APPLiED GEOLOGY

REMEDIATION STRATEGY AND VERIFICATION PLAN FOR SAXTON LANE, LEEDS

REPORT STATUS SHEET

Client:	Torsion Group
Report Title:	Remediation Strategy and Verification Plan for Saxton Lane, Leeds
Report Number:	AG2906A-19-AI03
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Date:	May 2019

		Date	Signed for and on behalf of Applied Geology Limited
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APPENDICES

1.0 INTRODUCTORY INFORMATION

An area of developed land adjacent to Saxton Lane, Leeds (the site), is being considered for redevelopment by Torsion Group (the Client). It is understood that the proposals for the site comprise demolition of two existing buildings and construction of a twenty-two-storey mixed residential/commercial building, with a single storey basement and associated areas of landscaping, as shown on the Proposed Basement Car Park and Proposed Ground Floor Plan Option 4, Dwg Nos SK212 and SK213, by Den Architecture, included in Appendix A.

A Phase I Desk Study (report ref: AG2906-18-AF22, dated September 2018) and a Phase 2 Geotechnical and Geo-environmental ground investigation (report ref: AG2906-18-AF59, dated November 2018) was previously undertaken for the site by Applied Geology.

The site is located adjacent to Saxton Lane, Leeds. The Ordnance Survey grid reference for the centre of the site is approximately 431042, 433441 as shown on the Site Location Plan in Appendix A. The site is irregular in plan shape with an approximate area of 0.46ha. The site is generally topographically flat at an elevation of approximately 30m AOD.

In order to develop the site safely (with respect to soil contamination) it has been necessary to incorporate measures to protect the proposed end users. This Remediation Strategy and Verification Plan has been prepared to document the method to be used for placing and verifying the installation of a cover layer in landscaped areas.

This report has been written in accordance with CLR11 (Model Procedures for the Management of Land Contamination) and has been produced to acknowledge comments raised by Leeds City Council's Contaminated Land Team in relation to Planning Application 19/01010/FU. These comments can be found in the Planning Consultation response documentation, ref: PCL02569_19_01010_PRD1, dated March 2019 and PCL02569_19_01010_PRD2, dated April 2019, which are available through Leeds City Council's Planning Portal.

2.0 BACKGROUND INFORMATION

Site History

From the earliest available OS maps dated 1852, the site is shown to have comprised terraced housing, a corn mill and businesses including public houses and a timber workshop. By the early 1950s, the terraced housing had been removed and replaced by a marble works in the north of the site. By the early 1990s, a large building is shown in the east with a garage in the centre of the site, adjacent to warehouses and an ice cream factory which had replaced the timber workshop and abattoir. By the turn of the century, the marble works, public houses, ice cream factory and warehouses had made way for another large building in the west of the site, currently used by the Living Hope Church. This unit is separated from the building in the east, currently used by Amazing Grace Nursery, by a car park which has remained until the present day.

Ground Conditions

The Phase 2 investigation undertaken by Applied Geology in November 2018 identified Made Ground, generally to depths of between 1m and 2.15m below ground level (bgl), apart from at the location of BH3, where Made Ground was encountered to 19m bgl (base not proven), which was interpreted as being a suspected infilled mine shaft. The Made Ground elsewhere was underlain by Solid strata of the Pennine Lower Coal Measures Formation, encountered as clay and sand at surface, becoming rock strength mudstone, siltstone and sandstone between 1.7m and 4.5m bgl.

Hydrogeology

The Bedrock aquifer designation maps indicate the Pennine Lower Coal Measures Formation to be a Secondary 'A' Aquifer. There are no recorded groundwater abstraction licenses within 500m of the site and the site is not shown to be located within a groundwater Source Protection Zone (SPZ).

Hydrology

The nearest watercourse is the culverted Lady Beck located approximately 120m west of the site. The River Aire is located approximately 350m southwest of the site.

Soil Contamination

Considering the nature of the proposed development (i.e. used for predominantly commercial purposes on the ground floor and no private garden areas), screening values for a commercial end use were considered appropriate in the Phase 2 report. Subsequently, when the soil chemical test results from the 2018 Applied Geology Phase 2 investigation were screened against values for a commercial end use, no determinands exceeded their corresponding screening values. Asbestos screening tests also did not detect the presence of any Asbestos fibres. It was therefore considered that there was a negligible risk to end users with regards to soil contamination. However, further to a review of the Applied Geology Phase 2 investigation report by Leeds City Council's Contaminated Land Team (ref: PCL02569_19_01010_PRD1, dated March 2019 and PCL02569_19_01010_PRD2, dated April 2019), it was considered that screening values for a commercial end use were not appropriate because although the ground floor will be occupied by mostly commercial properties, some residential flats will also be present at ground floor level. However, these are located above the basement, where all of the Made Ground shall be removed. It was therefore agreed that conservative screening criteria for a Public Open Space (Residential) end use should be used, assuming 2.5% SOM (based on the results of the samples tested).

