificate of analysis and source details.

A summary of the required imported material sampling requirements is presented in Table 7-1. Where possible, validation samples should be taken prior to placement in gardens to ensure suitability for use.

Material Type	Source	Suite of Analysis	Sampling Rate
Topsoil	Greenfield	Suite A	1 sample per 50m ³ (min. 3 per source)
	Brownfield / Unknown	Suite B	
Subsoil	Brownfield / Unknown / Site Won	Suite B	1 sample per 50m ³ (min. 3 per source)
	First Generation i.e. quarried sand	No testing is required. Certification of material provenance is required.	
Stone (break layer)	Recycled Stone	Suite A	1 sample per 500m ³ (min. 3 per source)
	First Generation i.e. quarried stone	No testing is required. Certification of material provenance is required.	

Table 7-1: Sampling requirements for imported soils.

Notes:

Suite A: Heavy metals, pH, water soluble sulphate, speciated PAH, soil organic matter, asbestos screen.

Suite B: Heavy metals, pH, water soluble sulphate, speciated PAH, phenol, total and free cyanide, soil organic matter, asbestos screen, banded petroleum hydrocarbons (TPH CWG), BTEX, MTBE.

Any soil with visual or olfactory evidence of hydrocarbons should be rejected.

Imported material to be used in gardens will be compared against residential with plant uptake criteria (as used in the contamination risk assessment (Section 6-1)). Appropriate remedial target criteria are presented in Appendix D.

7.2 Other Considerations during Development

Earthworks Inspections / Unexpected Contamination

The relevant contractors should be briefed that during development works at the site should any unusual ground conditions and / or visual or olfactory evidence of contamination (including asbestos containing material) be encountered at the site, LKC and the Local Authority should be informed, and further assessment of the material may be required.

Should asbestos be identified during groundworks, precautions should be taken to ensure the safety of the construction workers and nearby land users. It would be advisable to introduce an asbestos management strategy in line with CIRIA C733²⁶.

Health and Safety Considerations

In working with, removing or treating any contaminating material it is important that any potential risks associated with the actual site works are mitigated by good environmental management of the site during the remedial phases. Standard health and safety precautions (as per HSE guidance²⁷) should be adopted by all workers involved with site enabling and construction works.

7.3 Site Completion Report

It is recommended that any remediation carried out on the site is validated by a third party and suitable documentary evidence provided in a Site Completion Report, such as photographs, consignment documents and analytical results. This should include as a minimum:

- If option 1 (source removal): Validation of any made ground removal (photographic evidence that natural strata was reached).
- If option 2 (environmental capping layer): Validation of environmental cover system.
- Verification testing of all imported soil for garden and soft landscaping areas.
- Waste tickets to be provided showing made ground removed from site to an appropriate facility.
- Details of any unexpected contamination identified onsite, suitably risk assessed and / or validated.

Once the above is satisfied the Local Authority should be able to discharge all the relevant contaminated land conditions.

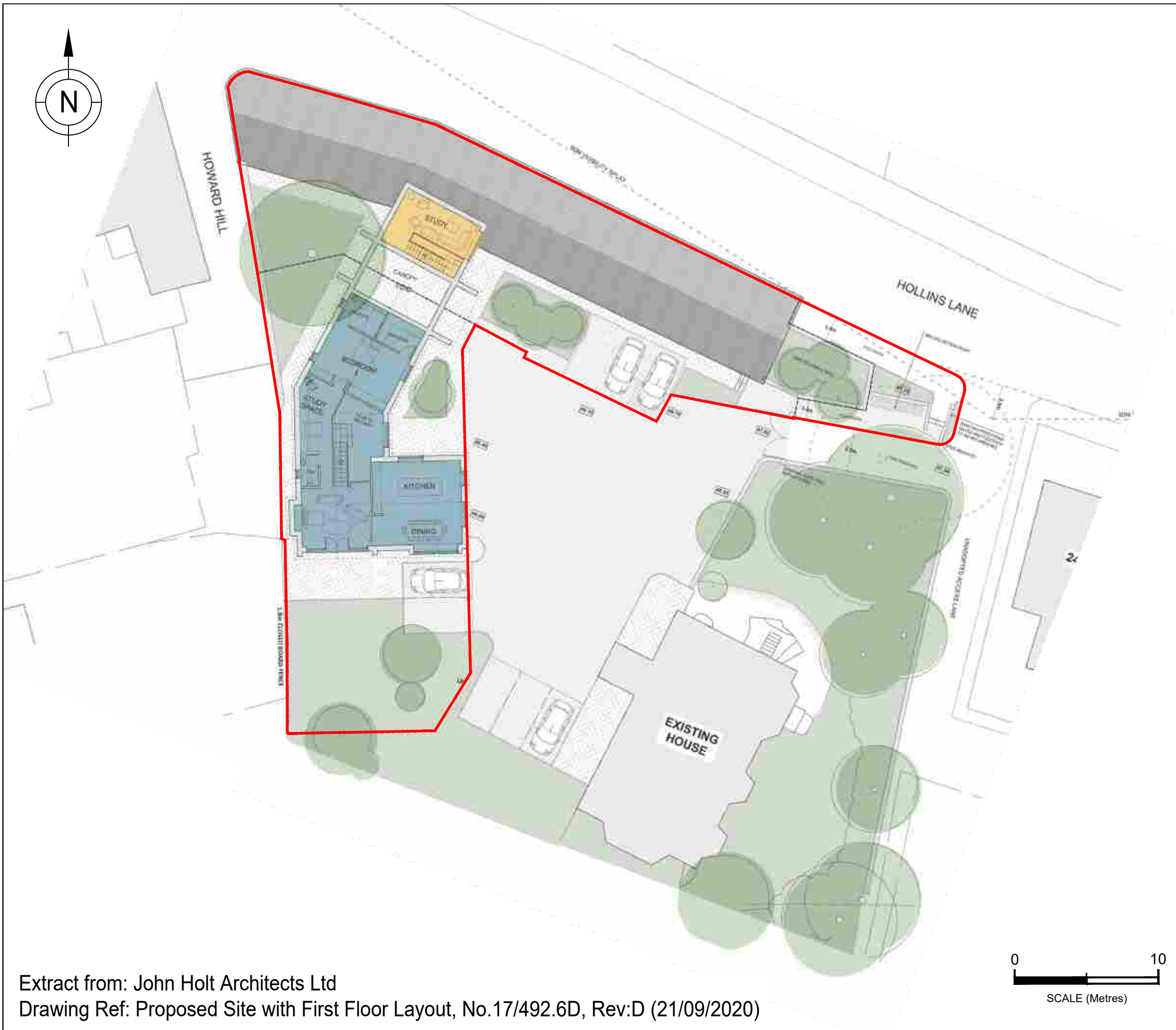
²⁶ CIRIA (2014). "Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks". C733.

²⁷ HSE (1991). "Protection of Workers and the General Public During Development of Contaminated Land" London HMSO.

