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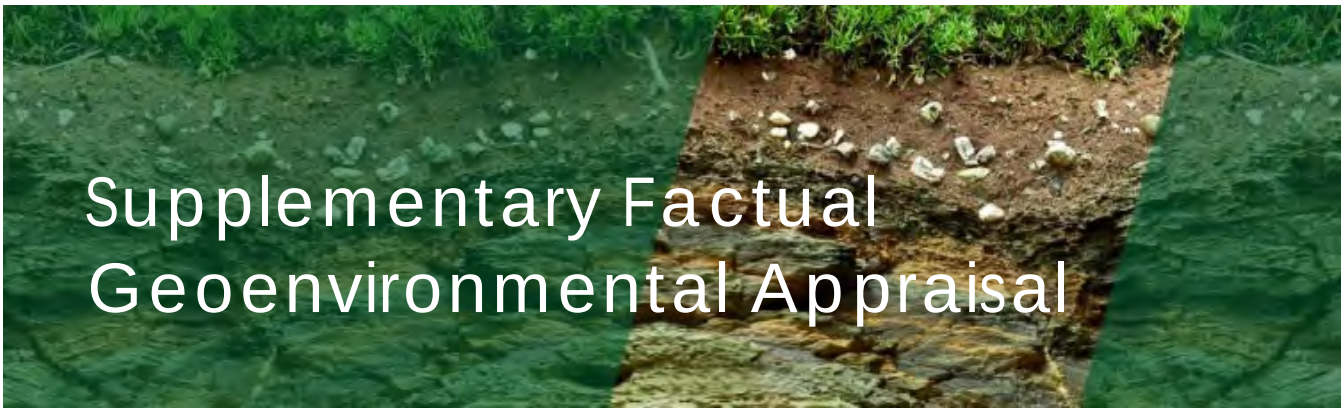

Supplementary Factual Geoenvironmental Appraisal

Land at Turnpike Close, Grantham

For South Kesteven District Council

Report no: 3546/3

Date: June 2024

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FOREWORD (GEOENVIRONMENTAL APPRAISAL REPORT)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Lithos Consulting Limited (Lithos); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

This report has been reviewed by a Competent Person, as defined in the National Planning Policy Framework. We ensure that all projects are managed by individuals with necessary experience, relevant qualifications, and current membership of a relevant professional organisation. Records of engineers, project managers and reviewers involved in this project are maintained by us. Lithos QA/QC procedures for all our work forms an integral part of our ISO9001 accreditation and as such is regularly audited.

The report presents observations and factual data obtained during our site investigation and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Lithos prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Lithos cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context. However, it should be noted that in order to keep the number of pages to a minimum, some information (e.g. full copy of the Landmark/Groundsure Report) is not included in the PDF; by request it can be provided.

The findings and opinions conveyed in this report (including review of any third-party reports) are based on information obtained from a variety of sources as detailed within this report, and which Lithos believes are reliable. Reasonable care and skill has been applied in examining the information obtained. Nevertheless, Lithos cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Lithos, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy.

It should be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

Lithos cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

The report represents the findings and opinions of experienced geoenvironmental consultants. Lithos does not provide legal advice and the advice of lawyers may also be required.

Lithos standard terms and conditions apply to the report, a copy of the terms and conditions can be found with our proposal in Appendix C.

SUPPLEMENTARY FACTUAL GEOENVIRONMENTAL APPRAISAL of land at TURNPIKE CLOSE, GRANTHAM

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by South Kesteven District Council to carry out supplementary trial pitting, rotary drilling, sampling and testing of soils and groundwater at land off Turnpike Close, Grantham.

1.1.2 Lithos have previously issued the following reports for the site:

- Geoenvironmental Appraisal: Land at Turnpike Close, Grantham. Report No. 3546/2, dated April 2021
- Groundwater sampling and testing, Lithos letter 050/3546/REG/jr, dated 17th May 2024.
- Remediation Strategy Report for Land at Turnpike Close, Grantham. Report No. 3546/4, dated May 2024

1.1.3 This document has been produced in addition to the above reports, which should be read in conjunction with this report.

1.1.4 Correspondence regarding Lithos' appointment, including the brief for this investigation, is included in Appendix C. The agreed scope of works included:

- A site walkover and inspection
- Confirmation of the removal of significant obstructions (relict foundations, redundant services etc)
- Confirmation of the absence of any residual contamination (hydrocarbons) within the made ground and underlying natural soils
- Sampling and chemical testing of stockpiled materials (arisings generated from the grubbing up and crushing of hardstand etc)

1.1.5 Primary aims of this supplementary phase of investigation were to confirm the efficacy of the recent site remediation and preparatory works to allow production and issue of a verification report for submission for planning.

1.1.6 The report primarily considers the findings of the recent trial pitting, results of the additional chemical laboratory testing and removal of buried obstructions (relict foundations etc).

1.1.7 Background details on the site history, environmental setting etc are provided in Report 3546/2 and as such are not considered further in this report which considered the factual data resulting from the supplementary intrusive works.

1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with a Council Depot comprising stores, HGV parking, carparking, washing and refuelling areas. At this stage no immediate development is proposed in the far northeast of the site which is shown as potential future office development with additional car parking (c. 760m^2).

1.2.2 A site layout has been provided by SKDC (Drawing reference 8765-NDA-ST-XX-DR-A-1001 Rev P18, dated August 2023) which is reproduced as Drawing 3546/102 in Appendix B to this report.

1.2.3 Access to the development will be from Turnpike Close.

1.2.4 The Local Planning Authority has agreed planning permission (S23/1959) for redevelopment of this site. There are several Conditions associated with remediation, most notably:

- Condition 5 (Part b) - A site investigation report assessing the ground conditions of the site and incorporating chemical and gas analysis identified as appropriate by the desk top study;
- Condition 14 - The development hereby permitted shall not be occupied or brought into use until a verification report has been submitted to and approved in writing by the Local Planning Authority.

1.2.5 This report has been prepared in addition to Lithos Report 3546/2 to assist in the discharge of Condition 5 (Part b) and Condition 14.

1.3 Report format and limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on:

- Assessment of the site's environmental setting
- Ground investigation fieldwork
- Contamination testing

1.3.2 General notes and limitations relevant to all Lithos geoenvironmental investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 3546/101 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	2 km southwest of Grantham town centre
NGR	SK 897 345
Area	3.4 ha (8.4 acres)
Known live services	Storm water drains (Anglian Water) along western boundary Foul sewer (Anglian Water) along western boundary 11 kV cable (Western Power Distribution) crosses eastern corner Drinking water supply to site in the northeastern corner Gas supply (in eastern boundary)

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 26th February 2024 after completion of grubbing up of hardstand and remedial works.

2.2.2 Existing salient features, at the time of the walkover are presented on Drawing 3546/103a in Appendix B to this report and summarised in the table below.

Feature	Remarks
Current Access	Off Turnpike Close.
Topography	Relatively flat with embankment and retaining wall along the northern boundary. Land in the northeast is c. 2.5m higher than the remaining site area.
Approximate areas	17,523m² sub-base, crushed demolition arisings 3,655 m² tarmac / concrete hardstand. 6,600 m² vegetation. 6,222 m² stockpiles (crushed arisings, demolition rubble)
Nature of boundaries	North – palisade / chain link fencing with a c. 35m long section of retaining wall (c. 2m high). South – palisade / chain link fencing. West – palisade fencing. East – chain link fencing and site access.
Surrounding land uses	North – Houses with industrial park beyond. South – Small industrial park and Mow Beck, Turnpike Close adjacent to boundary. East – Industrial and retail parks and associated car parking. West – Drainage ditch with A1 and open fields beyond.

2.2.3 At the time of the walkover, remediation works had been completed with the majority of concrete and tarmac hardstand grubbed up, crushed and placed in separate stockpiles in the centre-east of the site.

2.2.4 A third stockpile comprising a mix of concrete, tarmac, brick and rare plastic (mixed arisings) was also noted.

2.2.5 The majority of the site had been surfaced with granular sub-base or crushed demolition arisings.

2.2.6 Two access chambers remained in the far southwest of the site, in an area of a former catch pit. Tarmac hardstand remined in the south and southeast, formerly car parking areas.

3 PREVIOUS INVESTIGATION FINDINGS

3.1 General

3.1.1 Lithos have previously issued the following reports for the site:

- Geoenvironmental Appraisal: Land at Turnpike Close, Grantham. Report No. 3546/2, dated April 2021
- Groundwater sampling and testing, Lithos letter report 050/3546/REG/jr, dated 17th May 2024.

3.1.2 The Geoenvironmental Appraisal report included a review of the site's history and environmental setting, and a ground investigation comprising 55 trial pits (with soakaway testing in 5 pits) and 9 rotary openhole Probeholes.

3.1.3 Chemical and geotechnical testing of soils and groundwater recovered from the site were submitted to UKAS accredited laboratories to allow classification of the materials.

3.1.4 Chemical testing suggested that the existing Topsoil is chemically suitable for re-use.

3.1.5 No significant inorganic or organic contamination was encountered, although, based on past use of the site, the report concluded that localised areas of hydrocarbon contamination may be encountered.

3.1.6 Two main foundation solutions were considered likely to be the most appropriate for the proposed development:

- Strip/trench-fill for the offices (northeast) and DWO workshop (southeast)
- Pad footings for the depot building (centre)

3.1.7 The results of the groundwater monitoring and testing concluded that risks to the underlying Secondary A Aquifer and nearby surface watercourses from residual contamination within the soils/groundwater are not considered significant.

4 PRELIMINARY CONCEPTUAL SITE MODEL

4.1 Based on the findings of the Geoenvironmental Appraisal (Report 3546/2), potential contaminants associated with the former uses include:

- Inorganics (metals associated with made ground)
- Asbestos &/or ACMs within the made ground associated with from the former buildings etc
- TPH & PAH (fuels, oils associated with machinery use and maintenance, heating oils / diesel tanks)

4.2 It should be noted that no significant concentrations of contaminants were identified during the initial intrusive investigation works in 2021.

5 GROUND INVESTIGATION DESIGN

5.1 Anticipated ground conditions & potential issues

5.1.1 Based on the data reviewed in Lithos Report 3546/2, dated April 2021, anticipated ground conditions are expected to comprise:

Anticipated condition	Remarks
Made ground	Made ground between 0.2m and 2.7m thick.
Natural soils	Cohesive and Granular Residual Soils from the complete weathering of bedrock.
Bedrock	Shallow (from around 1.1m depth) Marlstone Rock Formation (Limestone) underlain by Dyrham Formation (Siltstone)
Groundwater	It is likely that shallow groundwater may be encountered across the site.

5.1.2 Based on the review of site record sheets for the remediation works undertaken, no significant obstructions are anticipated in the made ground.

5.2 Ground investigation design & strategy

5.2.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

Exploratory holes	Purpose
TPs 101 to 111	To confirm the efficacy of the recent remedial works (turnover etc), with confirmation of: • The removal of undesirable elements e.g. biodegradable matter, relict foundations etc • The absence of any residual organic (hydrocarbon) contamination
BHs 101 to 105	To install monitoring wells across the site in order to retrieve representative groundwater samples, to determine water quality

5.2.2 Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

5.2.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about 3 samples will be taken from most trial pits.

5.2.4 Samples were also recovered from each of the stockpiles on site to allow laboratory testing to determine the materials suitability for re-use on site.

6 FIELDWORK

6.1 Objectives

6.1.1 The original investigation strategy is outlined in Section 5.2 above.

6.2 Scope of works

6.2.1 On completion of the site preparatory works, supplementary fieldwork was supervised by Lithos on 26th February 2024 and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Rotary open-hole probeholes	BHs 101 to 105	6m	Monitoring wells installed in each hole
Trial pitting (machine dug)	TPs 101 to 111	1.3m to 2.4m	Trial pits taken through made ground into underlying natural strata
Trial pitting (machine dug)	Stockpile 1 (samples 1 to 5) Stockpile 2 (samples 1 to 6) Stockpile 3 (samples 1 to 6)	0.5m	To recover samples for laboratory testing from each of the 3 stockpiles at the site

6.2.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix A to this report.

6.2.3 Exploratory hole logs (trial pits) are presented in Appendix D to this Report. These logs include details of the:

- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of the in-situ testing

6.2.4 Monitoring well locations and post remediation trial pit locations are shown on Drawings 3546/104 & 3546/106 respectively, presented in Appendix B; hole positions have been picked-up by a surveyor and co-ordinates/ground levels are included on the logs.

6.2.5 Drawing 3456/106 shows all of the exploratory holes excavated across the site by Lithos, pre and post site turnover.

6.2.6 Full details of the ground conditions encountered and monitoring well installations in the rotary openhole probeholes (BHs 101 to 105) are presented in Lithos letter ref 050/3546/REG/jr, dated 17th May 2024.

7 GROUND CONDITIONS

7.1 General

7.1.1 A complete record of strata encountered beneath the proposed development site is given on the trial pit logs, presented in Appendix D.

7.1.2 Typical ground conditions encountered at the site in the trial pits (TPs 101 to 111) are described below in Sections 7.2 (made ground) and 7.4 (natural ground), with a summary provided in the table on page 7.