When the soil chemical test results from the 2018 Applied Geology Phase 2 investigation are screened against values for a Public Open Space (Residential) end use, assuming 2.5% SOM, a single exceedance for benzo(a)pyrene (11mg/kg) is identified in a sample of the shallow Made Ground collected at 0.25 in DCS1 on the western site boundary. Considering that only a single exceedance was identified, these results have been statistically analysed (in accordance with CIEH methodology) and copies of the resulting spreadsheets are included within Appendix B. In the first instance, the presence of statistical outliers within the shallow Made Ground was established using the Grubb's Test. The maximum concentration of Benzo(a)pyrene was not shown to be an outlier and the concentrations were found to show non-normal

distributions and therefore the 95% Upper Confidence Limits (UCL) were calculated following the Chebychev theorem. The results give a 95% UCL of 10.2mg/kg for benzo[a]pyrene which is only marginally above the Public Open Space (Residential) screening value of 10mg/kg.

Based on the PAH ratios and soil descriptions, the concentrations of benzo[a]pyrene in the shallow Made Ground are considered likely to be associated with the presence of coal, ash and clinker.

Controlled Waters

Soil leachate testing has not detected the presence of any contaminants above the adopted screening criteria, including PAHs, which were all reported below the laboratory detection limits.

In addition to leachate testing, a groundwater sample was collected from a standpipe installed within the suspected backfilled mine shaft in BH3. Several PAH compounds exceeded the adopted waters screening value, or in the absence of a formal screening value exceeded the laboratory detection limit. Based on the PAH ratios and soil descriptions, the elevated concentrations of benzo[a]pyrene in the shallow Made Ground are considered likely to be associated with the presence of coal, ash and clinker encountered within the backfill material.

Based on the context of the site and the proposed redevelopment, without any remedial action there was considered to be a low to moderate risk to the Pennine Lower Coal Measures Formation Secondary A Aquifer. This is however dependent on the extent of any existing lining/plugging of the suspected backfilled mineshaft which would likely offer some additional protection.

Suspected Mineshaft Treatment

Treatment of the suspected mine shaft by a combination of drilling and grouting and capping is considered necessary for engineering purposes. It is anticipated that delineation of the suspected mine shaft by probing and excavation will be undertaken prior to capping.

It is considered that the process of grouting the assumed abandoned mine shaft with cement grout would decrease overall mobility of any contaminants present within this feature and therefore reduce migration of contaminants and reduce any existing preferential pathways into the Secondary A Aquifer.

The drilling and grouting scheme will need to be designed and validated by a suitably experienced engineer/geologist based on the final foundation design adopted and in particular the depths of the proposed piled foundations. These aspects will be reported separately in a drilling and grouting specification and subsequent validation report on the drilling and grouting works undertaken.

3.0 SCOPE OF REMEDIATION TO BE UNDERTAKEN

3.1 Reasons and Objectives for Undertaking the Remediation

The Made Ground is considered likely to contain benzo(a)pyrene at concentrations marginally above relevant screening values for a Public Open Space (Residential) end

use. Based on the nature of the development and the marginal exceedances it is considered that this is unlikely to pose a risk to end users by ingestion, inhalation and direct contact pathways and is not considered to pose a risk to Controlled Waters. However, since topsoil will need to be imported to site anyway for the proposed landscaped areas, it is considered appropriate to utilise the imported topsoil as a clean cover layer system to ensure that the source-pathway-receptor linkages to Human Health receptors are broken.

3.2 Remedial Methods

Following discussions with Leeds City Council's Contaminated Land Team, a clean cover layer thickness of at least 450mm has been agreed. Imported Topsoil/ Subsoil will need to be tested and the thickness of cover layer to be placed should be re-assessed once the source of the topsoil is known.

In other parts of the site, the source-pathway-receptor linkages to potential end users, would be effectively broken where the proposals involve placement of hardstanding or where the complete removal of the Made Ground to accommodate the proposed basement will take place. As such, in these areas there is considered to be a negligible risk to human health via ingestion/direct contact pathways and no specific remedial actions are warranted here.

3.3 Testing of Imported Topsoil/Subsoil Material

Given the absence of excess clean topsoil or subsoil on site, it will need to be imported. The source of the imported topsoil is not known at the time of writing but shall be confirmed prior to import and regardless of the source, it will need to be described and tested. The imported soil shall be tested for a range of potential contaminants as given in the Imported Topsoil/ Subsoil Acceptance Criteria included in Appendix B. Three tests shall be taken at source to confirm suitability of the soil prior to import. Once imported to site, one soil sample shall be tested per 250m^3 (assuming a greenfield or manufactured soil source) which is in line with the Yorkshire and Lincolnshire Advisory Group technical guidance on verification requirments for cover systems, Version 3.4, November 2017. If the imported Topsoil/ Subsoil is to be obtained from another source, then the testing criteria and testing frequency will be dependent on the donor site history and will need to be agreed with Applied Geology.

The Imported Topsoil/Subsoil Acceptance Criteria, included in Appendix B, are generally based on LQM/ CIEH S4UL (2015) criteria for a residential with plant uptake end use where avaliable and BS3882: 2015. The screening value used for lead is based on the C4SL for a Residential With Plant Uptake end use. For PAH compounds and TPH fractions where the S4UL criteria is in excess of 1000mg/kg, the overall limits for total TPH and total PAH of 1000mg/kg are proposed to reduce the risks of potentially hazardous soils (from a waste classification point of view) being brought to site, which would otherwise be compliant with the S4UL criteria and thus not a risk to human health receptors. The screening values given include those for soil with 1%, 2.5% and 6% Soil Organic Matter (SOM). The Soil Organic Matter of the imported topsoil shall also be confirmed as part of the testing.