Figures



Client: Mr Nield				Title: Site Location & Boundary Plan			
Site: Hollins House Farm				Scale (see scale bar): 1:25,000 & 1:1,000 @ A4			
Job No.: LKC 21 1391	Drawn By: JW	Checked By: CB	Drawn: Dec 2022	Figure: 1	Revision:		



KEY

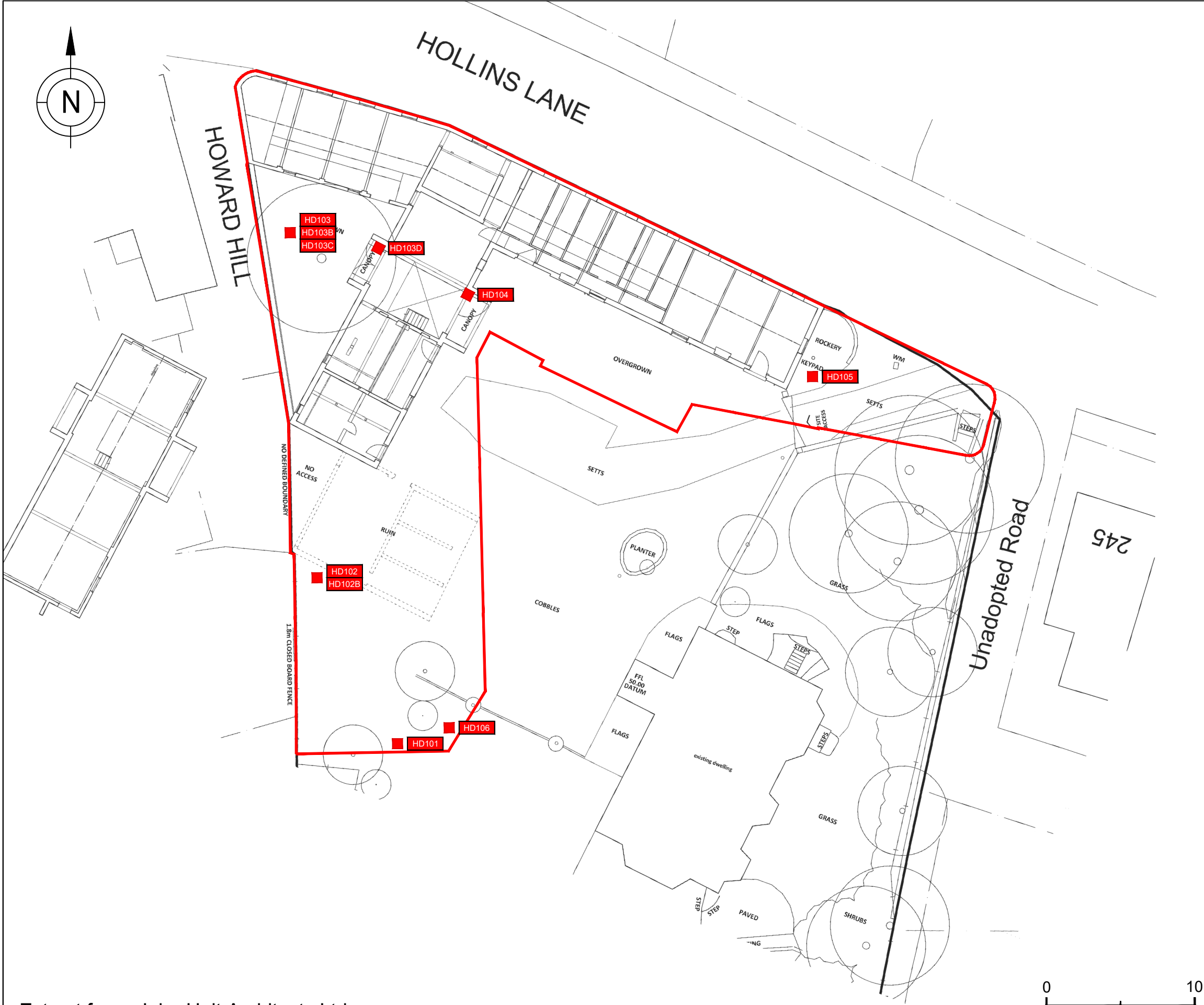
 Site Boundary

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client:		Mr Nield		
Site:				
Hollins House Farm, Bury				
Title:				
Proposed Development Plan				
Job No.:		Scale (See Scale Bar):	Figure:	Revision:
LKC 21 1391		See Scale Bar	2	A
Drawn By:	Checked By:	Drawn:		
AC	CB	Dec 2022		

Extract from: John Holt Architects Ltd
Drawing Ref: Proposed Site with First Floor Layout, No.17/492.6D, Rev:D (21/09/2020)



KEY

- Site Boundary
- Hand Dug Trial Pit (HD)

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client: Mr Nield

Site: Hollins House Farm, Bury

Title: Site Investigation Location Plan

Job No.: LKC 21 1391	Scale (See Scale Bar): See Scale Bar	Figure: 3	Revision: A
Drawn By: AC	Checked By: CB	Drawn: Dec 2022	

Appendix A

Risk Matrix

Risk Evaluation

The method for risk evaluation is a qualitative method of interpreting the output from the risk estimation stage of the assessment, based on CIRIA 552²⁸. It involves the classification of the:

- Magnitude of the potential consequence (severity) of the risk occurring (Table A).
- Magnitude of the probability (likelihood) of the risk occurring (Table B).

Consequence (Severity)		
Classification	Definition	Example
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 (note: water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. - Catastrophic damage to buildings/properties. - A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definition of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	- High Concentrations of cyanide on the surface of an informal recreation area. - Major spillage of contaminants from site into controlled waters. - Explosion, causing building collapse (can also equate to short term human health risk if buildings are occupied).
Medium	- Chronic damage to Human Health ('significant harm' as defined in DETR, 2000). - Pollution of sensitive water resources (note Water Resources Act contains no scope for considering significance of pollution). - A significant change in a particular ecosystem, or organism forming part of such ecosystem.	- Concentrations of a contaminant from site exceed generic, or site-specific assessment criteria. - Leaching of contaminants from a site to a major or minor aquifer (Principal and Secondary). - Death of a species within a designated nature reserve.
Mild	- Pollution of non-sensitive water resources. - Significant damage to crops, buildings, structures and services ('significant harm' as defined in DETR, 2000). - Damage to sensitive buildings/structures/services or the environment.	- Pollution of non-classified groundwater. - Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	- Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. - Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). - Easily repairable damage to buildings, structures and services.	- The presence of contaminants at such concentrations that protective equipment is required during site works. - The loss of plants in a landscaping scheme. - Discoloration of concrete.

Table A. Classification of Consequence

Probability (Likelihood)	
Classification	Definition
High Likelihood	- There is a pollutant linkage and an event that either 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	- There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. - Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	- There is a pollutant linkage and circumstances are possible under which an event could occur. - However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	- There is a pollutant linkage, but circumstances are such that it is improbable that an event would occur in the very long term.