7.2 Made ground *(post site re-grade)*

7.2.1 Made Ground was encountered in all 11 trial pits to a maximum 1.7m depth (TP105), typically to <0.9m, comprising:

- **Granular Made Ground**: slightly clayey, slightly sandy Gravel of limestone and concrete with rare brick, metal, timber, and plastic. Recorded in the majority of the trial pits.
- **Sub-base**: yellowish brown, slightly sandy subangular medium to coarse Gravel of limestone. Recorded in 3 of the trial pits
- **Cohesive Made Ground**: light brown, gravelly Clay. Recorded in two of the trial pits.

7.3 Obstructions *(post site re-grade)*

7.3.1 It is apparent from a review of historical OS Plans and the 2021 site visit that buildings have been present on about 35% of the site area. Furthermore, concrete and tarmac hardstand, typically 300mm and 100mm thick respectively, covered an area of approximately 10,700m^2.

7.3.2 Drawing 3546/103a shows the footprints of the former structures, and areas of hardstand.

7.3.3 All buildings have now been demolished with the majority of hardstand grubbed up, crushed and stockpiled. It is understood that turnover of the full thickness of made ground was undertaken after grubbing up to remove all former relict foundations, utility runs etc.

7.3.4 No significant in-situ obstructions were encountered in any of the 11 recently excavated trial pits suggesting that former foundations etc were removed during turnover.

7.3.5 However, boulders of concrete (up to 0.5m diameter) were recorded in the made ground in TP105 with a large diameter ceramic drainage pipe recorded in TP110 at 1.0m depth.

7.4 Natural ground

7.4.1 All of the exploratory holes were taken through the made ground into underlying natural soils which typically comprised:

- **Cohesive Residual Soil:** firm to stiff sandy/gravelly Clay
- **Marlstone Rock Formation**: typically strong Limestone (locally sandstone) encountered in TP103 at 1.7m depth and TP111 at 1.5m depth.

7.4.2 Bedrock was encountered in all of the rotary boreholes, between 1.0m and 2.5m depth

Summary of Ground Conditions (Trial Pits)

Hole	Final depth (m)	Depth to Base of Made Ground (m)	Depth to Base of (m)						Depth to bedrock (m)	Remarks
			Made Ground			Natural Soils				
			Sub-base	Granular Made Ground	Cohesive Made Ground	Topsoil	Cohesive Residual Soil	Granular Residual Soil		
TP101	1.6	0.1	0.1	-	-	-	>1.6	-	-	-
TP102	1.8	1.1	-	1.1	-	-	>1.8	-	-	Low cobble content of Limestone.
TP103	1.8	0.4	0.4	-	-	-	1.7	-	1.7	-
TP104	1.8	0.8	0.8	0.4	-	-	>1.8	-	-	-
TP105	2.4	1.7	-	1.7	-	-	>2.4	-	-	Difficult to excavate below 0.5m due to boulders of concrete (0.2m to 0.5m diameter). Groundwater at 2.3m
TP106	1.6	0.6	-	0.6	-	-	>1.6	-	-	Cobble-sized fragments of metal and plastic.
TP107	1.4	0.5	-	0.5	-	-	>1.4	-	-	Cobbles of reinforced concrete.
TP108	1.8	0.6	-	0.6	-	-	>1.8	-	-	Groundwater at 1.8m
TP109	1.5	0.3	-	-	0.3	-	>1.5	-	-	-
TP110	1.3	0.9	-	1.3	-	-	>1.5	-	-	Pea Gravel from 0.9m with ceramic drainage pipe. Sidewalls unstable during excavation.
TP111	1.6	1.2	-	-	1.2	-	1.5	-	1.5	-

7.5 Stockpile sampling (post site re-grade)

7.5.1 Grubbing up of hardstand and turnover of made ground have resulted in the generation of 3 separate stockpiles located in the centre-east (Stockpiles 1 to 3).

7.5.2 The locations of the stockpiles are shown on Drawing 3546/103a in Appendix B. Each stockpile has been surveyed in with approximate volumes of each material type shown in the table below:

Stockpile reference	Material description	Approximate Volume #
Stockpile 1	Grey and brown sandy, gravelly angular to subangular COBBLES of tarmac and concrete with rare metal re-bar.	396m^3
Stockpile 2	Grey sandy, gravelly angular to subangular COBBLES of concrete, tarmac and brick with rare plastic, scrap metal and re-bar. Rare boulders (up to 300mm diameter) of concrete.	731m^3
Stockpile 3	Light grey slightly sandy, gravelly angular to subangular COBBLES of concrete.	5,095m^3

Notes: # Stockpiles have been surveyed in.

7.6 Visual & olfactory evidence of organic contamination

7.6.1 Exploratory locations where visual or olfactory evidence of organic contamination was noted are summarised below:

Site area	Hole	Material	Depth (m)	Observation
Northwest	TP103	Cohesive Residual Soil	0.35m to 0.4m	Green staining with slight organic odour in east wall. Spot sample taken.
Southwest	TP108	Granular Made Ground	0.5m	Dark brown pockets of clay in the north wall. Spot sample taken.

7.6.2 Selected samples of made ground, including those with evidence of organic contamination, together with samples recovered from each of the stockpiles, were scheduled for chemical testing to confirm the absence of any significant contamination.

7.7 Groundwater

7.7.1 No significant inflows of groundwater were encountered during the investigation, with perched water recorded at 1.8m and 2.3m depth in two of the trial pits. All of the remaining trial pits were dry during excavation.

7.7.2 Full details of the groundwater levels recorded in the monitoring wells are presented in Lithos letter ref 050/3546/REG/jr, dated 17th May 2024.

7.8 Stability

7.8.1 Some spalling of the sides and collapse occurred in the made ground in 3 of the trial pits during excavation.

8 CONTAMINATION (ANALYSIS)

8.1 General

8.1.1 The site was formerly used as an industrial food production facility between 1987 and 2010. A former quarry is shown on historical OS maps between 1889 and c. 1930 although no evidence of this was encountered during the intrusive investigation.

8.1.2 Potential contaminants associated with the former use include:

- Hydrocarbons (predominantly diesel and hydraulic oils)
- Ammonia used in cooling system (propylene glycol is nontoxic if consumed or to the environment)
- Disinfectants (stored in bulk)
- Detergents (stored in bulk)
- Aluminium sulphate and sulphuric acid
- Asbestos

8.1.3 The site's former usage is likely to have given rise to some ground contamination although this is likely to be minor given the good state of repair (and age) of the factory prior to demolition. Furthermore, no significant concentrations of contaminants were identified during the 2021 intrusive ground investigation.

8.1.4 In the context of risks to human health associated with commercial/industrial redevelopment, the Tier 1 Soil Screening Values referenced in this report have been derived via the CLEA default conceptual site model (CSM) used for generating SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process.

8.1.5 Where available, Category 4 Screening Levels (C4SL) have also been referenced.

8.1.6 Generic Note 04 in Appendix A provides further details with respect to current guidance and the interpretation of analytical data.

8.2 Testing scheduled

8.2.1 Based on the above assessment and the remedial works undertaken, Lithos submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory.

Type of sample	No. of samples	Determinands
Made ground	9	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID
	8	TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Banded Total Petroleum Hydrocarbons (TPH)
Natural soil	1	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID
	4	TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Banded Total Petroleum Hydrocarbons (TPH)
Groundwater	10	pH and metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc), ammoniacal nitrogen, sulphide, sulphate, BTEX by GC-MS, Speciated TPH and Speciated PAH
Stockpiles	12	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc)
	12	Asbestos ID, TOC,
	17	Speciated Polycyclic Aromatic Hydrocarbons (PAH)

8.3 Soil contamination results

8.3.1 The soil contamination test results are summarised in the tables on pages 11 to 16.

8.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix E to this report.

8.3.3 Full details of the results of groundwater testing are presented in Lithos letter ref. 050/3546/REG/jr, dated 17th May 2024.

Inorganic determinands

8.3.4 Of the 27 samples analysed for inorganic parameters, 21 can be classified as uncontaminated and 6 could be classified as contaminated.

8.3.5 These samples have been classified by comparison with Tier 1 Soil Screening Values for an end use including domestic gardens and any area where plants are to be grown (the most sensitive of proposed end-uses).

8.3.6 The most common contaminant is zinc (up to 540mg/kg) in the materials recovered from Stockpile 2, with one sample from Stockpile 2 also recording an elevated concentration of copper (270mg/kg).

8.3.7 However, zinc is a phytotoxic metal; phytotoxicity describes the inhibitive and toxic effect high concentrations of some substances can have on plant growth.

8.3.8 Most substances are harmful to human health at lower concentrations than would be detrimental to plant growth. However, there are three notable exceptions - boron, copper and zinc. Plants are the more sensitive receptor to these elements i.e. detrimental effects are seen in plants at concentrations which do not present a risk to human health. Consequently, for zinc, consideration and protection of flora would also be protective of human health.

8.3.9 Allowable concentrations of heavy metals in arable soils are set out in Defra's Code of Good Agricultural Practice 2009. The value for zinc is 200mg/kg, and is based on a continued annual application of heavy metal rich fertiliser (sludge); as such it is not representative of activity in a standard UK area of landscaping.

8.3.10 Lithos have also derived a value for zinc in relation to risks to human health, using the CLEA model, assuming a residential end use with consumption of home grown produce in a sandy loam soil with 6% SOM. The reported value is 2,170mg/kg, ten times greater than the potential phytotoxic concentration.

8.3.11 Similar logic applies to copper (human health Tier of 2,400mg/kg), and consequently on balance, given the context of a commercial development and the relatively low concentrations recorded, the elevated concentrations of copper and zinc are not considered significant and no special remedial measures are considered necessary.

Summary of degree of soils contamination - trial pits (inorganics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Trigger Level Concentrations are shown in BLUE and assume a **commercial or industrial** end use.											
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Vn	Zn$	Asbestos
				640	5	410	28767	100	2330	3603	892	13018	584	200	
TP109	0.2	Cohesive Made Ground	9.3	63	0.7	0.2	35	18	16	< 0.05	29	< 0.5	82	99	N.D.
TP111	0.5	Cohesive Made Ground	11.3	46	0.4	0.2	37	23	14	< 0.05	31	< 0.5	54	93	N.D.
TP102	0.7	Granular Made Ground	10.6	45	0.4	0.2	45	13	14	< 0.05	34	< 0.5	83	99	N.D.
TP104	0.4	Granular Made Ground	12.0	16	0.7	0.2	16	9	11	< 0.05	11	< 0.5	31	63	N.D.
TP105	0.4	Granular Made Ground	11.9	21	0.6	0.2	22	9.1	9.5	< 0.05	15	< 0.5	39	66	N.D.
TP106	0.5	Granular Made Ground	11.7	19	0.5	0.2	14	6	5.1	< 0.05	9	< 0.5	28	45	N.D.
TP107	0.2	Granular Made Ground	11.7	22	0.6	0.3	26	10	60	< 0.05	16	< 0.5	43	94	N.D.
TP108	0.5	Granular Made Ground	9.0	62	0.3	0.1	75	13	15	< 0.05	48	< 0.5	130	110	N.D.
TP110	0.8	Granular Made Ground	10.8	38	0.4	0.1	23	10	12	< 0.05	19	< 0.5	38	77	N.D.
TP103	0.5	Cohesive Residual Soil	7.7	71	0.5	0.2	95	15	20	< 0.05	54	< 0.5	180	130	N.D.

Key	
36	Parameter tested for and found to be in excess of Tier 1 value.
179	Parameter tested for and found to be > 5 x Tier 1 value.
12	Parameter tested for but not found to be in excess of Tier 1 value.
-	Parameter not tested for.
♣	Tier 1 Value is pH dependent.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI Tier 1 would be 21mg/kg.
ND	No fibres detected (asbestos screen)

Source of guidance trigger level	
With the exception of those annotated with one of the symbols below (∞, $, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.071.	
∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).
$	MAFF. Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
~	Engineering judgement (Lithos). Boron is a phytotoxic, although most phytotoxic compounds can pose a risk to human health if sufficient concentrations are present. However, plants represent the most sensitive receptor, and a Tier 1 value which is protective of flora is therefore also protective of human health.
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

Summary of degree of soils contamination – trial pits (organics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Trigger Level Concentrations are shown in BLUE and assume a **commercial or industrial** end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				76	619	2,178	5000	5000
TP109	0.20	Cohesive Made Ground	0.5	< 0.03	< 0.03	< 0.1	< 10	17
TP102	0.70	Granular Made Ground	< 0.5	< 0.03	< 0.03	< 0.1	< 10	< 10
TP104	0.40	Granular Made Ground	0.9	< 0.03	< 0.03	< 0.1	< 10	< 10
TP105	0.40	Granular Made Ground	0.8	< 0.03	< 0.03	< 0.1	< 10	66
TP106	0.50	Granular Made Ground	1.9	< 0.03	< 0.03	< 0.1	< 10	< 10
TP107	0.20	Granular Made Ground	1.6	< 0.03	< 0.03	< 0.1	< 10	15
TP108	0.50	Granular Made Ground	< 0.5	< 0.03	< 0.03	< 0.1	< 10	< 10
TP110	0.80	Granular Made Ground	1.7	< 0.03	< 0.03	< 0.1	< 10	24
TP103	0.45	Cohesive Residual Soil	0.6	< 0.03	< 0.03	< 0.1	< 10	< 10
TP103	0.70	Cohesive Residual Soil	< 0.5	< 0.03	< 0.03	< 0.1	< 10	< 10
TP108	0.55	Cohesive Residual Soil	1.0	< 0.03	< 0.03	< 0.1	< 10	< 10
TP109	0.40	Cohesive Residual Soil	< 0.5	< 0.03	< 0.03	< 0.1	< 10	< 10

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.071. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
-	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
		∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).