If all concentrations are less than the Imported Topsoil Acceptance criteria, the imported topsoil/subsoil will 'pass'. If any of the concentrations are above the criteria, the results will be discussed with Leeds City Council's Contaminated Land Team to

agree the required action. It should, however, be noted that other testing may be required, depending on the origin and nature of the source material.

3.4 Validation of Clean Soil Layer

Confirmation that the required depth of clean soil layer has been placed will be via the excavation of hand dug pits in the placed imported topsoil material by a suitably qualified geo-environmental engineer, with photographs also taken for inclusion in a Validation Report. Although it should be agreed beforehand with Leeds City Council's Contaminated Land Team, a rate of 1 hand dug pit per $50m^3$ or 10 pits evenly spread across the landscaped areas is considered appropriate.

3.5 Consignment and Waste Transfer Notes

Prior to removal (from site) of any Made Ground, it will need to be appropriately classified in accordance with waste management legislation and disposed off-site. The site investigation results for the Made Ground can be used, but further testing may be required by the receiver of the waste soils. All consignment/waste transfer notes from the Made Ground removed from site and soils imported onto site will be made available for inspection by third parties.

3.6 Post-Remediation Conceptual Site Model

Following installation of the cover layer to the landscaped areas, there will be no remaining source-pathway-receptor linkages to Human Health receptors.

Following treatment of the assumed abandoned mine shaft by grouting, the likelihood of the existing potential pathway presenting a risk to Controlled Waters is expected to be reduced.

3.7 Anticipated Programme for the Remedial Works

The installation of the topsoil cover layer across the landscaped areas is envisaged to be carried out towards the end of the main construction phase.

3.8 Variations to the Verification Plan

Should previously unidentified contamination be encountered during redevelopment of the site or any remediation be proposed to be altered, then Leeds City Council's Contaminated Land Team will be notified and a course of action agreed.

3.9 Local Authority Contact

Eloise Murray
Contaminated Land Team
Leeds City Council
Tel: 0113 378 9865

4.0 FINAL SITE CONDITIONS

4.1 Status at Completion

The topsoil cover layer results will be confirmed as complying with the Imported Topsoil/Subsoil Acceptance criteria and copies will be provided within the Validation Report, which will also include confirmation of the 'as built' cover layer thickness. Should any contaminated soils be encountered in proposed landscaped areas during construction, it will have been removed, replaced with clean fill and covered with imported topsoil.

4.2 Identification of Post-Treatment Management Needs

Once the cover layer is installed, no post-treatment management or monitoring is envisaged to be necessary for soil contamination issues.

5.0 SUPPORTING INFORMATION

5.1 Plans, As-Built Drawings, Site Diaries and Photographs

Any necessary plans/drawings, site diaries and photographs in support of the verification will be provided in the Validation Report. This will include photographs to demonstrate an appropriate thickness of cover layer has been placed.

5.2 Test Results

Laboratory test results for the imported soils will be included within the Validation Report.

5.3 Consignment Notes etc

Proof of disposal of Made Ground soils sent off site and delivery tickets for imported soils etc will be made available for inspection by third parties.

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GENERAL NOTES

A) The assessment made in this report is based on the site terrain and ground conditions revealed by the various field investigations undertaken and also any other relevant data for the site including previous site investigation reports (if available) and desk study data. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which have not, therefore, been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available. It must be recognised that many of the Environmental Searches obtained during the course of the desk study are often lengthy. Applied Geology have, where appropriate and in the interests of simplicity, only reproduced the summary of the searches within the report. A full copy of all the search data is held at the Applied Geology office and is available for inspection if required.

B) Where any data supplied by the Client or other external source, including that from previous site investigations, has been used it has been assumed that the information is correct. No responsibility can be accepted by Applied Geology for inaccuracies within this data.

C) Whilst the report may express an opinion on possible configurations of strata between or beyond the exploratory locations, or on the possible presence of features based on either visual, verbal or published evidence this is for guidance only and no liability can be accepted for the accuracy.

D) Comments on groundwater (and landfill gas) conditions are based on observations made during the course of the present and past investigations or with reference to published data unless otherwise stated. It should be noted, however, that groundwater (and landfill gas) levels vary due to seasonal (or atmospheric conditions) or other effects.

E) The copyright of this report and other plans and documents prepared by Applied Geology is owned by Applied Geology and no such report, plan or document may be reproduced, published or adapted without the written consent of Applied Geology. Complete copies of the report may, however, be made and distributed by the Client as an expedient in dealing with matters related to its submission.

F) This report is prepared and written in the context of the proposals stated in the introduction to the report and should not be used in a differing context. Furthermore, new information, improved practices and legislation may necessitate an alteration to the report in whole or in part after its submission. Therefore with any change in circumstances or after the expiry of one year from the date of the report, the report should be referred to Applied Geology for re-assessment and if necessary, re-appraisal.