Table B. Classification of Probability.

²⁸ CIRIA C552 (2001) Contaminated Land Risk Assessment - A Guide to Good Practice.

These classifications are then compared to indicate the risk presented by each pollutant linkage (Table C). It is important that this classification is only applied where there is a possibility (which can range from high likelihood to unlikely) of a pollutant linkage existing.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate / Low Risk
	Likely	High Risk	Moderate Risk	Moderate / Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate / Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate / Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table C. Comparison of Consequence against Probability

Once the risk has been determined the corresponding action can be assessed (Table D).

Risk	Action Required
Very High Risk	- There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. - This risk, if realised, is likely to result in a substantial liability. - Urgent investigation (if not already undertaken) and remediation are likely to be required.
High Risk	- Harm is likely to arise to a designated receptor from an identified hazard. - Realisation of the risk is likely to present a substantial liability. - Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate Risk	- It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. - Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	- It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	- There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Table D. Description of the Classification and Likely Action Required.

Where a very low risk is identified no specific remediation is required.

Where a low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where there is a moderate/low risk is identified, an assessment will be undertaken to establish what category the pollutant linkage will fall into.

Where LKC identifies a moderate or higher risk, remediation or further investigation work is recommended.

Appendix B

Profile Logs

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD101****Excavation Method**Hand Excavated Trial Pit to
1.20mbgl.**Dimensions**

0.30 x 0.30 x 1.20m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381398 E 408010 N

Dates

17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.85	ES				(0.85)	MADE GROUND: Dark brown gravelly sandy SILT with occasional rootlets, rare coal fragments, brick fragments and clinker. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded.		
0.85-1.20	ES			100.15	0.85	Brown SAND with occasional silt lenses. Sand is fine to coarse.		
					(0.35)			
				99.80	1.20	Complete at 1.20m		

**Remarks**Grid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD101

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD102****Excavation Method**Hand Excavated Trial Pit to
0.50mbgl.**Dimensions**

0.30m x 0.30m x 0.50m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381394 E 408014 N

Dates

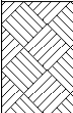
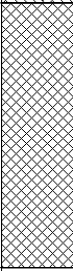
17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						TOPSOIL: Dark brown sandy SILT with frequent rootlets. Sand is fine to coarse.		
				100.85	0.15 (0.15)	MADE GROUND: Brown very sandy GRAVEL with frequent cobble, whole and fragmented brick, occasional concrete, breezeblock, coal and clinker. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.		
				100.50	0.50 (0.35)	Complete at 0.50m		

No image available

RemarksGrid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry.
Hand excavated trial pit unstable, collapse in made ground.
Refusal on cobble at 0.50mbgl**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD102

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD102B****Excavation Method**Hand Excavated Trial Pit to
0.75mbgl.**Dimensions**

0.30m x 0.30m x 0.75m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381394 E 408014 N

Dates

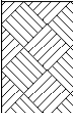
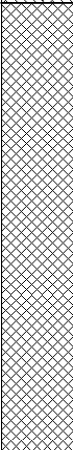
17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.10	ES				(0.15)	TOPSOIL: Dark brown sandy SILT with frequent rootlets. Sand is fine to coarse.		
0.20-0.50	ES			100.85	0.15	MADE GROUND: Brown very sandy GRAVEL with frequent cobbles, whole and fragmented brick, occasional concrete, breezeblock, clinker and coal. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.		
					(0.60)			
				100.25	0.75	Complete at 0.75m		

**Remarks**

Grid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry.
Hand excavated trial pit unstable, collapse at 0.75mbgl. Pit backfilled.

Scale (approx)

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD102B

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD103****Excavation Method**Hand Excavated Trial Pit to
0.15mbgl.**Dimensions**

0.30m x 0.30m x 0.15m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381393 E 408047 N

Dates

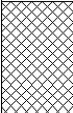
17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				100.85	(0.15) 0.15	MADE GROUND: Brown gravelly SAND with frequent roots, rootlets, occasional brick fragments, clinker and rare plastic. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Complete at 0.15m		

No image available

RemarksGrid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.
Refusal at 0.15mbgl on tree root.**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD103

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD103B****Excavation Method**Hand Excavated Trial Pit to
0.10mbgl.**Dimensions**

0.30m x 0.30m x 0.10m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381393 E 408047 N

Dates

17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				100.90	(0.10) 0.10	MADE GROUND: Brown gravelly SAND with frequent roots, rootlets, occasional brick fragments and clinker. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Complete at 0.10m		

No image available

RemarksGrid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.
Refusal at 0.10mbgl on cobble.**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD103B

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD103C****Excavation Method**Hand Excavated Trial Pit to
0.20mbgl.**Dimensions**

0.30m x 0.30m x 0.20m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381393 E 408047 N

Dates

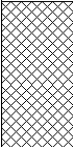
17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.20	ES			100.80	(0.20) 0.20	MADE GROUND: Brown gravelly SAND with frequent roots, rootlets, occasional brick fragments, clinker and rare ceramic fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Complete at 0.20m		

**Remarks**Grid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.
Refusal at 0.20mbgl on tree root.**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD103C

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD103D****Excavation Method**Hand Excavated Trial Pit to
0.70mbgl.**Dimensions**

0.30m x 0.30m x 0.70m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381394 E 408047 N

Dates

17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.20	ES				(0.20)	MADE GROUND: Dark grey sandy GRAVEL of frequent ash, clinker, occasional coal and brick fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.		
0.20-0.70	ES			100.80	0.20	Brown SAND with occasional silt lenses. Sand is fine to coarse.		
					(0.50)			
				100.30	0.70	Complete at 0.70m		

No image available

RemarksGrid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD103D

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number
HD104****Excavation Method**Hand Excavated Trial Pit to
0.70mbgl.**Dimensions**

0.30m x 0.30m x 0.70m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381405 E 408042 N

Dates

17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10-0.15	ES			100.90	(0.10)	MADE GROUND: COBBLE PAVING.		
0.20-0.50	ES			100.85	0.10 (0.05) 0.15	MADE GROUND: Dark grey very sandy GRAVEL of occasional ash, clinker, brick fragments and rare clinker. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.		
					(0.55)	Brown SAND with occasional silt lenses. Sand is fine to coarse.		
				100.30	0.70	Complete at 0.70m		

**Remarks**Grid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD104

**LK CONSULT LTD**Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com**Site**

Hollins Farm, Bury

**Trial Pit
Number****HD105****Excavation Method**Hand Excavated Trial Pit to
0.85mbgl.**Dimensions**

0.30m x 0.30m x 0.85m

Ground Level (mOD)

101.00

Client

C W Nield

**Job
Number**

LKC 21 1391

Location

381426 E 408040 N

Dates

17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.45	ES					MADE GROUND: Dark brown gravelly sandy SILT with rare coal and brick fragments. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded of various lithologies.		
					(0.45)			
						Brown decorative gravels underlain by membrane at surface.		
0.45-0.70	ES			100.55	0.45	Brown SAND with occasional silt lenses. Sand is fine to coarse.		
					(0.40)			
				100.15	0.85	Complete at 0.85m		

**Remarks**Grid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.**Scale (approx)**

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD105



LK CONSULT LTD

Eton Business Park, Eton Hill Road, Radcliffe, M26 2ZS
Tel: 0161 763 7200 web: www.thelkgroup.com

Site

Hollins Farm, Bury

Trial Pit Number

HD106

Excavation Method

Hand Excavated Trial Pit to 0.80mbgl.