Summary of degree of soils contamination – stockpile samples (inorganics)

Stockpile ref.	Sample ID	Material	Concentrations in mg/kg unless otherwise stated. Trigger Level Concentrations are shown in BLUE and assume a **commercial or industrial** end use.											
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Vn	Zn$	Asbestos
				640	5	410	28767	100	2330	3603	892	13018	584	200	
Stockpile 1	1	Tarmac	9.3	0.6	< 0.2	1.8	2.4	3.2	7.7	< 0.05	2.4	< 0.5	6.8	38	N.D.
	2	Tarmac	9.1	4	< 0.2	0.3	6.5	27	8.4	< 0.05	6.3	< 0.5	42	50	N.D.
	3	Tarmac	10.9	1.4	< 0.2	1.2	19	15	4.5	< 0.05	3.1	< 0.5	19	60	N.D.
	4	Tarmac	9.2	1.4	< 0.2	0.9	2.8	4.4	26	< 0.05	3.6	< 0.5	12	47	N.D.
	5	Tarmac	9.6	5.8	0.2	0.1	7.7	37	7.7	< 0.05	5.5	< 0.5	45	72	N.D.
Stockpile 2	1	Demolition Arisings	11.2	10	1.0	0.6	21	30	41	< 0.05	16	< 0.5	42	**540**	N.D.
	2	Demolition Arisings	10.8	9.5	1.4	0.3	15	21	52	< 0.05	13	< 0.5	25	**280**	N.D.
	3	Demolition Arisings	10.6	13	1.5	1.0	16	**270**	33	< 0.05	11	< 0.5	21	**240**	N.D.
	4	Demolition Arisings	11.0	9.8	1.2	0.5	15	27	26	< 0.05	13	< 0.5	23	**260**	N.D.
	5	Demolition Arisings	10.5	9.7	1.6	0.2	15	20	16	< 0.05	12	< 0.5	22	**220**	N.D.
	6	Demolition Arisings	11.0	9.9	1.2	0.3	21	32	22	< 0.05	17	< 0.5	23	**260**	N.D.
Stockpile 3	1	Crushed Concrete	11.6	17	0.6	0.2	21	11	11	< 0.05	15	< 0.5	35	74	N.D.
	2	Crushed Concrete	11.9	13	0.5	0.2	17	10	8.4	< 0.05	12	< 0.5	24	67	N.D.
	3	Crushed Concrete	12.0	14	0.6	0.1	15	9.9	8.8	< 0.05	12	< 0.5	24	53	N.D.
	4	Crushed Concrete	12.0	10	0.5	0.1	13	7.4	6.7	< 0.05	9.1	< 0.5	21	47	N.D.
	5	Crushed Concrete	12.1	11	0.5	0.1	13	7.6	6.4	< 0.05	9.6	< 0.5	21	48	N.D.
	6	Crushed Concrete	12.1	11	0.6	0.1	13	7.5	6.2	< 0.05	8.9	< 0.5	21	44	N.D.

Notes: Key on following page

Key		Source of guidance trigger level	
36	Parameter tested for and found to be in excess of Tier 1 value.	With the exception of those annotated with one of the symbols below (∞, $, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.071.	
179	Parameter tested for and found to be > 5 x Tier 1 value.		
12	Parameter tested for but not found to be in excess of Tier 1 value.	∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).
-	Parameter not tested for.	$	MAFF. Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
♣	Tier 1 Value is pH dependent.	~	Engineering judgement (Lithos). Boron is a phytotoxic, although most phytotoxic compounds can pose a risk to human health if sufficient concentrations are present. However, plants represent the most sensitive receptor, and a Tier 1 value which is protective of flora is therefore also protective of human health.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI Tier 1 would be 21mg/kg.		
ND	No fibres detected (asbestos screen)		
		*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

Summary of degree of soils contamination – stockpile samples (organics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Trigger Level Concentrations are shown in BLUE and assume a **commercial or industrial** end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				76	619	2,178	5000	5000
Stockpile 1	1	Tarmac	-	< 0.30	< 0.30	-	-	-
	2	Tarmac	-	< 0.30	< 0.30	-	-	-
	3	Tarmac	-	< 0.30	< 0.30	-	-	-
	4	Tarmac	-	< 0.30	< 0.30	-	-	-
	5	Tarmac	-	< 0.30	< 0.30	-	-	-
Stockpile 2	1	Demolition Arisings	1.5	< 0.03	< 0.03	< 0.1	< 36	< 67
	2	Demolition Arisings	1.1	< 0.03	< 0.03	< 0.1	<30	< 60
	3	Demolition Arisings	1.1	< 0.03	< 0.03	< 0.1	<30	< 55
	4	Demolition Arisings	1.2	< 0.03	< 0.03	< 0.1	<30	< 45
	5	Demolition Arisings	1.3	< 0.03	< 0.03	< 0.1	<30	< 47
	6	Demolition Arisings	1.2	< 0.03	< 0.03	< 0.1	< 35	< 91
Stockpile 3	1	Crushed Concrete	0.5	< 0.03	< 0.03	< 0.1	<30	< 57
	2	Crushed Concrete	< 0.5	< 0.03	< 0.03	< 0.1	<30	<20
	3	Crushed Concrete	< 0.5	< 0.03	< 0.03	< 0.1	<30	<20
	4	Crushed Concrete	0.7	< 0.03	< 0.03	< 0.1	<30	< 22
	5	Crushed Concrete	< 0.5	< 0.03	< 0.03	< 0.1	<30	84
	6	Crushed Concrete	< 0.5	< 0.03	< 0.03	< 0.1	<30	<20

Notes: Key on following page

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.071. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
-	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
		∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).

Organic determinands

8.3.12 This site is brownfield and underlain by made ground which has yielded elevated concentrations of a number of inorganic determinands. Consequently, for organic compounds, the Tier 1 Soil Screening Values used in this report have been derived with reference to a CSM that assumes a commercial/industrial end use (Lithos Scenario D).

8.3.13 Lithos have used the CLEA model to derive risk-based screening values for hydrocarbons, in accordance with the methodology detailed by the TPHCWG, and reviewed by a UK workshop of experts with respect to UK adoption of the method.

8.3.14 However, these screening values assume a Soil Organic Matter (SOM) of 6% (equivalent to a TOC of 3.5%). Many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with lower screening values may be required.

8.3.15 In order to check the validity of Lithos' Tier 1 Soil Screening Values, the average TOC for each common fill type (beyond any areas of obvious hydrocarbon impact) has been determined:

Fill type	Typical TOC (%)	Comparison of soil results with revised screening value necessary?
Cohesive Residual Soil	<1.0	Yes, but no significant organic contamination was recorded in this soil type. All determinands well below "6%" screening value; most below limit of detection.
Granular Made Ground	<2.0%	
Cohesive Made Ground	0.5%	
Demolition Arisings (Stockpile 2)	<1.0%	
Crushed Concrete (Stockpile 3)	<0.5%	

Hydrocarbons (TPH)

8.3.16 Given the previous uses of the site together with the absence of visual/olfactory evidence of any hydrocarbon contamination, only a simple banded TPH (cf full speciation) was scheduled on 12 soil samples recovered from the trial pits.

8.3.17 Assessment of TPH associated with a fuel/oil source would normally be undertaken in accordance with a 3-step approach, (outlined in Generic Note 04 in Appendix A) on fully speciated TPH results. However, although only banded TPH analysis has been scheduled here, none of the fractions exceed their respective Tier 1 criteria, even if it is conservatively assumed all of each fraction is either aliphatic or aromatic.

8.3.18 Consequently, no significant petroleum hydrocarbon concentrations have been identified, and there is no risk to human health from these hydrocarbons.

Polycyclic Aromatic Hydrocarbons (PAH)

8.3.19 There are numerous PAH compounds. The USEPA identified 16 PAHs that are considered to represent the most problematic in terms of toxicology, fate and behaviour. The UK have also focused on these 16 and these are included in the laboratory report where speciated PAH analysis has been scheduled.

8.3.20 Speciated PAH analysis has been undertaken in order to determine concentrations of the key "marker" compounds: benzo(a)pyrene (considered the most toxic of the PAHs); and naphthalene (the most mobile and volatile of the PAHs).

8.3.21 Speciated analysis has confirmed the absence of significant concentrations of both benzo(a)pyrene and naphthalene in the soils beneath this site.

Asbestos

8.3.22 No visual evidence of asbestos-containing materials (ACMs), such as broken fragments of asbestos-cement sheeting, was noted during the excavation of trial pits or inspection of the stockpiles.

8.3.23 No asbestos fibres were identified in any of the 27 samples screened.

8.4 Water contamination results

8.4.1 The groundwater contamination test results are presented in Lithos letter 050/3546/REG/jr, dated 17th May 2024, with a summary of the findings provided below.

8.4.2 Sampling and testing was carried out in two phases, the first phase in April 2021 comprising two sampling visits and testing with a further two rounds undertaken in April and May 2024.

8.4.3 All concentrations of inorganic contaminants were below the selected screening values during either phases of the investigation.

8.4.4 Concentrations of total petroleum hydrocarbons were recorded during the 2021 sampling. However, during the recent sampling and analysis all concentrations of total petroleum hydrocarbons recorded were below the laboratory limit of detection.

8.4.5 Marginally elevated concentrations, above relevant Tier 1 screening values, of polycyclic aromatic hydrocarbons were recorded in samples from two locations on 3rd April 2024, but subsequent sampling on 1st May 2024 showed concentrations to be below the laboratory limit of detection, indicating the absence of any plausible ongoing sources of organic contamination. Furthermore, no visual evidence of free product or iridescent sheen was noted whilst on site.

8.5 Summary of significant contamination

8.5.1 Made ground underlies the majority of the site, which has been recorded up to 1.7m thick during this phase of investigation (made ground up to 2.7m thick was recorded prior to remediation and turnover works).

8.5.2 This made ground predominantly comprises Granular Made Ground with localised Cohesive Made Ground and granular Sub-base.

8.5.3 The Mixed Arisings in Stockpile 2 contain concentrations of a number of inorganic determinands (predominantly zinc) and contains materials (e.g. metal re-bar, plastic, timber), which would generally be considered undesirable as a near-surface material in landscaped areas.

8.5.4 The location of Stockpile 2 is shown on Drawing 3546/103a.

8.5.5 No significant groundwater water contamination has been encountered during this ground investigation.

8.6 Revised conceptual ground model (contamination)

8.6.1 The Preliminary Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably with respect to the distribution of made ground and contaminants.

8.6.2 A revised Conceptual Site Model which considers the remediation works undertaken to date (turnover etc) is presented as Drawing 3546/107a in Appendix B. The Model includes the contaminants described in Section 8.5 above, and potential contaminant linkages.

9 SUMMARY OF CONCLUSIONS

9.1 General

9.1.1 The site is located off Turnpike Close, approximately 2km southwest of Grantham town centre, and currently comprises a single parcel of land. Until recently the site was occupied by an industrial food production facility, constructed in 1987, which has now been demolished with the majority of concrete and tarmac hardstand grubbed up and stockpiled.

9.1.2 Historical OS plans show a rectangular quarry in the centre between 1889 and c. 1930 although no evidence of the quarry has been identified during any of the intrusive investigations to date.

9.1.3 It is understood that consideration is being given to redevelopment of the site with a Council Depot comprising stores, HGV parking, carparking, washing and refuelling areas. At this stage no immediate development is proposed in the far northeast of the site which is shown as 'potential future office development' with additional car parking (c. 760m^2).

9.1.4 It is understood that remedial works (turnover etc) have been undertaken at the site although these were not supervised by Lithos.

9.1.5 Therefore, to confirm the efficacy of the recent remedial works, additional trial pitting, stockpile sampling and groundwater testing has been undertaken to allow confirmation of:

- the removal of undesirable elements e.g. biodegradable matter, relict foundations etc
- the absence of any residual organic (hydrocarbon) contamination

9.1.6 Samples were also recovered from each of the stockpiles on site to allow laboratory testing to determine the materials suitability for re-use on site.

9.1.7 The findings of this report should be used to produce a suitable verification report for the site, subject to the uncertainties given in Section 9.6 below.

9.2 Inorganic contamination

9.2.1 Made ground underlies the majority of the site, which has been recorded up to 1.7m thick during this phase of investigation (made ground up to 2.7m thick was recorded prior to remediation and turnover works).

9.2.2 This made ground predominantly comprises Granular Made Ground with localised Cohesive Made Ground and granular Sub-base and has typically been found to be essentially "clean" (i.e. it has not yielded elevated concentrations of any contaminants), but it does include some "unsuitable" materials.

9.2.3 However, the Mixed Arisings in Stockpile 2 contain concentrations of a number of inorganic determinands (predominantly zinc, locally copper) and contains materials (e.g. metal re-bar, plastic, timber), which would generally be considered undesirable as a near-surface material in landscaped areas.