G) The survey was conducted and this report was prepared for the sole internal use and reliance of the Client. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Applied Geology. If an unauthorised third party comes into possession of this report they rely on it at their peril and Applied Geology owes them no duty of care and skill.

H) Ground conditions should be monitored during the construction of the works and the recommendations of the report re-evaluated in the light of this data by the supervising geotechnical or geo-environmental engineers.

I) Unless specifically stated, the investigation has not taken into account the possible effects of mineral extraction.

J) The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, depends on very many factors in addition to geotechnical considerations and hence its evaluation is outside the scope of this report.

K) Applied Geology operates as a Consultancy and does not operate it's own laboratory for soil testing, this work being sub contracted to known and respected, generally UKAS accredited, laboratories. Applied Geology can therefore not be held responsible for the testing carried out.

APPENDIX A

Reproduced from the Ordnance Survey Map with permission of the Controller of Her Majesty's Stationery Office, Crown Copyright* LICENCE No: 100055022

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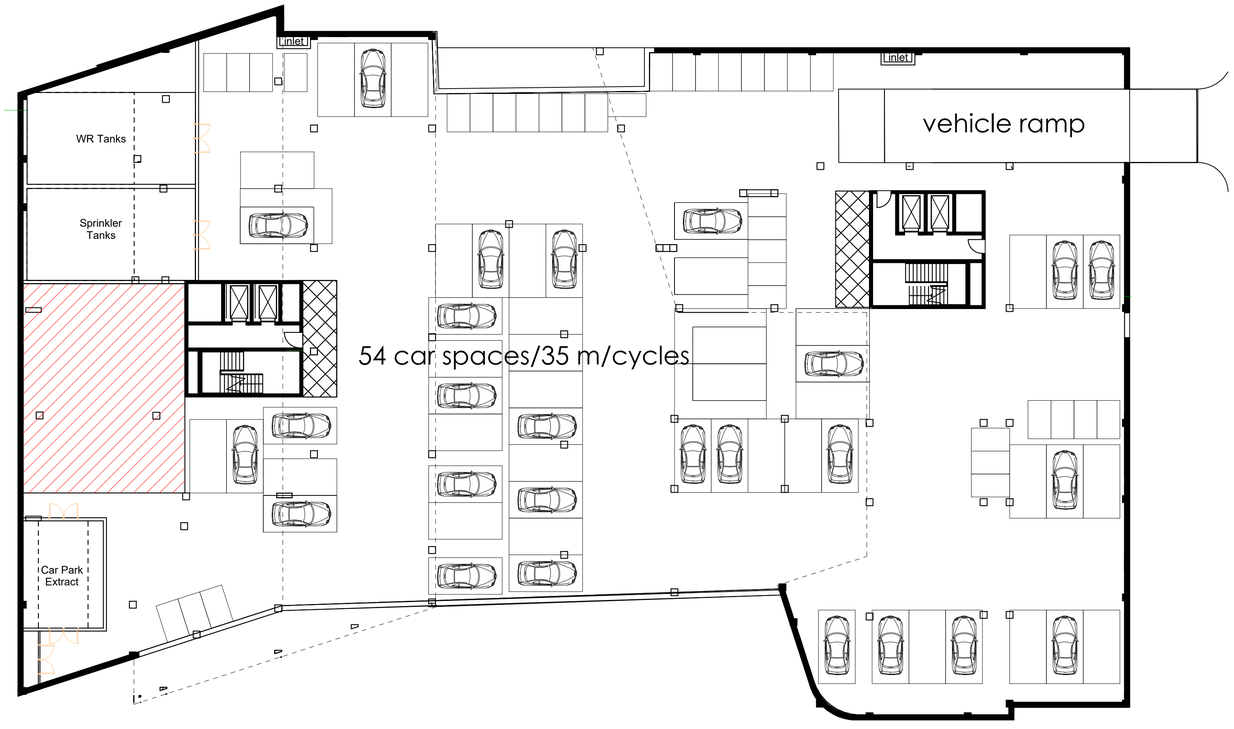
Client:	TORSION GROUP
Project:	SAXTON LANE, LEEDS

Drawn By:	Checked By:	Paper Size:
JS	PG	A4

Scale:	Date:	NGR:
1:50,000	25.04.2019	431042 433441

Drawing No:	Revision:
AG2906A-19-01	0

Title: SITE LOCATION PLAN



Northpoint:

Rev	Date	Amendment	By	Chk
A	30.08.18	Amendments to Structure/Layout	SA	LD

Notes:

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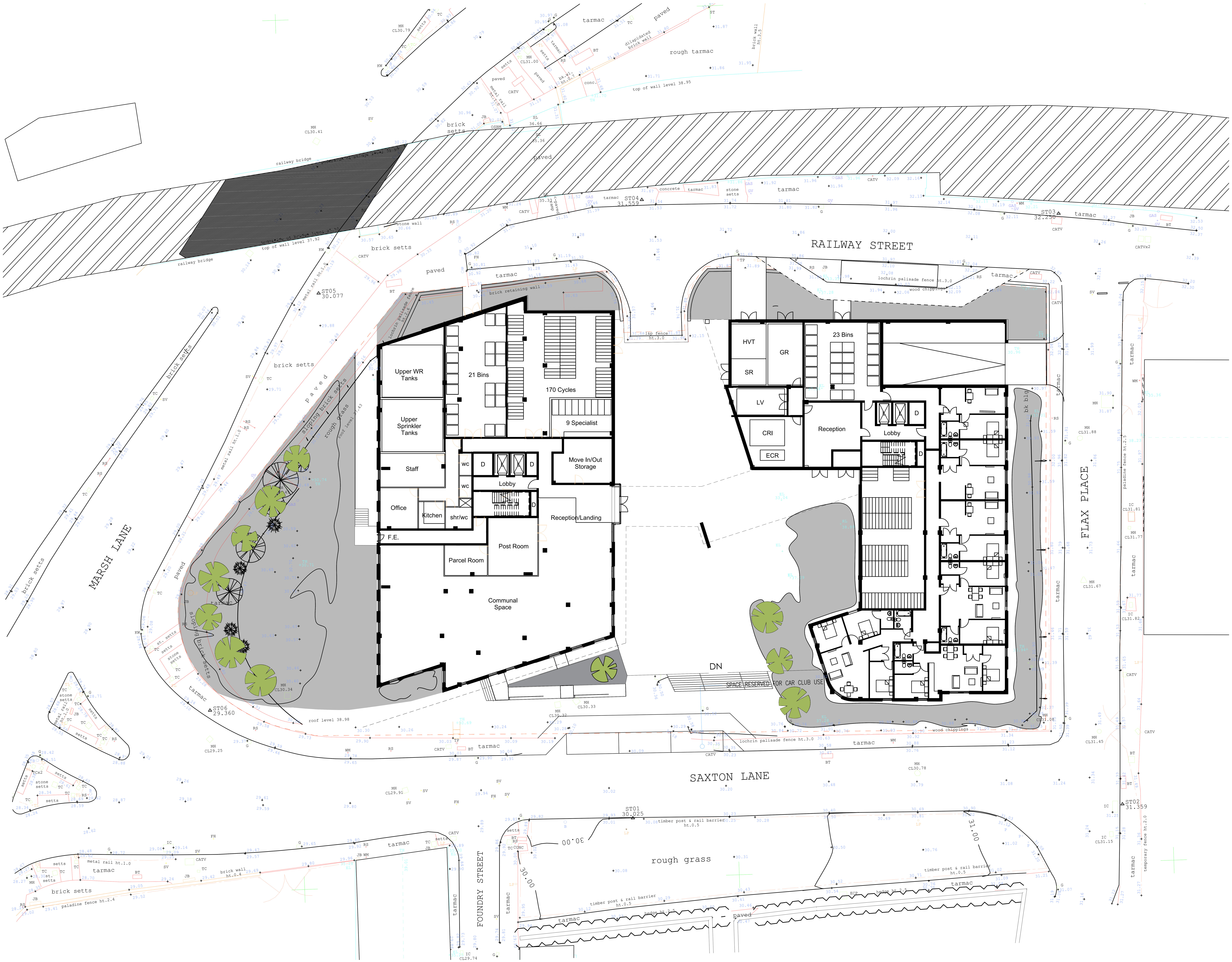
Project:
Proposed Development, Saxton Lane, Leeds

Client:
Court Collaborations

Title:
Proposed Basement Car Park

Date:	Scale:	Size:	Drawn:	Checked:
Jul 18	1:200	A1	SA	LD

Project No:	Dwg No:	Rev:	Status:
2960	SK212	A	Preliminary



File

Northpoint:

Rev	Date	Amendment	By	Chk
-	-	-	-	-

Notes:

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Project:
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Client:
Court Collaborations

Title:
Proposed Ground Floor Plan Option 4

Date:	Scale:	Size:	Drawn:	Checked:
Aug 18	1:200	A1	SA	LD

Project No:	Dwg No:	Rev:	Status:
2960	SK213		Preliminary

APPENDIX B

SOIL CHEMICAL RESULTS COMPARED AGAINST SCREENING VALUES FOR HUMAN HEALTH

Site: Saxton Lane, Leeds
Job No: AG2906A-19

Land Use: Public Open Space (Residential)
Dataset: All results
Soil Organic Matter (%) 2.5 %