Dimensions

0.30m x 0.30m x 0.80m

Ground Level (mOD)

101.00

Client

C W Nield

Job Number

LKC 21 1391

Location

381401 E 408015 N

Dates

17/11/2022

Engineer

JW

Sheet

1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.45	ES					MADE GROUND: Dark brown gravelly sandy SILT with rare coal fragments, brick fragments and clinker. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded.		
0.45-0.70	ES			100.55	0.45	Brown SAND with occasional silt lenses. Sand is fine to coarse.		
				100.20	0.80	Complete at 0.80m		



Remarks

Grid reference estimated using www.gridreferencefinder.com
Elevation estimated using www.freemaptools.com/elevation-finder.htm
Hand excavated trial pit dry and stable.

Scale (approx)

1:10

Logged By

JW

Figure No.

LKC 21 1391.HD106

Appendix C

Certificates of Analysis – Soil



Final Report

Report No.: 22-44363-1
Initial Date of Issue: 24-Nov-2022
Client LK Consult
Client Address: Unit 29 Eton Business Park
Eton Hill Road
Radcliffe
Manchester
Lancashire
M26 2ZS
Contact(s): Catherine Baranek
Contaminated Land
Project LKC 21 1381 Hollins Farm, Bury
Quotation No.:
Order No.: LKC 211381-CB
No. of Samples: 6
Turnaround (Wkdays): 5
Date Approved: 24-Nov-2022

Date Received: 18-Nov-2022

Date Instructed: 18-Nov-2022

Results Due: 24-Nov-2022

Approved By:

Details: Stuart Henderson, Technical
Manager

Results - Soil

Project: LKC 21 1381 Hollins Farm, Bury

Client: LK Consult	Chemtest Job No.:					22-44363	22-44363	22-44363	22-44363	22-44363	22-44363
Quotation No.:	Chemtest Sample ID.:					1548453	1548454	1548455	1548456	1548457	1548458
Order No.: LKC 211381-CB	Client Sample Ref.:					ES	ES	ES	ES	ES	ES
	Client Sample ID.:					HD101	HD102	HD102	HD103D	HD14	HD105
	Sample Location:					HD101	HD102B	HD102	HD103D	HD104	HD105
	Sample Type:					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					0.00	0.00	0.20	0.00	0.10	0.00
	Bottom Depth (m):					0.85	0.10	0.50	0.20	0.15	0.45
	Date Sampled:					17-Nov-2022	17-Nov-2022	17-Nov-2022	17-Nov-2022	17-Nov-2022	17-Nov-2022
	Asbestos Lab:					DURHAM	DURHAM	NEW-ASB	DURHAM	DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD							
ACM Type	U	2192		N/A	-	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	15	17	16	22	22	15	15
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand	Sand	Sand	Sand
pH	M	2010		4.0	5.9	6.3	7.4	6.9	7.3	7.5	7.5
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	0.062	0.021	< 0.010	< 0.010
Arsenic	M	2455	mg/kg	0.5	12	5.3	5.0	30	7.2	16	16
Cadmium	M	2455	mg/kg	0.10	3.3	0.13	0.10	0.35	0.24	0.15	0.15
Chromium	M	2455	mg/kg	0.5	24	6.7	6.5	13	9.7	8.5	8.5
Copper	M	2455	mg/kg	0.50	51	11	11	82	51	58	58
Mercury	M	2455	mg/kg	0.05	0.12	< 0.05	0.12	0.28	0.10	0.09	0.09
Nickel	M	2455	mg/kg	0.50	19	6.0	6.3	36	12	15	15
Lead	M	2455	mg/kg	0.50	230	25	35	500	490	110	110
Selenium	M	2455	mg/kg	0.25	0.68	0.32	< 0.25	1.4	0.53	0.65	0.65
Vanadium	U	2455	mg/kg	0.5	15	8.4	11	44	15	21	21
Zinc	M	2455	mg/kg	0.50	340	31	34	100	100	43	43
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	M	2625	%	0.40	9.1	3.0	2.2	14	12	6.8	6.8
Naphthalene	M	2800	mg/kg	0.10	0.62	0.21	0.18	0.53	0.64	0.52	0.52
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.14	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.12	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.42	0.42	0.13	1.2	0.60	0.31	0.31
Anthracene	M	2800	mg/kg	0.10	0.12	0.30	< 0.10	< 0.10	0.27	< 0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	0.57	1.0	0.21	1.9	0.84	0.26	0.26
Pyrene	M	2800	mg/kg	0.10	0.55	1.0	0.23	1.9	0.81	0.30	0.30
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.27	1.0	< 0.10	0.99	0.36	0.13	0.13
Chrysene	M	2800	mg/kg	0.10	0.19	0.96	< 0.10	0.96	0.36	0.12	0.12
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	0.36	1.1	< 0.10	1.5	0.65	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.14	0.85	< 0.10	0.55	0.22	< 0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	0.18	1.0	< 0.10	0.99	0.45	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	0.24	1.2	< 0.10	0.69	0.30	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	0.97	< 0.10	0.11	< 0.10	< 0.10	< 0.10

Results - Soil

Project: LKC 21 1381 Hollins Farm, Bury

Client: LK Consult	Chemtest Job No.:				22-44363	22-44363	22-44363	22-44363	22-44363	22-44363
Quotation No.:	Chemtest Sample ID.:				1548453	1548454	1548455	1548456	1548457	1548458
Order No.: LKC 211381-CB	Client Sample Ref.:				ES	ES	ES	ES	ES	ES
	Client Sample ID.:				HD101	HD102	HD102	HD103D	HD14	HD105
	Sample Location:				HD101	HD102B	HD102	HD103D	HD104	HD105
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.00	0.00	0.20	0.00	0.10	0.00
	Bottom Depth (m):				0.85	0.10	0.50	0.20	0.15	0.45
	Date Sampled:				17-Nov-2022	17-Nov-2022	17-Nov-2022	17-Nov-2022	17-Nov-2022	17-Nov-2022
	Asbestos Lab:				DURHAM	DURHAM	NEW-ASB	DURHAM	DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD						
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	0.22	1.0	< 0.10	0.64	0.29	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	3.9	11	< 2.0	12	5.9	< 2.0