9.2.4 Zinc and copper are phytotoxic, consequently, on balance, given the context of a commercial development and the relatively low concentrations recorded, the elevated concentrations of copper and zinc are not considered significant and no special remedial measures are considered necessary.

9.2.5 As such, it is recommended that landscaped areas to be provided with topsoil to a thickness of not less than 300mm. Topsoil thicknesses in excess of 400mm should generally be avoided. Alternatively the made ground could be isolated beneath concrete oversite or areas of hardstand where suitable.

9.2.6 However, the Mixed Arisings in Stockpile 2 are unlikely to be suitable for placement beneath hardstand (roads, car parking) without further treatment (screening).

9.3 Organic contamination

9.3.1 No significant organic (hydrocarbon) contamination has been encountered in the made ground underlying the site.

9.4 Groundwater contamination

9.4.1 No significant groundwater water contamination has been encountered.

9.5 Obstructions

9.5.1 It is apparent from the supplementary trial pitting and stockpile testing that significant obstructions (relict foundations etc) have been removed from beneath the site.

9.5.2 However, boulders of concrete (up to 0.5m diameter) were recorded in the made ground in TP105 with a large diameter ceramic drainage pipe recorded in TP110 at 1.0m depth.

9.6 Uncertainties

9.6.1 Remedial works including turnover of the made ground were not supervised by Lithos and as such Lithos cannot guarantee that all obstructions and residual contaminants have been removed.

9.6.2 Even after an appropriate ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), trial pitting typically allows inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m).

9.6.3 As such, localised obstructions and/or areas of more onerous contamination than that identified to date may still be present.

9.6.4 Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the construction phase. If this is the case Lithos should be consulted for further advice.

Appendix A

General Notes

01 - Environmental setting
Generic notes – geoenvironmental investigations

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the "Search Responses" Appendix of this Geoenvironmental Report.

Geology, mining & quarrying

In order to establish the geological setting of a site, Lithos refer to BGS maps for the area, and the relevant geological memoir. Further information is sourced by reference to current and historical OS plans.

In July 2011, the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology. The CA, using its extensive records has prepared plans for all coalfield Local Planning Authorities, which effectively refines the defined coalfield areas into High Risk and Low Risk areas. **High Risk** areas are likely to be affected by a range of legacy issues that pose a risk to surface stability, including: mine entries; shallow coal workings; workable coal seam outcrops; mines gas; and previous surface mining sites. **Low Risk** areas comprise the remainder of the defined coalfield, and are areas where no known defined risks have been recorded; although there may still be unrecorded issues. Where a site lies within either a High or Low Risk area, a mining report is obtained from the CA.

Landfills

Reference is made to publicly available Government held digital data via **QGIS** (an Open Source Geographic Information System), data from Landmark or Groundsure, and sometimes the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site.

Historical OS plans are also inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move though fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Lithos refer to BRE Report BR211[1], and the UK Health Protection Agency (HPA) website. In December 2022, the British Geological Survey (BGS), deployed a revised dataset which increased accuracy and also the number of properties falling within radon affected areas. This revised dataset is now referenced by maps on the HSA website.

Advice on the limitation of exposure of the population to radon in buildings was originally published in 1990 by the National Radiological Protection Board (NRPB), which joined the HPA in 2005; the HPA updated NRPB advice in July 2010[2].

The HPA recommended that the NRPB radon Action Level for homes be retained, and a new Target Level for radon in homes be introduced. The values of the Action Level and Target Level, expressed as the annual average radon concentration in the home, are 200 Bqm^{-3} and 100 Bqm^{-3} respectively. The Target Level was to provide an objective for remedial action in existing homes and preventive action in new homes.

The term 'radon Affected Area' is defined as those parts of the country with >1% of homes estimated to be above the Action Levels. The level of protection needed is site-specific and can be determined by reference to this mapping on the Public Health England website, which indicates the highest radon potential within each 1km grid square. Each 1km grid square is classified on the basis of the percentage of existing homes within that grid square estimated to have radon concentrations above the Action Level. There are 6 'bands': <1%; 1 to 3%; 3 to 5%; 5 to 10%; 10 to 30%; and >30%.

The NRPB advised that action should be taken to reduce radon concentrations in existing homes if the radon concentration exceeded the Action Level of 200 Bqm^{-3} in room air averaged over a year; ten times the average UK domestic radon concentration. NRPB advice informed changes in the requirements for radon protection in new buildings.

- **Basic** preventive measures are required in new buildings, extensions, conversions and refurbishments if the probability of exceeding the Action Level is **>3%** in England and Wales, and >1% in Scotland and Northern Ireland.
- Provision for further preventive (**Full**) measures is required in new buildings if the probability of exceeding the Action Level is **>10%**.

At present Building Regulations Approved Document C advocates basic measures for the probability banding 3% to 10%, and full measures if >10%. However, HPA would like to see all new build include basic measures.

Action & Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hrs/yr and to all schools.

Hydrogeology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Groundwater quality
- Recorded pollution incidents
- Licensed groundwater abstractions

From April 2010 the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply), but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are split into two different types of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels
- Bedrock - solid permeable formations e.g. sandstone, chalk and limestone

The maps display the following aquifer designations:

Principal aquifers: These are layers of rock or superficial deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary aquifers: These include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into three types:

- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers
- Secondary undifferentiated - In most cases, this is because the rock type in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics.

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1 BRE Report BR211, 2023: "Radon: guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects".

2 Limitation of Human Exposure to Radon, Documents of the Health Protection Agency - Radiation, Chemical and Environmental Hazards, RCE-15. July 2010.

Unproductive strata: These are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

The EA maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the map will be unproductive strata. However, for uncoloured areas on the superficial (drift) designation map it is not possible to distinguish between areas of unproductive strata and areas where no superficial deposits are present; to do this, it is necessary to consult the published geological survey maps.

For the purposes of the EA's Groundwater Protection Policy the following default position applies, unless there is site specific information to the contrary:

- If no superficial (drift) aquifers are shown, the bedrock designation is adopted
- In areas where the bedrock designation shows unproductive strata (the uncoloured areas) the superficial designation is adopted
- In all other areas, the more sensitive of the two designations is used (e.g. If secondary superficial overlies principal bedrock, an overall designation of principal is assumed)

The EA have also designated groundwater Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

Hydrology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Surface water quality
- Recorded pollution incidents
- Licensed abstractions (groundwater & surface waters)
- Licensed discharge consents
- Site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are 6 GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas. There are two different kinds of area shown on the Flood Map:

1. Dark blue areas (Flood Zone 3) could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year
2. Light blue areas (Flood Zone 2) show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Where there is no blue shading (Flood Zone 1), there is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year, areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for: proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and any new development in Flood Zones 2 and 3.

COMAH & explosive sites

Lithos obtain information from Landmark or Groundsure with respect to Control of Major Accident Hazards (COMAH) or explosive sites within 1km of the proposed development site. Lithos' report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

Preliminary conceptual site model

The site's environmental setting (and proposed end use) is used by Lithos to assess the significance of any contamination encountered during the subsequent ground investigation.

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential receptors.

Potential pollutant linkages are shown on a preliminary conceptual site model (pCSM). A CSM is essentially a cross-section through a site that reflects both the surface topography and underlying geology, and shows surface features of interest. The most significant sources of contamination are then superimposed onto this cross-section together with potential receptors (human health & controlled waters), and plausible pathways between the two. In addition to environmental issues, the CSM should also highlight geotechnical issues.

A pCSM is prepared after consideration of all available "desk study" data, and before design of the ground investigation. Data reviewed should include historical plans (with superimposition on a current-day plan), previous SI reports, geological maps etc. The pCSM, in conjunction with knowledge of site constraints (buildings, services, slopes etc) is used to design the ground investigation.

The revised CSM takes account of data obtained during the ground investigation, including the distribution of made ground, the nature and distribution of contamination etc.

02 - Ground investigation fieldwork
Generic notes – geoenvironmental investigations

General

Lithos Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:2015 "Code of practice for site investigation"
- Eurocode 7: BS EN 1997-1:2004. Geotechnical design - Part 1: General rules
- Eurocode 7: BS EN 1997-2:2007. Geotechnical design - Part 2: Ground investigation and testing
- BS10175:2013 "Code of practice for the identification of potentially contaminated sites"
- "Technical Aspects of Site Investigation" – EA R&D Technical Report P5-065/TR (2000)
- "Development of appropriate soil sampling strategies for land contamination" – EA R&D Technical Report P5-066/TR (2001)
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 "Sampling strategies for contaminated land"
- "Guidance on the protection of housing on contaminated land" – NHBC & EA R&D Publication 66 (2000)
- AGS: 1996 "Guide to the selection of Geotechnical Soil Laboratory Testing"

Exploratory hole locations

Exploratory hole locations are selected by Lithos, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

Investigation techniques

Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 2015 and BS1377: 1990. Techniques most commonly used by Lithos include:

- Machine excavated **trial pits**, usually equipped with a backactor and a 0.6m wide bucket. Allows a thorough inspection of the ground; especially the uppermost 1m or so (but able to reach depths of up to c. 4m), with the recovery of representative, disturbed samples. Also used to conduct soakaway testing.
- **Window or windowless** sampling boreholes (**dynamic sampling**). Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often the most appropriate technique. A window sampling drilling rig can be manoeuvred in areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).
- **Cable percussive** (Shell & Auger) boreholes, typically using 150mm diameter tools and casing. Enables the recovery of soil samples and data from greater depth than is possible via trial pitting or a mini-percussive drill rig. Also enables the installation of better/deeper monitoring wells (cf use of a mini-percussive drill rig) due to the utilisation of temporary steel casing during drilling.
- **Rotary percussive** open-hole probeholes are typically drilled using a tri-cone rock roller or polycrystalline diamond compact (PDC) bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse. Often used to penetrate bedrock to investigate abandoned shallow mineworkings
- **Rotary cored** boreholes. A rock core is cut by a bit, passes up into the inner barrel and, at the end of the coring run, the core barrel assembly is lifted to the surface. Core drilling is relatively expensive, but essential if quality data is required to assess issues associated with deep excavation, rock slope stability etc.

Where installed, gas\groundwater monitoring **wells** typically comprise a lower slotted section, surrounded by a filter pack of 10 mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete. Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

In-situ testing

Relative densities of granular materials given on the trial pit logs are based on visual inspection only, they do not relate to any specific bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as N* = x. The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results (hand vane readings) reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

Sampling

Typically Lithos collect at least three soil samples from each exploratory hole, although in practice a greater number are often taken. The collection of a sufficient number of samples provides a sound basis upon which to schedule laboratory analysis, ensuring:

- A sufficient number of samples from each (common) site material are tested
- Horizontal and vertical coverage of the site is adequate, thereby providing a robust data set for use in the conceptual ground model
- Any localised, significant, but non-pervasive conditions are considered

Made ground and natural soils encountered in the field during a ground investigation often contain a significant proportion of coarse grained material (e.g. brick etc). Soil samples obtained during most investigations are often only truly representative of the in-situ soil mass where there is an absence of particles coarser than medium gravel; i.e the entire soil mass would pass a 20mm sieve.

Representative bulk samples of the **soil mass** are retrieved from coarse soils for specific geotechnical tests (most notably grading and compaction); this typically requires the collection of at least 10kg of soil, and occasionally >50kg. However, in the context of assessing land contamination, it is generally accepted that samples should be representative of the **soil matrix** of the stratum from which they are taken. Consequently, truly representative samples of coarse soils for subsequent contaminant analysis are not obtained - only the finer fraction is placed in sample containers. Coarse constituents not sampled would typically comprise any 'particles' with an average diameter greater than about 20mm (i.e. coarse gravel, cobble and boulder).

At present, neither ISO/IEC 17025 nor MCERTS specify sample pre-treatment with respect to stone removal. Unsurprisingly therefore UKAS accredited testing laboratories do not adopt the same approach to stones[1] – some crush and test the "as received" soil, whilst others sieve out stones and analyse only the residual soil (the sieve size used varies depending on the laboratory).

In essence, samples taken from coarser soils for contaminant analysis are "screened" by the geoenvironmental engineer in the field, and often sieved again by the laboratory during sample preparation. Geoenvironmental engineers do not typically re-calculate soil mass contaminant concentrations by taking account of the unsampled coarse fraction. Likewise, laboratories that remove stones typically report contaminant concentrations based on the dry weight of soil passing the sieve. In the context of land contamination and human health risk assessment, this is considered reasonable, because it is the soil matrix which is of greatest concern. Stones are unlikely to:

- Provide a significant source for plant uptake (consumption of vegetables)
- Remain on vegetables after washing (consumption of vegetables)
- Be eaten (accidentally by an adult, or deliberately by a child)
- Be whipped-up by the wind for dust generation (inhalation)
- Stick to the skin for any length of time (dermal contact)
- Yield toxic vapour (inhalation)

Consequently, Lithos instruct labs to remove all stones >10mm, and to report the results as dry-weight based on the mass of matrix tested. However, the laboratory are given site-specific instruction where coarse stones are coated in say oil, or impregnated with mobile contaminants such as diesel. Where the stones are predominantly natural, or inert (e.g. brick, concrete etc), removal will clearly result in higher reported concentrations, than if the stones were crushed and added to the matrix.

Where the stones include a significant proportion of contaminant-rich material (e.g. slag, fragments of galvanised metal etc) an argument could be made for crushing and analysing. However, provided the stones are stable (i.e. unlikely to disintegrate or degrade) they should not pose a significant risk to human health for the reasons stated above.