Exploratory Hole Reference Depth (m) Strata	Units		DCS1 0.25 MG	DCS1 0.85 MG	DCS2 0.85 MG	DCS3 0.50 MG	DCS3A 0.70 MG	DCS4 0.30 MG	DCS5 0.50 MG	BH2 0.30 MG	BH1 0.70 MG	BH4 1.40 N	No. of samples (n)	Public Open Space (Residential)	Source/Justification
Organic Matter (%)	%	%	2.8	7.1	7	3.5	3.1	4.6	5.5	5.5	2	0.3	10		
pH			8.6	8	7.9	9.9	8.9	10.2	8.2	9.9	9.8	8.1	10		
Arsenic		mg/kg	14	36	24	9.5	11	1	22	1.9	20	3.8	10	79	LQM/CIEH S4UL (2015)
Cadmium		mg/kg	**0.2**	**0.2**	**0.2**	0.3	**0.2**	0.5	**0.2**	**1.7**	**0.2**	**0.2**	10	120	LQM/CIEH S4UL (2015)
Chromium		mg/kg	27	22	19	14	15	51	13	8	29	21	10		LQM/CIEH S4UL (2015)
Chromium (Hexavalent)		mg/kg	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	10		LQM/CIEH S4UL (2015)
Copper		mg/kg	63	140	100	42	47	18	70	15	53	27	10	12000	LQM/CIEH S4UL (2015)
Lead		mg/kg	110	200	78	50	84	14	220	15	120	15	10	630	C4SL (2014)
Mercury		mg/kg	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	0.5	**0.3**	**0.3**	**0.3**	10	120	LQM/CIEH S4UL (2015)
Nickel		mg/kg	18	39	26	13	16	5.5	21	4.4	16	23	10	230	LQM/CIEH S4UL (2015)
Selenium		mg/kg	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	10	1100	LQM/CIEH S4UL (2015)
Zinc		mg/kg	80	78	61	130	51	42	35	110	120	53	10	81000	LQM/CIEH S4UL (2015)
													0		
Naphthalene		mg/kg	2.5	1.5	**0.05**	0.93	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	10	4900	LQM/CIEH S4UL (2015)
Acenaphthylene		mg/kg	0.66	0.72	**0.05**	0.2	**0.05**	0.2	**0.05**	**0.05**	0.19	**0.05**	10	15000	LQM/CIEH S4UL (2015)
Acenaphthene		mg/kg	2.7	1.2	0.32	2.7	**0.05**	0.83	**0.05**	0.57	0.63	**0.05**	10	15000	LQM/CIEH S4UL (2015)
Fluorene		mg/kg	2.9	1.5	0.31	2	**0.05**	0.56	**0.05**	0.66	0.57	**0.05**	10	9900	LQM/CIEH S4UL (2015)
Phenanthrene		mg/kg	21	12	2.7	13	0.45	6.2	0.56	3.7	5.5	0.31	10	3100	LQM/CIEH S4UL (2015)
Anthracene		mg/kg	5.9	2.6	0.64	2.8	0.11	2.1	**0.05**	0.9	1.1	**0.05**	10	74000	LQM/CIEH S4UL (2015)
Fluoranthene		mg/kg	21	15	2.8	14	1.2	13	0.29	4.7	5.7	0.2	10	3100	LQM/CIEH S4UL (2015)
Pyrene		mg/kg	19	14	2.4	13	1.2	13	0.29	4.3	4.8	0.14	10	7400	LQM/CIEH S4UL (2015)
Benzo[a]anthracene		mg/kg	13	8.2	1.5	8.6	0.99	8.4	0.21	2.9	3	**0.05**	10	*	Genotoxic PAH see Benzo(a)pyrene
Chrysene		mg/kg	12	7.7	1.3	7.8	0.82	6.8	0.3	2.3	3	**0.05**	10	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[b]fluoranthene		mg/kg	13	8.3	1.4	8.6	1.3	10	0.31	3	3.8	**0.05**	10	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[k]fluoranthene		mg/kg	6.1	3.3	0.61	4	0.58	6	0.14	1.7	1.3	**0.05**	10	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[a]pyrene		mg/kg	11	7.1	1.1	8	1.1	10	0.25	2.9	3	**0.05**	10	10	C4SL (2014)
Dibenzo[a,h]anthracene		mg/kg	1.5	1	**0.05**	0.98	0.16	1.4	**0.05**	0.38	1.4	**0.05**	10	*	Genotoxic PAH see Benzo(a)pyrene
Indeno[1,2,3-cd]pyrene		mg/kg	4.5	2.7	0.47	3	0.53	4.7	**0.05**	1.3	0.49	**0.05**	10	*	Genotoxic PAH see Benzo(a)pyrene
Benzo[g,h,i]perylene		mg/kg	5.6	3.4	0.58	3.7	0.61	6.4	**0.05**	1.7	1.7	**0.05**	10	*	Genotoxic PAH see Benzo(a)pyrene
Total of 16 PAHs		mg/kg									36.3				
Phenols (Total)		mg/kg	143	90.8	**16.1**	93.4	**8.96**	**88.8**	2.35	**31**	1	**0.8**	10	690	LQM/CIEH S4UL (2015)
Benzene		mg/kg	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	10	72	LQM/CIEH S4UL (2015)
Toluene		mg/kg	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	10	56000	LQM/CIEH S4UL (2015)
Ethylbenzene		mg/kg	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	10	24000	LQM/CIEH S4UL (2015)
m&p Xylene		mg/kg	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	10	42000	LQM/CIEH S4UL (2015)
o-Xylene		mg/kg	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	10	42000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C5-C6		mg/kg	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	10	590000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C6-C8		mg/kg	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	10	610000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C8-C10		mg/kg	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	10	13000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C10-C12		mg/kg	**1**	**1**	**1**	**1**	**1**	**1**	**1**	49	1.5	**1**	10	13000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C12-C16		mg/kg	7.4	**2**	**2**	5.7	**2**	**2**	**2**	140	4.8	**2**	10	13000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C16-C21		mg/kg	20	**8**	**8**	13	**8**	15	**8**	230	**8**	**8**		-	-
Aliphatic TPH >C21-C35		mg/kg	150	40	**8**	130	**8**	840	**8**	1200	27	**8**	10	250000	LQM/CIEH S4UL (2015)
Aliphatic TPH >C35-C44		mg/kg	220	19	**8.4**	230	**8.4**	700	**8.4**	850	**8.4**	**8.4**	10	250000	LQM/CIEH S4UL (2015)
Total Aliphatic Hydrocarbons		mg/kg	400	62	**10**	380	**10**	1600	**10**	2500	41	**10**	10		
Aromatic TPH >C5-C7		mg/kg	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**		56000	LQM/CIEH S4UL (2015)
Aromatic TPH >C7-C8		mg/kg	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	10	56000	LQM/CIEH S4UL (2015)
Aromatic TPH >C8-C10		mg/kg	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	10	5000	LQM/CIEH S4UL (2015)
Aromatic TPH >C10-C12		mg/kg	4.7	5.2	1.3	1.8	**1**	**1**	**1**	7.8	**1**	**1**	10	5000	LQM/CIEH S4UL (2015)
Aromatic TPH >C12-C16		mg/kg	40	21	**10**	37	**2**	16	**2**	85	8.6	**2**	10	5100	LQM/CIEH S4UL (2015)
Aromatic TPH >C16-C21		mg/kg	170	100	25	130	**10**	180	**10**	270	44	**10**	10	3800	LQM/CIEH S4UL (2015)
Aromatic TPH >C21-C35		mg/kg	390	230	69	320	**10**	1800	**10**	2000	92	**10**	10	3800	LQM/CIEH S4UL (2015)
Aromatic TPH >C35-C44		mg/kg	310	37	150	470	**8.4**	2600	**8.4**	3000	14	**8.4**	10	3800	LQM/CIEH S4UL (2015)
Total Aromatic Hydrocarbons		mg/kg	910	400	250	950	**10**	4600	**10**	5300	160	**10**	10		
Total Petroleum Hydrocarbons		mg/kg	1300	460	250	1300	**10**	6100	**10**	7800	200	**10**	10		
Asbestos in Soil	Type	Type	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected	10		