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.: 22-44644-1

Initial Date of Issue: 25-Nov-2022

Client LK Consult

Client Address: Unit 29 Eton Business Park
Eton Hill Road
Radcliffe
Manchester
Lancashire
M26 2ZS

Contact(s): Catherine Baranek
Contaminated Land

Project LKC 21 1381 Hollins Farm, Bury

Quotation No.:

Order No.: LKC211381-CB

No. of Samples: 1

Turnaround (Wkdays): 5

Date Approved: 25-Nov-2022

Date Received: 21-Nov-2022

Date Instructed: 21-Nov-2022

Results Due: 25-Nov-2022

Approved By:

Details: Stuart Henderson, Technical
Manager

Results - Soil

Project: LKC 21 1381 Hollins Farm, Bury

Client: LK Consult	Chemtest Job No.:		22-44644		
Quotation No.:	Chemtest Sample ID.:		1549583		
Order No.: LKC211381-CB	Client Sample Ref.:		ES		
	Client Sample ID.:		HD103C		
	Sample Location:		HD103C		
	Sample Type:		SOIL		
	Top Depth (m):		0		
	Bottom Depth (m):		0.2		
	Date Sampled:		17-Nov-2022		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	15
Soil Colour	N	2040		N/A	Brown
Other Material	N	2040		N/A	Stones and Roots
Soil Texture	N	2040		N/A	Sand
pH	M	2010		4.0	7.5
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010
Arsenic	M	2455	mg/kg	0.5	13
Cadmium	M	2455	mg/kg	0.10	0.25
Chromium	M	2455	mg/kg	0.5	10
Copper	M	2455	mg/kg	0.50	51
Mercury	M	2455	mg/kg	0.05	0.09
Nickel	M	2455	mg/kg	0.50	13
Lead	M	2455	mg/kg	0.50	130
Selenium	M	2455	mg/kg	0.25	0.70
Vanadium	U	2455	mg/kg	0.5	18
Zinc	M	2455	mg/kg	0.50	76
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Organic Matter	M	2625	%	0.40	2.3
Naphthalene	M	2800	mg/kg	0.10	0.16
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.53
Anthracene	M	2800	mg/kg	0.10	0.14
Fluoranthene	M	2800	mg/kg	0.10	0.85
Pyrene	M	2800	mg/kg	0.10	0.78
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.29
Chrysene	M	2800	mg/kg	0.10	0.22
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10

Results - Soil

Project: LKC 21 1381 Hollins Farm, Bury

Client: LK Consult	Chemtest Job No.:		22-44644		
Quotation No.:	Chemtest Sample ID.:		1549583		
Order No.: LKC211381-CB	Client Sample Ref.:		ES		
	Client Sample ID.:		HD103C		
	Sample Location:		HD103C		
	Sample Type:		SOIL		
	Top Depth (m):		0		
	Bottom Depth (m):		0.2		
	Date Sampled:		17-Nov-2022		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	3.0

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

Appendix D

Generic Assessment Criteria

Summary of Category 4 Screening Levels: 2015

Substance	Residential (with home- grown produce)	Residential (without home- grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37 mg/kg	40 mg/kg	49 mg/kg	640 mg/kg	79 mg/kg	170 mg/kg
Benzene	0.87 mg/kg	3.3 mg/kg	0.18 mg/kg	98 mg/kg	140 mg/kg	230 mg/kg
Benzo(a)pyrene	5.0 mg/kg	5.3 mg/kg	5.7 mg/kg	77 mg/kg	10 mg/kg	21 mg/kg
Cadmium	22 mg/kg	150 mg/kg	3.9 mg/kg	410 mg/kg	220 mg/kg	880 mg/kg
Chromium VI	21 mg/kg	21 mg/kg	170 mg/kg	49 mg/kg	21 mg/kg	250 mg/kg
Lead	200 mg/kg	310 mg/kg	80 mg/kg	2300 mg/kg	630 mg/kg	1300 mg/kg

Summary Table for the Generic Assessment Criteria for Human Health Risk Assessment Land Quality Management (LQM) S4ULs.

All GAC are based on sandy loam soils with a pH 7.

		LQM Generic Assessment Criteria (mg/kg) Dry weight soil						
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Metals	Inorganic Arsenic	6%	37	40	43	640	79	170
	Beryllium	6%	1.7	1.7	35	12	2.2	63
	Boron	6%	290	11,000	45	240,000	21,000	46,000
	Cadmium	6%	11	85	1.9	190	120	532
	Chromium (III)	6%	910	910	18,000	8,600	1,500	33,000
	Chromium (VI)	6%	6.0	6.0	1.8	33	7.7	220
	Copper	6%	2,400	7,100	520	68,000	12,000	44,000
	Elemental Mercury	6%	1.2	1.2	21	58 (25.8) ^{vap}	16	30 (25.8) ^{vap}
	Inorganic Mercury	6%	40	56	19	1,100	120	240
	Methylmercury	6%	11	15	6.0	320	40	68
	Nickel	6%	180	180	230	980	230	3,400
	Selenium	6%	250	430	88	12,000	1,100	1,800
	Vanadium	6%	410	1,200	91	9,000	2,000	5,000
	Zinc	6%	3,700	40,000	620	730,000	81,000	170,000
BTEX Compounds	Benzene	1%	0.087	0.38	0.017	27	72	90
		2.5%	0.17	0.70	0.034	47	72	100
		6%	0.37	1.4	0.075	90	73	110
	Toluene	1%	130	880 (869) ^{vap}	22	56,000 (869) ^{vap}	56,000	87,000 (869) ^{vap}
		2.5%	290	1,900	51	110,000 (1,920) ^{vap}	56,000	95,000 (1,920) ^{vap}
		6%	660	3,900	120	180,000 (4,360) ^{vap}	56,000	100,000 (4,360) ^{vap}
	Ethylbenzene	1%	47	83	16	5,700 (518) ^{vap}	24,000	17,000 (518) ^{vap}
		2.5%	110	190	39	13,000 (1,220) ^{vap}	24,000	22,000 (1,220) ^{vap}
		6%	260	440	91	27,000 (2,840) ^{vap}	25,000	27,000 (2,840) ^{vap}
	o-xylene	1%	60	88	28	6,600 (478) ^{sol}	41,000	17,000 (478) ^{sol}
		2.5%	140	210	67	15,000 (1,120) ^{sol}	42,000	24,000 (1,120) ^{sol}
		6%	330	480	160	33,000 (2,620) ^{sol}	43,000	33,000 (2,620) ^{sol}
	m-xylene	1%	59	82	31	6,200 (625) ^{vap}	41,000	17,000 (625) ^{vap}
		2.5%	140	190	74	14,000 (1,470) ^{vap}	42,000	24,000 (1,470) ^{vap}
		6%	320	450	170	31,000 (3,460) ^{vap}	43,000	32,000 (3,460) ^{vap}
	p-xylene	1%	56	79	29	5,900 (576) ^{sol}	41,000	17,000 (576) ^{sol}
		2.5%	130	180	69	14,000 (1,350) ^{sol}	42,000	23,000 (1,350) ^{sol}
		6%	310	430	160	30,000 (3,170) ^{sol}	43,000	31,000 (3,170) ^{sol}

NOTES

^{sol/vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

f = oral, dermal and inhalation exposures compared to oral HCV.