Sometimes it is necessary to obtain samples that are not representative of the wider soil matrix, for example when investigating localised, significant, but non-pervasive conditions. Any such unrepresentative samples are annotated with the suffix '*' (eg 2D*, or 4G*). Lithos' site engineer describes both the unrepresentative sample, and the soil mass from which it was been taken.

Sample Containers (for contaminant analysis). Samples of soil for contaminant testing are placed into appropriate containers (see below). Soil samples for organic analysis are stored in cool boxes, at a temperature of approximately 4ºC, until delivery to the selected laboratory.

Anticipated testing	Container(s)
Asbestos identification	1000ml plastic tub
pH & metals	1000ml plastic tub or 250ml glass jars
non-volatile organics	250ml glass jars
Speciated TPH	250ml & 50ml glass jars
VOCs (incl. naphthalene and \or GRO)	50ml glass jar

Sample Containers (for geotechnical analysis). The majority of samples are only scheduled for PI and sulphate testing, for which 500g of sample is required (a full 0.5-litre plastic tub). However, bulk bags are taken where scheduling of compaction or grading tests is proposed.

Groundwater

Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork. Long-term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Description of strata

Soils encountered during a Lithos investigation are described (logged) in general accordance with BS 5930:2015. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text. The materials encountered in the trial pits are logged, samples taken, and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

[1] *Mark Perrin. Stoned – Sample Preparation for Soils Analysis. Ground Engineering, April 2007.*

Determination of analytical suite

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "Potential contaminants for the assessment of land" and the relevant DETR Industry Profile(s).

Common contaminants

Common **Inorganic** Contaminants include:

- Metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc
- Semi-metals, most notably arsenic, selenium, and (water soluble) boron
- Non-metals, most notably sulphur
- Inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction. Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to UV digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO_4), sulphides etc.

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common **Organic** Contaminants include hydrocarbons, phenols, and polychlorinated biphenyls.

Petroleum is a mixture of hydrocarbons produced from the distillation of crude oil, and includes aliphatics (alkanes, alkenes and cycloalkanes), aromatics (benzene and derivatives) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen. Petroleum hydrocarbons can be grouped based on the carbon number range:

- GRO – Gasoline Range Organics (typically C_6 to C_{10}). Also referred to as PRO – Petroleum Range Organics
- DRO – Diesel Range Organics (typically C_{10} to C_{28})
- LRO - Lubricating Oil Range Organics (typically C_{28} to C_{40})
- MRO – Mineral Oil Range Organics (typically C_{18} to C_{44})

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies. Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C_5-C_{40}, whereas others define TPH as C_{10}-C_{30}.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (e.g. petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons (especially within the C_4 to C_5 range) that are volatile. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present. Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar nitrogen, sulphur and oxygen-containing compounds (NSO) compounds are also present. Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have two or more fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (benzo(a)pyrene) and\or mobile in the environment (naphthalene).

Volatile Organic Compounds (VOCs) are organic chemicals, and most are liquids that readily evaporate on exposure to air. Examples include benzene, toluene, xylene, chloroform etc. Semi-Volatile Organic Compounds (sVOCs) include phenol and benzo(a)pyrene, and have relatively low boiling points. Both groups of chemicals are readily absorbed through skin and some, such as benzene, are believed to be linked to tumour growth.

Phenols are compounds that have a hydroxyl group (-OH) attached to an aromatic ring (ie include a benzene ring and an –OH group). Most are colourless solids. A solution of phenol in water is known as carbolic acid, and is a powerful antiseptic. However, phenol vapour is toxic, and skin contact can result in burns.

Polychlorinated Biphenyls (PCBs) were used in pre-1974 transformers as dielectric fluids. PCB's are of increasing toxicity relative to the degree of chlorination. Acute symptoms of PCB poisoning are irritation of the respiratory tract leading to coughing and shortness of breath. Nausea, vomiting and abdominal pain are caused by ingestion of PCB's.

Dioxins and furans (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are some of the most toxic chemicals known; in the environment, they tend to bio-accumulate in the food chain. Dioxin is a general term that describes a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD.

Dioxin is formed by burning chlorine-based chemical compounds with hydrocarbons. The major source of dioxin in the environment comes from waste-burning incinerators and also from backyard burn-barrels. Dioxin pollution is also affiliated with paper mills which use chlorine bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals (like many pesticides).

Methods of analysis (organic compounds)

TPH by GC-FID is an analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C_{10} to C_{40} (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a broad, 'banded' breakdown of the TPH results into gasoline range organics (GRO), diesel range organics (DRO) and heavier lubricating oil range organics (LRO), or fully speciated results with the reporting of hydrocarbon concentrations in 14 specific carbon bandings based upon behavioural characteristics, e.g. aliphatic C_6 to C_8, aromatic C_{10} to C_{12} etc.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH by GC-FID.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.

Current UK guidance

The UK approach to contaminated land is set out in Land Contamination Risk Management (2020). The approach is based upon risk assessment, where risk is defined as the combination of the probability of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

In the context of land contamination, there are three essential elements to any risk: (1) a contaminant source; (2) a receptor (eg controlled water or people); and (3) a pathway linking (1) and (2). Risk can only exist where all three elements combine to create a pollutant linkage. Risk assessment requires the formulation of a conceptual model which supports the identification and assessment of pollutant linkages.

Lithos adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate UK guidance levels, Lithos risk-derived screening values, or remedial targets. It should be noted that exceedance of Tier 1 does not necessarily mean that remedial action will be required.

Soil screening values used by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 & 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 & 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software Handbook, Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

In December 2013 Defra published the results of research project SP1010 – Development of Category 4 Screening Levels (C4SLs) for Assessment of Land Affected by Contamination. The objective of this project was to provide technical guidance in support of Defra's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A, where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- Demonstration of the methodology, via derivation of C4SLs for 6 substances – arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene.

The methodology for deriving both the previous Soil Guideline Values and the Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of C4SLs has been achieved by modifying the toxicological and\or exposure parameters used within CLEA (while maintaining current exposure parameters).

Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Lithos consider C4SLs to be suitable for use as Tier 1 Screening Values. Lithos have discussed this matter with both NHBC and YALPAG (collection of Yorkshire & Lincolnshire local authorities) and received confirmation that they are satisfied with this approach.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). However, many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with revised, lower screening values may be required. Other CLEA default characteristics adopted by Lithos are:

Sandy Loam characteristics (source)	Default values adopted
Total porosity (fraction)	0.53
Water filled porosity (fraction)	0.33
Air filled porosity (fraction)	0.2

Lithos have derived Screening Values for five different CSMs (scenarios); these are:

A - Residential with gardens, but no cover (or only up to 300mm)

B - Residential with gardens and 600mm 'clean' cover

C - Residential apartments with landscaping (i.e. no home grown produce)

D - Commercial/industrial with landscaping

E – Importation of soil cover

The **exposure** pathways considered for each scenario are detailed in the table below.

Scenario	Land use	Pathways	Justification
A	Residential with garden, but no cover (or only up to 300mm)	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant.
B	Residential with garden minimum 600mm cover	• Inhalation of indoor vapours • Inhalation of outdoor vapours	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.

Scenario	Land use	Pathways	Justification
D	Commercial/ industrial with landscaped areas no cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.
E	Importation of soil for cover in garden and landscaped areas	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of outdoor vapours and dust	Material used as cover to break existing pathways therefore all direct and indirect pathways relevant; however cover is **not** placed below plots therefore indoor inhalation is not relevant.

Lithos have assumed the source of contamination is directly below the building foundation; i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default.

Lithos have derived Tier 1 values for a number of inorganic and organic determinands in the context of the five Scenarios A to E. The Tier 1 values are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part 2A of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; or
- Groundwater and surface water

Inorganic Tier 1 values for scenarios A to E

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen" If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			4,000		4,000	28,767	4,000	Assumes Cr is CrIII
Pb	450	200	200		314	2,330	200	C4SL adopted
Ni	130		109		123	892	109	Assessment of health risk only
Se	350		434		596	13,018	434	
Hg	170		199		244	3,603	199	Assumes in an inorganic compound
Vn			584		586	4,994	584	
B			5		5	5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu			100		100	100	100	
Zn			200		200	200	200	

Organic Tier 1 values for scenarios A to E

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.7	<1^	<1^	63	<1	<1 based on professional judgement and lower than calculated value.
Toluene	610		836	2,048	1,912	5,000	<1	Scenario D based on professional judgement and lower than calculated value.
Ethyl Benzene	350		379	592	566	5,000	<10	
Xylenes	240		535	590	585	5,000	<10	Scenario E based on professional judgement and lower than calculated value.
Phenol	420		1,434	3,360	2,264	5,000	<10	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5	76	5	C4SL adopted. Scenario B 5 times scenario A
Naphthalene			6	6	6	619	<10	Scenario E based on professional judgement and lower than calculated value
Gasoline Range Organics			22	23	23	2178	626	See 3-step assessment of TPH below ^Based on professional judgement and lower than calculated value
Diesel Range Organics			215	218	215	^5,000	1,429	
Lubricating Range Org			3,299	5,000	3,829	^5,000	3,299	

* *For a residential end use*

The significance of PAHs can be determined by considering indicator compounds. In most cases benzo(a)pyrene (BaP) is adopted as an indicator due to the amount of toxicological data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. A surrogate marker approach can be used to estimate the toxicity of a mixture of PAHs in soil using toxicity data for individual indicator compounds within that mixture. Exposure to the surrogate marker is assumed to represent exposure to all PAHs in that matrix. The surrogate marker approach relies on a number of assumptions:

- Surrogate marker (BaP) must be present in all soil samples
- Profile of the different PAH relative to BaP should be similar in all samples
- PAH profile in the soil samples should be similar to that used in the pivotal toxicity study[1]

To assess the PAH profile in a soil sample, the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated. The ratio relative to BaP should lie within an order of magnitude above and below the mean ratio to BaP.

[1] SP1010 Appendix E, Provisional C4SIs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

Naphthalene should also be considered separately against its generic screen. Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than most other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach.

Similarly, **TPH** cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the bandings.

The significance of speciated TPH results can be assessed by following the 3 steps outlined in the tables below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, naphthalene, benzo(a)pyrene above their respective Tier 1 values?	Yes	Remediation or dQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	Remediation or dQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	Remediation or dQRA required
	No	TPH compounds pose no significant risk

The equation used to assess cumulative effects in step 3 is shown below.

$$HI = \sum_{F_i=1}^{16} HQ\ F_i = \frac{Measured\ concentration\ F_i\ (mg\,kg^{-1})}{SGV\ F_i\ (mg\,kg^{-1})}$$

where HI = Hazard Index
HQ = Hazard Quotient
F_i = Fraction $_i$
SGV = Soil Guideline Value

Statistical Assessment

Current UK guidance is provided by CL:AIRE[2], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by **heterogenous made ground**, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 values).

The CL:AIRE (2020) guidance replaces the withdrawn "Guidance on Comparing Soil Contamination Data with a Critical Concentration" (2008).

The old approach to statistical analysis was based on a definitive yes/no answer which required limited consideration of the dataset and Conceptual Site Model. It was widely accepted that this did not allow sites or risk to be adequately assessed. The updated approach requires a comprehensive understanding of the datasets within the context of the Conceptual Site Model.

Current guidance requires that:

- A robust CSM is in place which identifies source areas, averaging areas and averaging zones
- Sampling locations are relatively evenly spread across the site and were selected using simple or stratified random sampling with no targeting being undertaken
- The field data and CSM do not suggest the presence of a hotspot of contamination which should be treated as a separate zone
- The samples are all taken from a similar same depth and within the same material type across the zone being assessed
- A minimum of 10 samples have been taken. It should be appreciated that confidence in a dataset increases as the number of samples obtained and tested from a zone increases.

The statistical analysis assumes a homogenous distribution of strata and contamination and therefore the dataset will be normally distributed (symmetric, log symmetric or fat tailed).

A normally distributed dataset is assessed using a number of statistical tools to generate a Dot and Box Plot which includes summary statistics and confidence intervals. The review of statistical data enables the assessor to make a decision, with an associated level of confidence, where the true mean of the sample population lies in relation to the critical concentration.

It is essential when using statistics to assess sample data that all decisions relate back to the conceptual site model. Statistics cannot indicate if contamination on a site is likely to present a risk to the end user, this is the role of the 'competent person' i.e. Lithos.

However, broadly speaking the following applies:

- Mean and UCL below the critical concentration – no further assessment required.
- Mean below the critical concentration, but UCL above – consider the CSM and likely sources.
- Mean and UCL above the critical concentration – further assessment required, remediation likely depending on the CSM.
- LCL, Mean & UCL above the critical concentration – further assessment required, remediation likely.

[2] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

Other screening values used by Lithos

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents (and further information is presented in Generic Note No. 5 – Hazardous Gas):

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2015 – Code of Practice for the characterisation & remediation from ground gas in affected developments

With respect to the assessment of potential **phytotoxic effects** of contaminants, Lithos refer to The Sewage Sludge in Agriculture: Code of Practice 2018 for copper and zinc (at pH 5.5 to 6.0). The CLEA derived Tier 1 value is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that: "*In general … it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn*".