Key -
Value within sample set exceeds screening value
Statistical value exceeds screening value

LQM/CIEH S4UL Reference No. S4UL3159 (2015)
Values in **bold** are reported at the laboratory limit of detection
Benzo(a)pyrene has been used as a 'surrogate marker for genotoxic PAH' as discussed in Appendix E of CL:AIRE SP1010 'Development of C4SL for Assessment of Land Affected by Contamination', December 2013.
This allows assessment of the combined carcinogenic risk associated with genotoxic PAH using only b(a)p. Genotoxic PAHs include Benz(a)pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(ah)anthracene, Indeno(123cd)pyrene, Benzo(ghi)perylene and have been markec

Saxton Lane, Leeds
AG2906A-19

Public Open Space (Residential)
Calculation of a $UCL_{0.95}$ for non normal data

False error check

Exploratory Hole Reference / Depth (m)		DCS1 0.25	DCS1 0.85	DCS2 0.85	DCS3 0.5	DCS3A 0.7	DCS4 0.3	DCS5 0.5	BH2 0.3	BH1 0.7	BH4 1.4	No. of samples (n)	Degrees of freedom	Confidence required	$k_{0.05}$	Arithmetic mean (x)*	Standard deviation (s)	Screening Value	Source	Upper Confidence Limit ($UCL_{0.95}$)	Test Statistic for Chebychev Theorem K_0	k critical value (=-$k_{0.05}$)	Is k_0 < k crit	k_1	α_1	Level of evidence against the Null Hypothesis p1	Is p1>95%
Detname	**Units**																										
Benzo[a]pyrene	mg/kg	11	7.1	1.1	8	1.1	10	0.25	2.9	3	0.05	10	9	95	4.360	4.45	4.18	10.00	Made Ground	10.2	-4.198	-4.360	H0 accepted	1.02	0.51	0.490	accept H0 as low degree of confidence