All GAC are based on sandy loam soils with a pH 7.

All GAC are based on sandy loam soils with a pH 7.			LQM Generic Assessment Criteria (mg/kg) Dry weight soil					
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene	1%	210	3,000 (57.1) ^{sol}	34	84,000 (57.0) ^{sol}	15,000	29,000
		2.5%	510	4,700 (141) ^{sol}	85	97,000 (141) ^{sol}	15,000	30,000
		6%	1,100	6,000 (336) ^{sol}	200	100,000	15,000	30,000
	Acenaphthylene	1%	170	2,900 (86.1) ^{sol}	28	83,000 (86.1) ^{sol}	15,000	29,000
		2.5%	420	4,600 (212) ^{sol}	69	97,000 (212) ^{sol}	15,000	30,000
		6%	920	6,000 (506) ^{sol}	160	100,000	15,000	30,000
	Anthracene	1%	2,400	31,000 (1.17) ^{vap}	380	520,000	74,000	150,000
		2.5%	5,400	35,000	950	540,000	74,000	150,000
		6%	11,000	37,000	2,200	540,000	74,000	150,000
	Benz(a)anthracene	1%	7.2	11	2.9	170	29	49
		2.5%	11	14	6.5	170	29	56
		6%	13	15	13	180	29	62
	Benzo(a)pyrene (only)	1%	2.2	3.2	0.97	35	5.7	11
		2.5%	2.7	3.2	2.0	35	5.7	12
		6%	3.0	3.2	3.5	36	5.7	13
	Benzo(b)fluoranthene	1%	2.6	3.9	0.99	44	7.1	13
		2.5%	3.3	4.0	2.1	44	7.2	15
		6%	3.7	4.0	3.9	45	7.2	16
	Benzo(ghi)perylene	1%	320	360	290	3,900	640	1,400
		2.5%	340	360	470	4,000	640	1,500
		6%	350	360	640	4,000	640	1,600
	Benzo(k)fluoranthene	1%	77	110	37	1,200	190	370
		2.5%	93	110	75	1,200	190	410
		6%	100	110	130	1,200	190	440
	Chrysene	1%	15	30	4.1	350	57	93
		2.5%	22	31	9.4	350	57	110
		6%	27	32	19	350	57	120
	Dibenzo(ah)anthracene	1%	0.24	0.31	0.14	3.5	0.57	1.1
		2.5%	0.28	0.32	0.27	3.6	0.58	1.3
		6%	0.3	0.32	0.43	3.6	0.58	1.4
	Fluoranthene	1%	280	1,500	52	23,000	3,100	6,300
		2.5%	560	1,600	130	23,000	3,100	6,300
		6%	890	1,600	290	23,000	3,100	6,400
	Fluorene	1%	170	2,800 (36.0) ^{sol}	27	63,000 (30.9) ^{sol}	9,900	20,000
		2.5%	400	3,800 (76.5) ^{sol}	67	68,000	9,900	20,000
		6%	860	4,500 (183) ^{sol}	160	71,000	9,900	20,000
	Indeno(123-cd)pyrene	1%	27	45	9.5	500	82	150
		2.5%	36	46	21	510	82	170
		6%	41	46	39	510	82	180
	Naphthalene	1%	2.3 ^f	2.3 ^f	4.1 ^f	190 ^f (76.4) ^{sol}	4,900 ^f	1,200 ^f (76.4) ^{sol}
		2.5%	5.6 ^f	5.6 ^f	10 ^f	460 ^f (183) ^{sol}	4,900 ^f	1,900 ^f (183) ^{sol}
		6%	13 ^f	13 ^f	24 ^f	1,100 ^f (432) ^{sol}	4,900 ^f	3,000
	Phenanthrene	1%	95	1,300 (36.0) ^{sol}	15	22,000	3,100	6,200
		2.5%	220	1,500	38	22,000	3,100	6,200
		6%	440	1,500	90	22,000	3,100	6,300
	Pyrene	1%	620	3,700	110	54,000	7,400	15,000
		2.5%	1,200	3,800	270	54,000	7,400	15,000
		6%	2,000	3,800	620	54,000	7,400	15,000
Coal Tar (B(a)P as surrogate marker)	1%	0.79	1.2	0.32	15	2.2	4.4	
	2.5%	0.98	1.2	0.67	15	2.2	4.7	
	6%	1.1	1.2	1.2	15	2.2	4.8	

NOTES

^{sol} / ^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^f = naphthalene is based on comparison of inhalation exposure with TDI_{Inhal} for localised effect.

All GAC are based on sandy loam soils with a pH 7.