Tier 1 **groundwater risk assessments** are always site specific and compare leachate or groundwater concentrations with the appropriate water quality standard based on the CSM and consideration of relevant water quality impacts and assessments.

Waste classification & WAC

In the context of waste soils generated by remediation and\or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics)
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds)
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds)

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

Landfill operators require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Lithos typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc. If off-site disposal of soils classified as hazardous waste during redevelopment is anticipated, then WAC analysis should be scheduled at an early stage in the remediation programme. However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous, and these contaminants can often be dealt with by alternative technologies (e.g. by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

Possible action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

1. Undertake further statistical analysis following the approach set out in Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 (see above) in order to determine whether contaminant concentrations of inorganic contaminants within soil\fill actually present a risk (only applicable to assessing the risk to human health).
2. Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
3. Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis the issue of the **averaging area** requires further consideration. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration, 2020 provides some guidance on averaging areas noting that they are the area within which a receptor may be exposed to contamination but leaving the site assessor to determine the appropriate averaging area for their site.

Lithos consider the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Lithos gather and analyse sample results by fill type, and\or by former use in a given sub-area of the site, before undertaking statistical analysis; i.e. the averaging area is associated with the extent of a particular fill type, or an area affected by spillage\leakage.

In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil\fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil\fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass, i.e. contamination would normally be more pervasive and significant in granular soils than cohesive soils

Appendix B

Drawings

LITHOS CONSULTING
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CLIENT	SOUTH KESTEVEN DISTRICT COUNCIL
JOB TITLE	TURNPIKE CLOSE, GRANTHAM
DRAWING TITLE	SITE LOCATION PLAN
DRAWN	ASw
DATE	29 01 24
CHECKED	SRJ
DATE	29 01 24
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	3546/101
REVISION	

NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM SOUTH KESTEVEN DISTRICT COUNCIL'S DRAWING REFERENCE 8765-NDA-ST-XX-DR-A-1001 REV. P18, DATED AUGUST 2023

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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CLIENT

SOUTH KESTEVEN DISTRICT COUNCIL

JOB TITLE

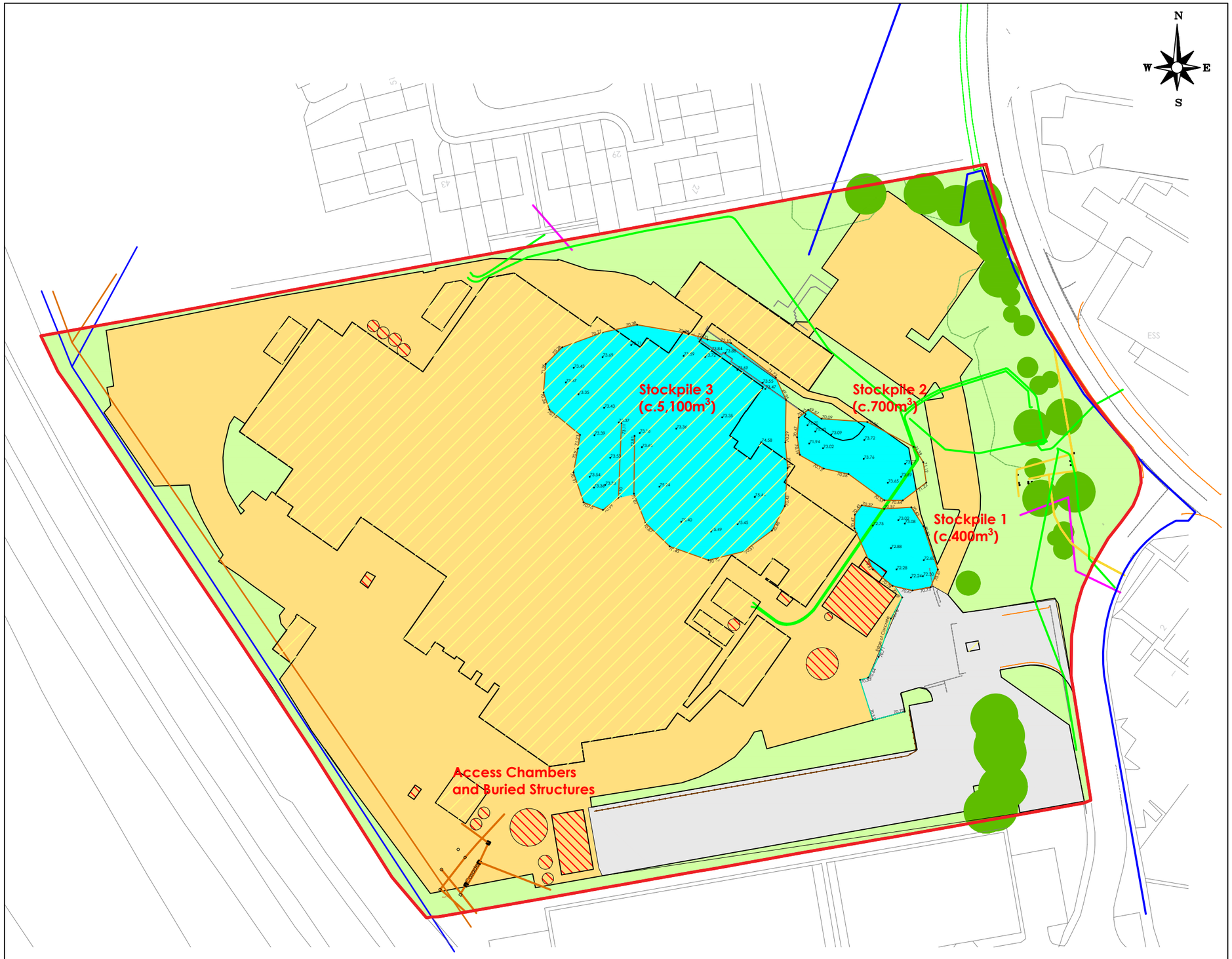
TURNPIKE CLOSE, GRANTHAM

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
ASw	24 03 21	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
SRJ	24 03 21	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3546/102	



NOTES

- LANDSCAPED AREAS
- TREES
- FORMER BUILDINGS (DEMOLISHED)
- SUB-BASE/GRANULAR DEMOLITION ARISINGS
- TARMAC HARDSTAND
- FORMER CONTAMINATION SOURCES (TANKS, TRANSFORMERS ETC)
- APPROXIMATE SITE BOUNDARY
- LINE OF ELECTRICITY UTILITY
- LINE OF GAS UTILITY
- LINE OF WATER UTILITY
- LINE OF SEWER/DRAINAGE UTILITY
- LINE OF BT/TELECOMMS UTILITY

NOTE THAT UTILITY LOCATIONS SHOULD NOT BE RELIED UPON FOR CONSTRUCTION PURPOSES, NOR SHOULD IT BE ASSUMED THAT ALL UTILITIES BENEATH THE SITE ARE SHOWN ON THIS PLAN. THERE MAY BE UTILITIES UNKNOWN TO LITHOS. THIS DRAWING IS NOT AN ALTERNATIVE TO VISUAL INSPECTION, USE OF A CAT DETECTION TOOL AND CAREFUL EXCAVATION.

REV.	DESCRIPTION	DATE

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CLIENT

SOUTH KESTEVEN DISTRICT COUNCIL

JOB TITLE

TURNPIKE CLOSE, GRANTHAM

DRAWING TITLE

SITE FEATURES (POST REMEDIATION & SITE PREPARATORY WORKS)

DRAWN	DATE	STATUS
ASw	01 05 24	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
SRJ	01 05 24	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3546/103a	

NOTES

LITHOS INVESTIGATION (2021)

WELL LOCATION (BHs 01 to 05)
(wells in BHs 01 & 05 reinstated, all others destroyed during earthworks)

LITHOS INVESTIGATION (2024)

WELL LOCATION (BHs 101 to 105)

STOCKPILE LOCATION

GRAVELLED AREAS / ROUGH GROUND

LANDSCAPED AREAS

TREES

FORMER BUILDINGS

TARMAC/CONCRETE HARDSTAND

FORMER CONTAMINATION SOURCES (TANKS, TRANSFORMERS ETC)

APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

SOUTH KESTEVEN DISTRICT COUNCIL

JOB TITLE

TURNPIKE CLOSE, GRANTHAM

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS (GROUNDWATER MONITORING WELLS)

DRAWN	DATE	STATUS
ASw	05 03 24	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
SRJ	05 03 24	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3546/104	

NOTES

LITHOS INVESTIGATION (2024)

- TRIAL PIT LOCATION (TPs 101 to 111)
- STOCKPILE LOCATION
- GRAVELLED AREAS / ROUGH GROUND
- LANDSCAPED AREAS
- TREES
- FORMER BUILDINGS
- TARMAC/CONCRETE HARDSTAND
- FORMER CONTAMINATION SOURCES (TANKS, TRANSFORMERS ETC)
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

SOUTH KESTEVEN DISTRICT COUNCIL

JOB TITLE

TURNPIKE CLOSE, GRANTHAM

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS (TRIAL PITS)

DRAWN	DATE	STATUS
ASw	05 03 24	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
SRJ	05 03 24	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3546/105	

NOTES

LITHOS INVESTIGATION (2021)

- TRIAL PIT LOCATION (TPs 01 to 50)
- SOAKAWAY TEST LOCATION (SAs 01 to 05)
- BOREHOLE LOCATION (BHs 01 to 05)

LITHOS INVESTIGATION (2024)

- TRIAL PIT LOCATION (TPs 101 to 111)
- WELL LOCATION (BHs 101 to 105)
- STOCKPILE LOCATION
- GRAVELLED AREAS / ROUGH GROUND
- LANDSCAPED AREAS
- TREES
- FORMER BUILDINGS
- TARMAC/CONCRETE HARDSTAND
- FORMER CONTAMINATION SOURCES (TANKS, TRANSFORMERS ETC)
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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CLIENT

SOUTH KESTEVEN DISTRICT COUNCIL

JOB TITLE

TURNPIKE CLOSE, GRANTHAM

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS (ALL HOLES)

DRAWN	DATE	STATUS
ASw	05 03 24	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
SRJ	05 03 24	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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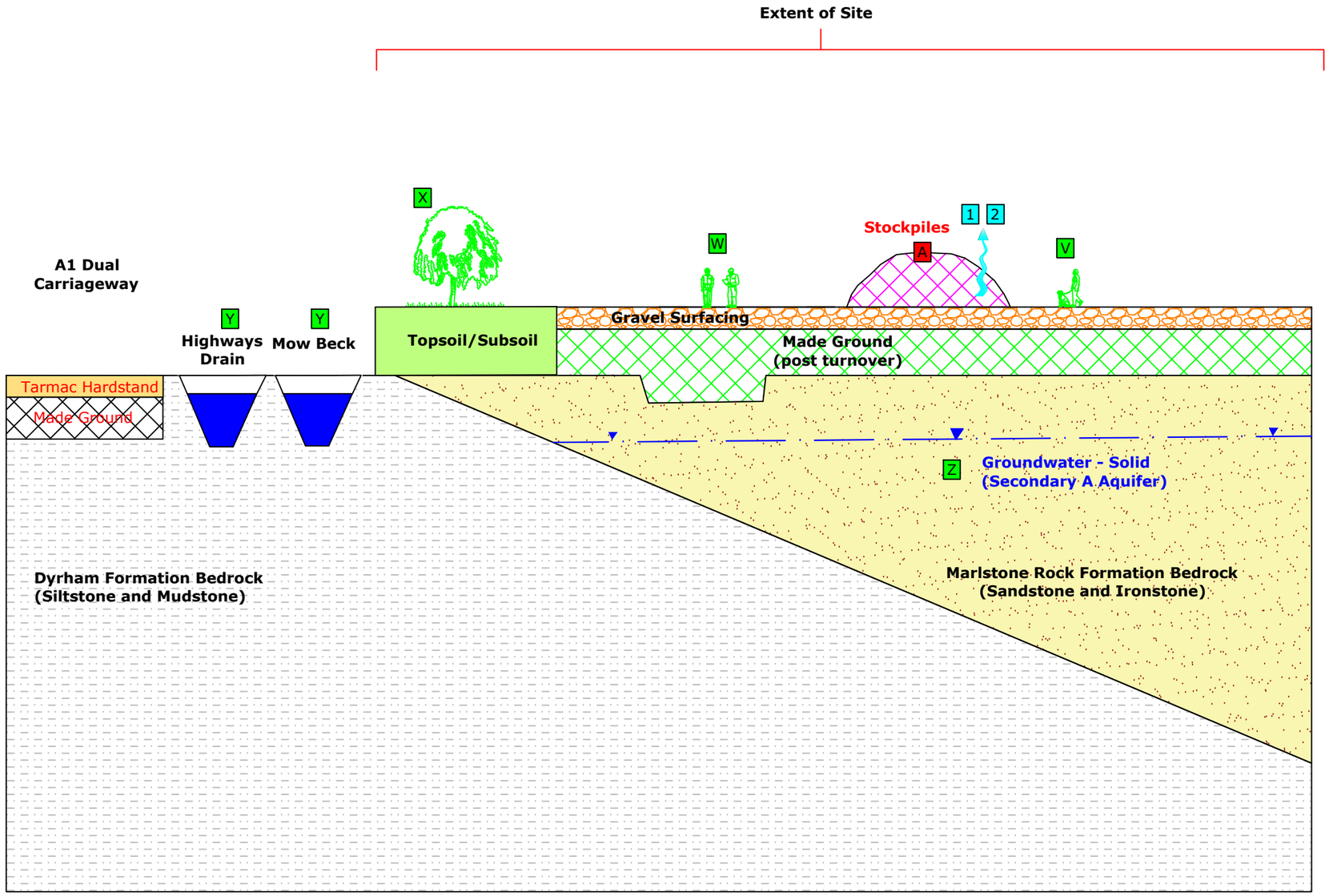