Key - Mean Value Test

$UCL_{0.95}$ exceeds screening value

individual exceedence compared to screening value

*geomean for lead

Imported Topsoil/Subsoil Acceptance Criteria

Site: **Saxton Lane, Leeds**
Job No: **AG2906A-19**

Exploratory Hole Reference Depth (m) Strata	Units	Soil Screening Value (6% SOM)	Soil Screening Value (2.5% SOM)	Soil Screening Value (1% SOM)	Source/Justification
Arsenic	mg/kg	37	37	37	LQM/CIEH S4UL (2015)
Beryllium	mg/kg	1.7	1.7	1.7	LQM/CIEH S4UL (2015)
Boron	mg/kg	290	290	290	LQM/CIEH S4UL (2015)
Cadmium	mg/kg	11	11	11	LQM/CIEH S4UL (2015)
Chromium	mg/kg	910	910	910	LQM/CIEH S4UL (2015)
Chromium (Hexavalent)	mg/kg	6	6	6	LQM/CIEH S4UL (2015)
Copper	mg/kg	2400	2400	2400	LQM/CIEH S4UL (2015)
Lead	mg/kg	200	200	200	C4SL (2014)
Mercury	mg/kg	40	40	40	LQM/CIEH S4UL (2015)
Nickel	mg/kg	130	130	130	LQM/CIEH S4UL (2015)
Selenium	mg/kg	250	250	250	LQM/CIEH S4UL (2015)
Vanadium	mg/kg	410	410	410	LQM/CIEH S4UL (2015)
Zinc	mg/kg	3700	3700	3700	LQM/CIEH S4UL (2015)
Naphthalene	mg/kg	13	6	2	LQM/CIEH S4UL (2015)
Acenaphthylene	mg/kg	*	510	210	LQM/CIEH S4UL (2015)
Acenaphthene	mg/kg	920	420	170	LQM/CIEH S4UL (2015)
Fluorene	mg/kg	860	400	170	LQM/CIEH S4UL (2015)
Phenanthrene	mg/kg	440	220	95	LQM/CIEH S4UL (2015)
Anthracene	mg/kg	*	*	*	-
Fluoranthene	mg/kg	890	560	280	LQM/CIEH S4UL (2015)
Pyrene	mg/kg	*	*	620	LQM/CIEH S4UL (2015)
Benzo[a]anthracene	mg/kg	13	11	7	LQM/CIEH S4UL (2015)
Chrysene	mg/kg	27	22	15	LQM/CIEH S4UL (2015)
Benzo[b]fluoranthene	mg/kg	3.7	3.3	2.6	LQM/CIEH S4UL (2015)
Benzo[k]fluoranthene	mg/kg	100	93	77	LQM/CIEH S4UL (2015)
Benzo[a]pyrene	mg/kg	3.0	2.7	2.2	LQM/CIEH S4UL (2015)
Dibenzo[a,h]anthracene	mg/kg	0.30	0.28	0.24	LQM/CIEH S4UL (2015)
Indeno[1,2,3-cd]pyrene	mg/kg	41	36	27	LQM/CIEH S4UL (2015)
Benzo[g,h,i]perylene	mg/kg	350	340	320	LQM/CIEH S4UL (2015)
Total PAH	mg/kg	1000	1000	1000	-
Phenol	mg/kg	380	200	120	LQM/CIEH S4UL (2015)
Benzene	mg/kg	0.37	0.17	0.087	LQM/CIEH S4UL (2015)
Toluene	mg/kg	660	290	130	LQM/CIEH S4UL (2015)
Ethylbenzene	mg/kg	260	110	47	LQM/CIEH S4UL (2015)
m&p Xylene	mg/kg	310	130	56	LQM/CIEH S4UL (2015)
o-Xylene	mg/kg	330	140	60	LQM/CIEH S4UL (2015)
Aliphatic TPH >C5-C6	mg/kg	160	78	42	LQM/CIEH S4UL (2015)
Aliphatic TPH >C6-C8	mg/kg	530	230	100	LQM/CIEH S4UL (2015)
Aliphatic TPH >C8-C10	mg/kg	150	65	27	LQM/CIEH S4UL (2015)
Aliphatic TPH >C10-C12	mg/kg	760	330	130	LQM/CIEH S4UL (2015)
Aliphatic TPH >C12-C16	mg/kg	*	*	*	-
Aliphatic TPH >C16-C21	mg/kg	*	*	*	-
Aliphatic TPH >C21-C35	mg/kg	*	*	*	-
Aliphatic TPH >C35-C44	mg/kg	*	*	*	-
Aromatic TPH >C5-C7	mg/kg	300	140	70	LQM/CIEH S4UL (2015)
Aromatic TPH >C7-C8	mg/kg	660	290	130	LQM/CIEH S4UL (2015)
Aromatic TPH >C8-C10	mg/kg	190	83	34	LQM/CIEH S4UL (2015)
Aromatic TPH >C10-C12	mg/kg	380	180	74	LQM/CIEH S4UL (2015)
Aromatic TPH >C12-C16	mg/kg	660	330	140	LQM/CIEH S4UL (2015)
Aromatic TPH >C16-C21	mg/kg	930	540	260	LQM/CIEH S4UL (2015)
Aromatic TPH >C21-C35	mg/kg	*	*	*	-
Aromatic TPH >C35-C44	mg/kg	*	*	*	-
Total Petroleum Hydrocarbons	mg/kg	1000	1000	1000	-
Asbestos		Absent	Absent	Absent	-
VOCs (other than BTEX)	µg/kg	Below Detection Limit of Test			Any values above detection to be assessed in more detail to determine suitability for end use. Ideally VOCs to be below detection.

Testing should be based on the donor site and its historical use.
* Individual PAH compounds and TPH fractions have S4UL's in excess of 1000mg/kg, therefore no specific limits are proposed as overall limits of 1000mg/kg TPH and 1000mg/kg PAH are to be adhered to.
LQM/CIEH S4UL Reference No. S4UL3159 (2015)