LQM Generic Assessment Criteria (mg/kg) Dry weight soil

Contaminant	SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Aliphatic							
EC 5-6	1%	42	42	730	3,200 (304) ^{sol}	570,000(304) ^{sol}	95,000 (304) ^{sol}
EC>6-8	1%	100	100	2,300	7,800 (144) ^{sol}	600,000	150,000 (144) ^{sol}
EC>8-10	1%	27	27	320	2,000 (78) ^{sol}	13,000	14,000 (78) ^{vap}
EC>10-12	1%	130 (48) ^{vap}	130 (48) ^{vap}	2,200	9,700 (48) ^{sol}	13,000	21,000 (48) ^{vap}
EC>12-16	1%	1,100 (24) ^{sol}	1,100 (24) ^{sol}	11,000	59,000 (24) ^{sol}	13,000	25,000 (24) ^{sol}
EC>16-35	1%	65,000 (8.48) ^{f, sol}	65,000 (8.48) ^{f, sol}	260,000 ^f	160,000 ^f	250,000 ^f	450,000 ^f
EC>35-44	1%	65,000 (8.48) ^{f, sol}	65,000 (8.48) ^{f, sol}	260,000 ^f	160,000 ^f	250,000 ^f	450,000 ^f
Aliphatic							
EC 5-6	2.5%	78	78	1,700	5,900 (558) ^{sol}	590,000	130,000 (558) ^{sol}
EC>6-8	2.5%	230	230	5,600	17,000 (322) ^{sol}	610,000	220,000 (322) ^{sol}
EC>8-10	2.5%	65	65	770	4,800 (190) ^{vap}	13,000	18,000 (190) ^{vap}
EC>10-12	2.5%	330 (118) ^{vap}	330 (118) ^{vap}	4,400	23,000 (118) ^{vap}	13,000	23,000 (118) ^{vap}
EC>12-16	2.5%	2,400 (59) ^{sol}	2,400 (59) ^{sol}	13,000	82,000 (59) ^{sol}	13,000	25,000 (59) ^{sol}
EC>16-35	2.5%	92,000 (21) ^{f, sol}	92,000 (21) ^{f, sol}	270,000 ^f	1,700,000 ^f	250,000 ^f	480,000 ^f
EC>35-44	2.5%	92,000 (21) ^{f, sol}	92,000 (21) ^{f, sol}	270,000 ^f	1,700,000 ^f	250,000 ^f	480,000 ^f
Aliphatic							
EC 5-6	6%	160	160	3,900	12,000 (1,150) ^{sol}	600,000	180,000 (1,150) ^{sol}
EC>6-8	6%	530	530	13,000	40,000 (736) ^{sol}	620,000	320,000 (736) ^{sol}
EC>8-10	6%	150	150	1,700	11,000 (451) ^{vap}	13,000	21,000 (451) ^{vap}
EC>10-12	6%	760 (283) ^{vap}	760 (283) ^{vap}	7,300	47,000 (283) ^{vap}	13,000	24,000 (283) ^{vap}
EC>12-16	6%	4,300 (142) ^{sol}	4,400 (142) ^{sol}	13,000	90,000 (142) ^{sol}	13,000	26,000 (142) ^{sol}
EC>16-35	6%	110,000 ^f	110,000 ^f	270,000 ^f	1,800,000 ^f	250,000 ^f	490,000 ^f
EC>35-44	6%	110,000 ^f	110,000 ^f	270,000 ^f	1,800,000 ^f	250,000 ^f	490,000 ^f
Aromatic							
EC5-7(benzene as non-threshold)	1%	70	370	13	26,000 (1,220) ^{sol}	56,000	76,000 (1,220) ^{sol}
EC>7-8(toluene)	1%	130	860	22	56,000 (869) ^{vap}	56,000	87,000 (869) ^{vap}
EC>8-10	1%	34	47	8.6	3,500 (613) ^{vap}	5,000	7,200 (613) ^{vap}
EC>10-12	1%	74	250	13	16,000 (364) ^{sol}	5,000	9,200 (364) ^{sol}
EC>12-16	1%	140	1,800	23	36,000 (169) ^{sol}	5,100	10,000
EC>16-21	1%	260 ^f	1,900 ^f	46 ^f	28,000 ^f	3,800 ^f	7,600 ^f
EC>21-35	1%	1,100 ^f	1,900 ^f	370 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>35-44	1%	1,100 ^f	1,900 ^f	370 ^f	28,000 ^f	3,800 ^f	7,800 ^f
Aromatic							
EC5-7(benzene as non-threshold)	2.5%	140	690	27	46,000 (2,260) ^{sol}	56,000	84,000 (2,260) ^{sol}
EC>7-8(toluene)	2.5%	290	1,800	51	110,000 (1,920) ^{sol}	56,000	95,000 (1,920) ^{sol}
EC>8-10	2.5%	83	110	21	8,100 (1,500) ^{vap}	5,000	8,500 (1,500) ^{vap}
EC>10-12	2.5%	180	590	31	28,000 (899) ^{sol}	5,000	9,700 (899) ^{sol}
EC>12-16	2.5%	330	2,300 (419) ^{sol}	57	37,000	5,100	10,000
EC>16-21	2.5%	540 ^f	1,900 ^f	110 ^f	28,000 ^f	3,800 ^f	7,700 ^f
EC>21-35	2.5%	1,500 ^f	1,900 ^f	820 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>35-44	2.5%	1,500 ^f	1,900 ^f	820 ^f	28,000 ^f	3,800 ^f	7,800 ^f
Aromatic							
EC5-7(benzene as non-threshold)	6%	300	1,400	57	86,000 (4,710) ^{sol}	56,000	92,000 (4,710) ^{sol}
EC>7-8(toluene)	6%	660	3,900	120	180,000 (4,360) ^{vap}	56,000	100,000 (4,360) ^{vap}
EC>8-10	6%	190	270	51	17,000 (3,580) ^{vap}	5,000	9,300 (3,580) ^{vap}
EC>10-12	6%	380	1,200	4	34,000 (2,150) ^{sol}	5,000	10,000
EC>12-16	6%	660	2,500	130	38,000	5,100	10,000
EC>16-21	6%	930 ^f	1,900 ^f	260 ^f	28,000 ^f	3,800 ^f	7,800 ^f
EC>21-35	6%	1,700 ^f	1,900 ^f	1,600 ^f	28,000 ^f	3,800 ^f	7,900 ^f
EC>35-44	6%	1,700 ^f	1,900 ^f	1,600 ^f	28,000 ^f	3,800 ^f	7,900 ^f
Aliphatic	1%	1,600 ^f	1,900 ^f	1,200 ^f	28,000 ^f	3,800 ^f	7,800 ^f
+Aromatic	2.5%	1,800 ^f	1,900 ^f	2,100 ^f	28,000 ^f	3,800 ^f	7,800 ^f
>EC44	6%	1,900 ^f	1,900 ^f	3,000 ^f	28,000 ^f	3,800 ^f	7,900 ^f

NOTES

^{sol}/^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^f = oral, dermal and inhalation exposures compared to oral HCV.

All GAC are based on sandy loam soils with a pH 7.