SOURCES	PATHWAYS	RECEPTORS
A STOCKPILES (INORGANICS)	1 DERMAL CONTACT	V END USERS (WORKERS)
	2 INGESTION/INHALATION	W SITE WORKERS
		X VEGETATION
		Y SURFACE WATERS
		Z GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING
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CLIENT
SOUTH KESTEVEN DISTRICT COUNCIL

JOB TITLE
TURNPIKE CLOSE, GRANTHAM

DRAWING TITLE
REVISED CONCEPTUAL SITE MODEL (POST SITE REMEDIATION)

DRAWN	DATE	STATUS
ASw	20 05 24	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
SRJ	20 05 24	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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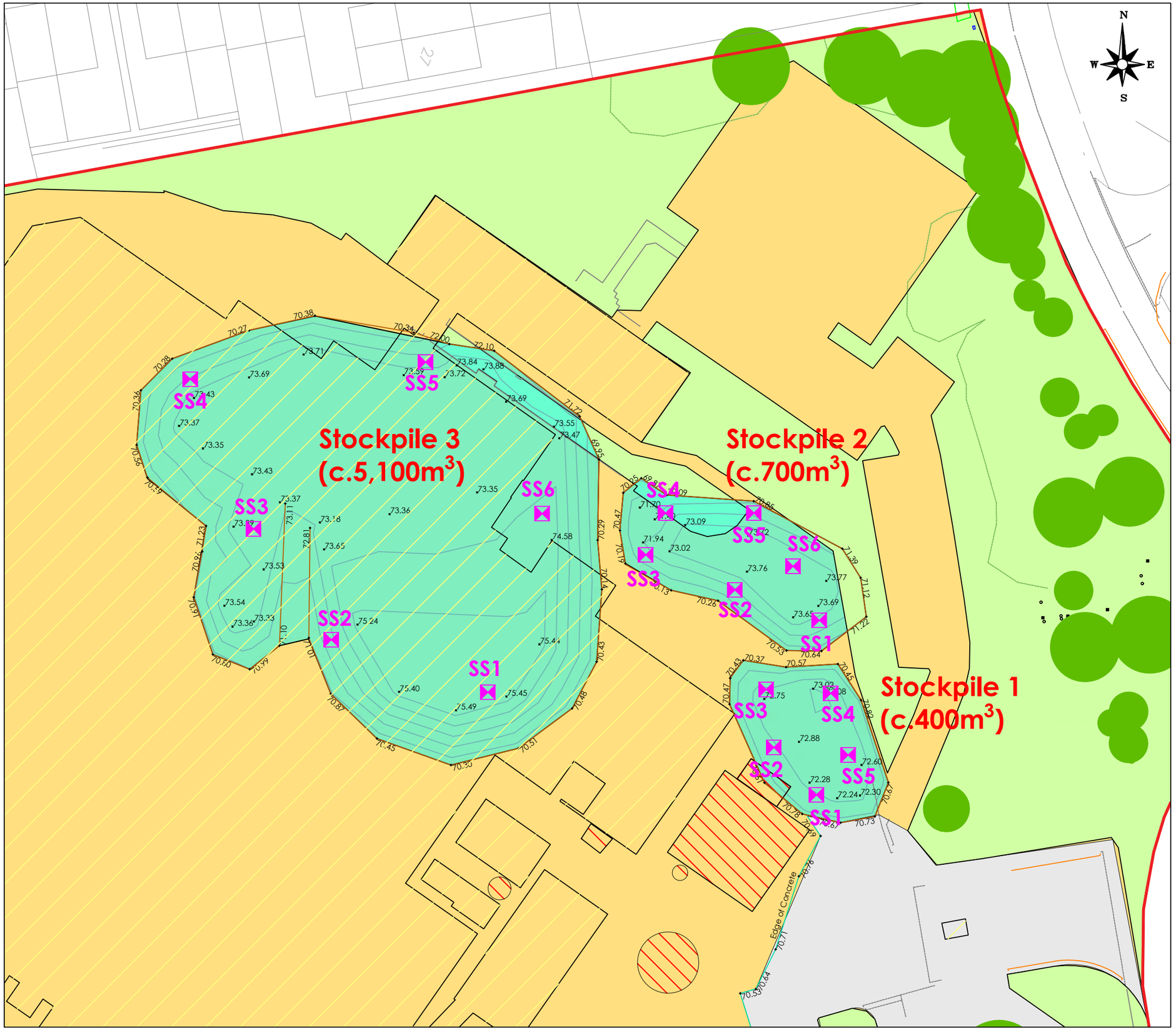

NOTES

- STOCKPILE LOCATION
- STOCKPILE SAMPLE LOCATIONS
  - STOCKPILE 1 (S1 TO S5)
  - STOCKPILE 2 (S1 TO S6)
  - STOCKPILE 3 (S1 TO S6)
- GRAVELLED AREAS / ROUGH GROUND
- LANDSCAPED AREAS
- TREES
- FORMER BUILDINGS
- TARMAC/CONCRETE HARDSTAND
- FORMER CONTAMINATION SOURCES (TANKS, TRANSFORMERS ETC)
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

SOUTH KESTEVEN DISTRICT COUNCIL

JOB TITLE

TURNPIKE CLOSE, GRANTHAM

DRAWING TITLE

STOCKPILE LOCATIONS & SAMPLING

DRAWN	DATE	STATUS
ASw	05 03 24	FOR COMMENT ☐
		FOR APPROVAL ☐
CHECKED	DATE	DRAFT ☐
SRJ	05 03 24	FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:500	A3	3546/108	

Appendix C

Commission

036/3546/ASw

29th January 2024

Registered in England 07068066

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Mr G Teasdale
South Kesteven District Council
St Peter's Hill
Grantham
Lincolnshire
NG31 6PZ

Dear Gyles

Turnpike Close, Grantham (monitoring well installation & groundwater testing).

Further to your recent invitation, please find attached our proposal for the installation of monitoring wells together with the sampling and testing of groundwater on the above land.

It is understood that consideration is being given to redevelopment of the site with a Council Depot comprising offices, workshops, car parking, HGV access, storage bins, wash areas and fuel storage / pumps. A sketch layout has been provided.

Lithos have previously issued the following reports for the site:

- 'Geoenvironmental Appraisal of land at Turnpike Close, Grantham', Report 3546/2, dated April 2021.
- Letter report ref 025/3546/LIZ/cc, dated 27th July 2021, 'Groundwater monitoring and testing'.

Results of groundwater sampling and testing (one round of sampling and testing) did not reveal any particularly high concentrations of contaminants for any of the determinands tested. However, C_{10}-C_{24} diesel range organics in BH02 (26ug/l) and both C_{10}-C_{24} diesel range organics and C_{24}-C_{40} lubricant range organics in BH05 (56ug/l & 110ug/l respectively) were identified.

After review of the Lithos groundwater monitoring and testing letter report, the Environment Agency (EA) requested two rounds of groundwater sampling with additional testing to confirm the absence of contaminants.

However, the wells installed at the site are understood to have been destroyed during recent site preparatory works (re-grade, grubbing up of hardstand).

As such, to satisfy the concerns of the EA, we have allowed for the following fieldwork and testing.

Fieldwork: We have allowed for the drilling of 5 rotary probeholes to allow installation of groundwater monitoring wells which will be supervised and logged by an experienced geoenvironmental engineer.

The site is underlain by shallow bedrock (from c. 1.5m depth), and therefore we have allowed for the mobilisation of a **rotary drilling rig** to allow installation of shallow groundwater monitoring wells to c.6m depth in bedrock.

Each monitoring well will comprise 50mm ID, HDPE pipework with bentonite seals and a gravel filter pack. Well headworks will comprise a 100mm diameter steel security helmet which will extend about 150mm above ground level (if required, the position of each helmet could be "marked" with a 1.5m high fence post to reduce the likelihood of damage by plant or machinery).

The groundwater **wells** will be developed, purged and sampled (twice each) shortly after completion of drilling.

We have allowed for all exploratory holes to be picked-up by a **surveyor** (co-ordinates/ground levels will be included on the logs) to allow meaningful interpretation of groundwater dip data.

We strongly recommend that groundwater wells be decommissioned after monitoring and sampling has been completed. Decommissioning involves removal of the metal covers, unscrewing the upper 1m to 2 m of pipework and filling the void / remaining well with bentonite.

Decommissioning of monitoring wells removes the potential for groundwater pollution caused by accidental spillages during the construction phase. Subject to your instruction, we will decommission accessible wells once monitoring and sampling are complete for an E\O price of £***+VAT. We will contact you to seek instruction once our groundwater dip and testing results have been approved by the EA.

Laboratory Testing: This will comprise the testing of groundwater samples recovered from each of the 5 monitoring wells on two occasions (10 no. total) as requested by the EA in their correspondence dated 2nd January 2024.

Groundwater samples will be tested for *pH, metals, ammoniacal nitrogen, sulphide, sulphate, Speciated PAH and Speciated TPH (TPHWCG) including BTEX*.

Reporting & timescales: on completion of the drilling we will issue a concise overview report within 3 days of fieldwork completion detailing the well installations, including a drawing showing their location.

On completion of the, fieldwork, sampling and laboratory testing a comprehensive, factual and interpretative letter report will be issued. This will contain exploratory hole logs, laboratory test results, copies of all relevant correspondence and drawings of the site. The report will include qualitative risk assessment with respect to controlled waters.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of **£****** plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent. Revision of the costings provided may be required if works are not instructed within **3 months** of the date this proposal was issued.

Our proposal allows for submission of the report to the Local Authority and EA, and for submission of a single piece of subsequent correspondence with each regulator to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

We will submit invoices for this project on completion of each Item(s) instructed.

Please note if following instruction of the works outlined in this proposal, it is necessary to subsequently **postpone or cancel**, this should be done at least 3 working days before Lithos are due to commence intrusive investigation on site. We reserve the right to charge a cancellation fee in the event of later notification to cover plant / drill rig costs and abortive consultancy time. The cancellation fee will not exceed £**** plus VAT.

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements. However, well installation is expected to be completed within one working day and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing.

Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption/repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, Lithos cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

Most developers have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), and it would be appreciated if you could forward these prior to the proposed fieldworks. However, if you do not have the necessary plans, Lithos will obtain them direct from each of the utility companies.

It is highly likely that the site is underlain by many "private" services and drains etc which will not be shown on statutory utility plans. Consequently, it would be appreciated if copies of plans showing these services could be made available to our field engineer, and/or someone with site knowledge could advise us with respect to safe locations for our exploratory holes.

Under the **CDM** Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

If no other designers or contractors have been appointed, Lithos could perform the role of Principal Contractor but only for the duration of the site investigation outlined in this proposal. If you require us to perform the role of Principal Contractor, please make this clear in your instruction. It should be noted that we are not suitably qualified to perform this role where other designers or contractors are also appointed.

It is anticipated that the site investigation outlined in this proposal will be undertaken several months before any construction is commenced on site. Consequently, our works can be considered in isolation and, given the anticipated number of person days on site, this site investigation is not notifiable to the HSE.

Terms & conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely

Alan Swales
Associate Director
for and on behalf of
LITHOS CONSULTING LIMITED

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" means these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording your unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing;

"Documents" means all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of us, and whether in paper form or stored electronically or on disk, or otherwise;

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Project" means the project described in the Proposal and any enquiry from you on which we have based our Proposal;

"Proposal" means the offer document prepared by us in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by us pursuant to the Agreement and as set out in the Proposal and includes any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment" as amended from time to time.

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 You agree to engage us and we agree to provide the Services in accordance with the provisions of this Agreement.

3 OUR OBLIGATIONS

3.1 We shall perform the Services using the reasonable standard of skill and care normally exercised by qualified members of our profession, performing similar services under similar conditions.

3.2 We shall use all reasonable endeavours to perform the Services in accordance with relevant environmental and safety legislation.

4 YOUR OBLIGATIONS

4.1 Throughout the period of this Agreement you shall afford to us, or procure for our benefit, access to any site where access is required for the performance of the Services.

4.2 You accept responsibility for ensuring that we are notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards, which you shall clearly mark on the ground or identify on accurate location plans supplied to us prior to the commencement of the Services. You shall also inform us in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. You shall indemnify us against all costs, losses, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If you discover any conflict, defect or other fault in the information or designs provided by us pursuant to the Agreement, you will advise us in writing of such defect, conflict or other fault and we shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 COPYRIGHT

5.1 The copyright in all Intellectual Property prepared by or on behalf of us in connection with the Project for delivery to you shall remain vested in us.

5.2 You shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable you to copy and use the Intellectual Property but solely for your own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by us.

5.3 Should you wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, you must obtain our prior written consent. The giving of such consent shall be at our absolute discretion and shall be upon such terms as we may require. We shall not be liable to you for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on our behalf.