		LQM Generic Assessment Criteria (mg/kg) Dry weight soil						
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Chloalkanes and Alkenes & Explosives	1,2 Dichloroethane (DCA)	1%	7.1E-03	9.2E-03	4.6E-03	0.67	29	21
		2.5%	1.1E-02	1.3E-02	8.3E-03	0.97	29	24
		6%	1.9E-02	2.3E-02	1.6E-02	1.7	29	28
	1,1,1 Trichloroethane (TCA)	1%	8.8	9.0	48	660	140,000	57,000 (1,425) ^{vap}
		2.5%	18	18	110	1,300	140,000	76,000 (2,915) ^{vap}
		6%	39	40	240	3,000	140,000	100,000 (6,392) ^{vap}
	1,1,2,2-Tetrachloroethanes (PCA)	1%	1.6	3.9	0.41	270	1,400	1,800
		2.5%	3.4	8.0	0.89	550	1,400	2,100
		6%	7.5	17	2.0	1,100	1,400	2,300
	1,1,1,2-Tetrachloroethanes (PCA)	1%	1.2	1.5	0.79	110	1,400	1,500
		2.5%	2.8	3.5	1.9	250	1,400	1,800
		6%	6.4	8.2	4.4	560	1,400	2,100
	Tetrachloroethene (PCE)	1%	0.18	0.18	0.65	19	1,400	810 (424) ^{sol}
		2.5%	0.39	0.40	1.5	42	1,400	1,100 (951) ^{sol}
		6%	0.90	0.92	3.6	95	1,400	1,500
	Tetrachloromethane (carbon tetrachloride)	1%	2.6E-02	2.6E-02	0.45	2.9	890	190
		2.5%	5.6E-02	5.6E-02	1.0	6.3	920	270
		6%	0.13	0.13	2.4	14	950	400
	Trichloroethene (TCE)	1%	1.6E-02	1.7E-02	4.1E-02	1.2	120	70
		2.5%	3.4E-02	3.6E-02	9.1E-02	2.6	120	91
		6%	7.5E-02	8.0E-02	0.21	5.7	120	120
	Trichloromethane (chloroform)	1%	0.91	1.2	0.42	99	2,500	2,600
		2.5%	1.7	2.1	0.83	170	2,500	2,800
		6%	3.4	4.2	1.7	350	2,500	3,100
	Chloroethene (vinyl chloride)	1%	6.4E-04	7.7E-04	5.5E-04	5.9E-02	3.5	4.8
		2.5%	8.7E-04	1.0E-03	1.0E-03	7.7E-02	3.5	5.0
		6%	1.4E-03	1.5E-03	1.8E-03	0.12	3.5	5.4
	2,4,6-Trinitrotoluene (TNT)	1%	1.6	65	0.24	1,000	130	260
		2.5%	3.7	66	0.58	1,000	130	270
		6%	8.1	66	1.4	1,000	130	270
	RDX	1%	120	13,000	17	210,000	26,000	49,000 (18.7) ^{sol}
		2.5%	250	13,000	38	210,000	26,000	51,000
		6%	540	13,000	85	210,000	27,000	53,000
	HMX	1%	5.7	6,700	0.86	110,000	13,000	23,000 (0.35) ^{vap}
		2.5%	13	6,700	1.9	110,000	13,000	23,000 (0.39) ^{vap}
		6%	26	6,700	3.9	110,000	13,000	24,000 (0.48) ^{vap}
Pesticides	Aldrin	1%	5.7	7.3	3.2	170	18	30
		2.5%	6.6	7.4	6.1	170	18	31
		6%	7.1	7.5	9.8	170	18	31
	Dieldrin	1%	0.97	7.0	0.17	170	18	30
		2.5%	2.0	7.3	0.41	170	18	30
		6%	3.5	7.4	0.96	170	18	31
	Atrazine	1%	3.3	610	0.5	9,300	1,200	2,300
		2.5%	7.8	620	1.2	9,400	1,200	2,400
		6%	17.4	620	2.7	9,400	1,200	2,400
	Dichlorvos	1%	3.2E-02	6.4	4.9E-03	140	16	26
		2.5%	6.6E-02	6.5	1.0E-02	140	16	26
		6%	0.14	6.6	2.2E-02	140	16	27
	Endosulfans (2 isomers)	1%	7.4	160 (3.0E-03) ^{vap}	1.2	5,600 (3.0E-03) ^{vap}	1,200	2,300
		2.5%	18	280 (7.0E-03) ^{vap}	2.9	7,400 (7.0E-03) ^{vap}	1,200	2,400
		6%	41	410 (1.6E-02) ^{vap}	6.8	8,400 (1.6E-02) ^{vap}	1,200	2,500
	Hexachlorocyclohexane (3 isomers), inc Lindane	1%	8.5E-02	3.7	1.3E-02	65	8.1	15
		2.5%	0.2	3.8	3.2E-02	65	8.1	15
		6%	0.46	3.8	7.7E-02	65	8.1	16

NOTES

^{sol} / ^{vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

All GAC are based on
sandy loam soils with a pH
7.

All GAC are based on sandy loam soils with a pH 7.			LQM Generic Assessment Criteria (mg/kg) Dry weight soil					
Contaminant		SOM	Res +	Res -	Allot.	Comm.	POS _{resi}	POS _{park}
Chlorobenzenes	Chlorobenzene	1%	0.46	0.46	5.9	56	11,000	1,300 (675) ^{sol}
		2.5%	1.0	1.0	14	130	13,000	2,000 (1,520) ^{sol}
		6%	2.4	2.4	32	290	14,000	2,900
	Dichlorobenzenes (3 isomers)	1%	23	24	94	2,000 (571) ^{sol}	90,000	24,000 (571) ^{sol}
		2.5%	55	57	230	4,800 (1,370) ^{sol}	95,000	36,000 (1,370) ^{sol}
		6%	130	130	540	11,000 (3,240) ^{sol}	98,000	51,000 (3,270) ^{sol}
	Trichlorobenzenes (3 isomers)	1%	2.6	2.6	55	220	15,000	1,700 (318) ^{vap}
		2.5%	6.4	6.4	140	530	17,000	2,600 (786) ^{vap}
		6%	15	15	320	1,300	19,000	4,000 (1,880) ^{vap}
	Tetrachlorobenzenes (3 isomers)	1%	0.66	0.75	0.38	49 (39.4) ^{vap}	78	110 (39) ^{vap}
		2.5%	1.6	1.9	0.90	120 (98.1) ^{vap}	79	120
		6%	3.7	4.3	2.2	240 (235) ^{vap}	79	130
	Pentachlorobenzene	1%	5.8	19	1.2	640 (43.0) ^{sol}	100	190
		2.5%	12	30	3.1	770 (107) ^{sol}	100	190
		6%	22	38	7.0	830	100	190
	Hexachlorobenzene	1%	1.8 (0.20) ^{vap}	4.1 (0.20) ^{vap}	0.47	110 (0.20) ^{vap}	16	30
		2.5%	3.3 (0.50) ^{vap}	5.7 (0.50) ^{vap}	1.1	120	16	30
		6%	4.9	6.7 (1.2) ^{vap}	2.5	120	16	30
Chlorophenol	Chlorophenols (4 congeners)	1%	0.87 ^g	94	0.13 ^g	3,500	620	1,100
		2.5%	2.0	150	0.30	4,000	620	1,100
		6%	4.5	210	0.70	4,300	620	1,100
	Pentachlorophenol	1%	0.22	27 (16.4) ^{vap}	3.0E-02	400	60	110
		2.5%	0.52	29	8.0E-02	400	60	120
		6%	1.2	31	0.19	400	60	120
Others	Carbon Disulphide	1%	0.14	0.14	4.8	11	11,000	1,300
		2.5%	0.29	0.29	10	22	11,000	1,900
		6%	0.62	0.62	23	47	11,000	2,700
	Hexachlorobutadiene	1%	0.29	0.32	0.25	31	25	48
		2.5%	0.7	0.78	0.61	66	25	50
		6%	1.6	1.8	1.4	120	25	51
	Phenol	1%	280	750	66	760 ^{dir} (31,000)	760 ^{dir} (11,000)	760 ^{dir} (8,600)
		2.5%	550	1,300	140	1,500 ^{dir} (35,000)	1,500 ^{dir} (11,000)	1,500 ^{dir} (9,700)
		6%	1,100	2,300	280	3,200 ^{dir} (37,000)	3,200 ^{dir} (11,000)	3,200 ^{dir} (11,000)

NOTES

^{sol / vap} = solubility / vapour limit (potentially use if free product identified, although highly conservative).

^{dir} = S4uls based on threshold protective of direct skin contact with phenol (brackets long term exposure for illustration purposes).

^g = derived based on 2,3,4,6-tetrachlorophenol.

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