5.4 Ownership of any proposals submitted to you that are not subsequently confirmed as part of the Services to be provided for you remain with us and such proposals must not be used as the basis for any future work undertaken by you or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of you being in default of payment of any fees or other amounts due, we may suspend further use of the licence on giving no less than 2 calendar days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 CONFIDENTIALITY

6.1 Neither you nor we shall at any time disclose to any person any confidential information concerning the business, affairs, customers, clients or suppliers of the other party or of any member of the group of companies to which the other party belongs, except as permitted by clauses 6.2 and 6.4.

6.2 Each party may disclose the other party's confidential information:

(a) to its employees, officers, representatives, contractors, sub-contractors or advisers who need to know such information for the purposes of exercising the party's rights or carrying out its obligations under or in connection with this Agreement. Each party shall ensure that its employees, officers, representatives, contractors, sub-contractors or advisers to whom it discloses the other party's confidential information comply with this paragraph 6; and

(b) as may be required by law, to a court of competent jurisdiction or any governmental or regulatory authority.

6.3 Neither you nor we shall use any other party's confidential information for any purpose other than to exercise our rights or perform our respective obligations under or in connection with this Agreement.

6.4 Subject to the above and our privacy policy which can be found on www.lithos.co.uk, we shall be permitted to use information related to the Services we provide in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

7 ASSIGNMENT

7.1 You may assign the benefit of this Agreement on two occasions with our prior written consent (not to be unreasonably withheld) and any additional assignments shall be with our prior consent.

7.2 We may at any time assign, mortgage, charge, subcontract, delegate, declare a trust over or deal in any other manner with any or all of our rights and obligations under this Agreement.

8 INSURANCE

8.1 We shall maintain a professional indemnity insurance policy covering our liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION POUNDS) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, We shall maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under this Agreement, provided such insurance is available at commercially reasonable rates and terms.

8.2 If for any period such insurance is not available at commercially reasonable rates and terms, we shall inform you and shall obtain in respect of such period such reduced level of professional indemnity insurance as is available and as would be fair and reasonable in the circumstances for us to obtain.

9 PAYMENT

9.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

9.2 You shall pay you any VAT properly chargeable on the Services and any amount expressed as payable to us under this Agreement is exclusive of VAT unless stated otherwise.

9.3 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

9.4 If you dispute the amount included for payment in an invoice then you must serve a written notice on us no later than 14 calendar days before the final date for payment. If no notice is given within the required timeframe the amount due shall be the amount stated in the invoice.

9.5 If you fail to pay any monies in accordance with the foregoing payment provisions, we shall be entitled to charge interest on any monies owed to us, such interest to be at a rate of 4% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis. The parties acknowledge that our liability under this clause 10.5 is a substantial remedy for the purposes of section 9(1) of the Late Payment of Commercial Debts (Interest) Act 1998.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, our total liability under or in connection with this Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either the level of insurance cover referred to within clause 8.1 above, or 20 times the total value of invoices issued to you for the Services.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against us after the expiry of a period of six years from the date of the completion (or termination) of the Services under this Agreement.

10.3 Whilst we usually scan for potential exploratory locations with a Cable Avoidance Tool, we shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 We shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by us or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless we have been advised in writing of the same by you and have been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 DELAY

We shall comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond our reasonable control and in the event of any such circumstances arising we undertake to complete the Services within a reasonable period, but will not be liable to you for any delay as a result.

12 TERMINATION

12.1 The Agreement may be terminated by either of us in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

12.2 If for any reason our Services are suspended for a period in excess of three calendar months then we shall be entitled to terminate our appointment under this Agreement in respect of the Services by no less than seven days written notice to you.

12.3 If you fail to pay in full any sum due under the terms of this Agreement by the final date for payment for that sum and no effective pay less notice is issued, we may serve written notice to you demanding payment within 14 days of such notice. If you fail to comply with such notice, we shall be entitled to terminate our employment under this Agreement forthwith.

12.4 Any termination of our appointment howsoever caused shall be without prejudice to our rights to require payment for all Services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

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The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

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We shall consider and may consent to a request from you for us to enter into a collateral warranty or letter of reliance with a third party with regard to the Services provided under this Agreement. The giving of such consent shall be at our absolute discretion and providing we agree to our standard form of collateral warranty or letter of reliance (subject to any reasonable changes to be approved by us at our absolute discretion) and in return for payment of a fee (to be notified at the time of the request).

15 NOTICES

15.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by pre-paid first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to our respective registered office addresses.

15.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by pre-paid first class post.

16 ENTIRE AGREEMENT

16.1 The Agreement constitutes the complete and entire agreement between us with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against us in respect of the Services can only be made in contract under the provisions of this Agreement and not otherwise under the law or tort or otherwise.

16.2 No amendments, modifications or variation of this Agreement shall be valid unless made in writing and agreed to by us; such agreement must be recorded in writing by at least one of us.

16.3 We shall not be bound by any standard or printed terms or conditions furnished by you in any of your documents unless we specifically state in writing separately from such documents that we intend such terms and conditions to apply.

17 DISPUTES, JURISDICTION AND GOVERNING LAW

17.1 This Agreement shall be governed by and construed in accordance with English law and we irrevocably and unconditionally submit to the jurisdiction of the English Courts.

17.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between us may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

037/3546/ASw

29th January 2024

Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

T 01937 545 330
www.lithos.co.uk

Mr G Teasdale
South Kesteven District Council
St Peter's Hill
Grantham
Lincolnshire
NG31 6PZ

Dear Gyles

Turnpike Close, Grantham (stockpile testing for disposal)

It is understood that stockpile(s) of potentially contaminated surplus arisings have been generated during the grubbing-up of hardstand / relict foundations at the above site that are considered unsuitable for re-use / retention on site. This material is surplus to site requirements and therefore off-site disposal is anticipated. At this stage the volumes destined for disposal are not known.

Site visit. Further to your request, we confirm that we will provide an Engineer to inspect and sample the stockpile(s) of potentially contaminated surplus arisings.

We will take and test a minimum of 6 composite samples (1 additional sample will be taken for every 500m^3 of material over and above 500m^3), that are representative of the stockpile mass from which they are taken. Where sampling is not truly representative because coarse gravel & cobble sized fragments are present, the Engineer will record the approximate proportion (and nature) of coarse material in each stockpile.

The stockpile could be inspected by a suitably qualified Geoenvironmental Engineer, via inspection pits excavated by hand to depths of about 0.75m. However, use of an excavator would allow more thorough inspection into the 'core' of the stockpile; we have provided costs for provision of a JCB type excavator under separate cover (see Lithos letter ref 038/3546/ASw, dated 25th January 2024.

It has been assumed that sampling of stockpiles would take place at the same time as trial pitting. If this is not the case then there would be an additional fee of £** plus VAT for provision of an excavator if none were available on site for use by the Lithos engineer.

Laboratory testing. Initially, appropriate, "routine" chemical analyses (based on our review of Lithos Report 3546/2 dated April 2021 and knowledge of the site's history), has been allowed for. In line with Appendix D of WM3 (which considers appropriate sampling and characterisation of a waste mass), we will arrange for a suitably accredited laboratory to analyse them for:

pH, asbestos ID, total metals (copper, nickel, zinc, chromium, arsenic, mercury, selenium, cadmium, and lead), TOC, speciated PAH, banded TPH and BTEX.

Note, if Ash & Clinker is encountered and off-site disposal is proposed, we will need to discount Persistent Organic Pollutants (POPs) and therefore we will also need to schedule some samples for Dioxins or POPs. The test costs £*** per sample (3 no. should suffice) and takes c. 3 weeks.

Assessment of laboratory results (Waste Classification): As there is no WRAP protocol for soils, the characterisation, sampling and classification of soils arising from development sites has been incorporated within the Environment Agency's Technical Guidance WM3[1].

Our letter report will provide a review of laboratory results with respect to each stockpile / soil mass and be considered against relevant hazardous properties and concentration limits within WM3. This approach ensures waste classification is undertaken on the stockpile as a whole, rather than a classification based on individual samples.

If waste soil is classed as hazardous following classification under WM3, and is destined for landfill, waste acceptance criteria (WAC) leachate testing will need to be undertaken. This is also the case for soils classified as non-hazardous that are destined for an inert landfill. Non-hazardous soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required. However, many landfill facilities request WAC testing and it is worthwhile undertaking this on say 2 samples per stockpile (assuming a reasonably homogenous content) in order to avoid subsequent delays.

This basic review will provide an indication of whether the surplus soil is hazardous or non-hazardous and provide the likely waste code. However, in some cases, particularly where there is a mixture of contaminants, or individual metal concentrations are found to exceed 1,000 mg/kg, a more detailed assessment may be required.

Given the history of the site / range of likely ground conditions a detailed WM3 assessment may be required. A fee for undertaking the WM3 assessment and allocating an appropriate waste code has been included below, this would replace the need for a separate letter report (item D1).

Our fee rates for undertaking these works are detailed below:

Item		No.	Unit	Rate (£)	Total
A1#	Site visit by Engineer to sample soil; including mileage, and up to 3 hours on site	1	Visit	****	****
A2#	Provision of a JCB to allow sampling of the stockpiles	1	No.	****	****
B1	"Routine laboratory" testing: pH, asbestos ID, total metals (copper, nickel, zinc, chromium, arsenic, mercury, selenium, cadmium, and lead), TOC, speciated PAH, banded TPH and BTEX – 5 day turnaround.	6	No.	****	****
B2	Confirmatory testing: asbestos quantification	-	No.	****	****
B3	POPs: PCBs, Organochlorine pesticides, Dioxins and chlorinated furans.	-	No.	****	****
C1	E/O B1. Confirmatory testing (WAC) for off-site disposal as **Hazardous** pH, Total Organic Carbon, Acid Neutralising Capacity, on the solid material, and 12 metals (As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se & Zn), chloride, fluoride, sulphate, Total Dissolved Solids, Phenol & Dissolved Organic Carbon on an eluate samples (derived from the waste soil via a prescribed leaching test).	-	No.	****	****
D1	Production of letter report (basic review)	1	Sum	****	****
D2	E/O D1. Production of full WM3 assessment and report	-	Sum	****	****
				Sum	**£****

Notes: # where supplementary trial pitting is undertaken in support of production of a validation report, Items A1 & A2 would be waived as the engineer on site would also recover samples from the stockpiles.

[1] Technical Guidance WM3 – Guidance on the classification and assessment of waste. Environment Agency 2015

This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which is enclosed.

Yours sincerely

Alan Swales
Associate Director
for and on behalf of
LITHOS CONSULTING LIMITED

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" means these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording your unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing;

"Documents" means all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of us, and whether in paper form or stored electronically or on disk, or otherwise;

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Project" means the project described in the Proposal and any enquiry from you on which we have based our Proposal;

"Proposal" means the offer document prepared by us in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by us pursuant to the Agreement and as set out in the Proposal and includes any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment" as amended from time to time.

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

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4.3 If you discover any conflict, defect or other fault in the information or designs provided by us pursuant to the Agreement, you will advise us in writing of such defect, conflict or other fault and we shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

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5.3 Should you wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, you must obtain our prior written consent. The giving of such consent shall be at our absolute discretion and shall be upon such terms as we may require. We shall not be liable to you for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on our behalf.

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16.3 We shall not be bound by any standard or printed terms or conditions furnished by you in any of your documents unless we specifically state in writing separately from such documents that we intend such terms and conditions to apply.

17 DISPUTES, JURISDICTION AND GOVERNING LAW

17.1 This Agreement shall be governed by and construed in accordance with English law and we irrevocably and unconditionally submit to the jurisdiction of the English Courts.

17.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between us may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Alan Swales

Subject: FW: 3546: Turnpike Close, Grantham

From: Gareth Dawkins <Gareth.Dawkins@southkesteven.gov.uk>
Sent: Thursday, February 1, 2024 2:22 PM
To: Alan Swales <Alan.Swales@lithos.co.uk>; Gyles Teasdale <Gyles.Teasdale@southkesteven.gov.uk>
Cc: Mark Genney <Mark.Genney@gleeds.com>; Phil Southgate <PhilSouthgate@norder.co.uk>; Alice Clarke <Alice.Clarke@southkesteven.gov.uk>
Subject: RE: 3546: Turnpike Close, Grantham

Hi Alan,

Thanks again for your quotes and I can confirm, that we would like to move forward with what you have kindly proposed.

My colleague Alice will kindly be arranging for Purchase Orders to be raised. If you could let us know approximately when the work could be undertaken that would be much appreciated.

On a related point, when you undertook the original survey, we think a UXO survey may have been undertaken at the time, would you be able to confirm please. Albeit considerable work has now been undertaken since any survey may have been carried out.

Many thanks in anticipation.

Regards,

Gareth

From: Alan Swales <Alan.Swales@lithos.co.uk>
Sent: Wednesday, January 31, 2024 2:24 PM
To: Gyles Teasdale <Gyles.Teasdale@southkesteven.gov.uk>
Cc: Gareth Dawkins <Gareth.Dawkins@southkesteven.gov.uk>
Subject: 3546: Turnpike Close, Grantham

Gyles,

Please find attached separate proposals to address recent comments from the EA and allow sampling of existing stockpiles prior to disposal.

We have provided separate proposals as each of the requirements here are independent of each other and you may not wish to instruct all at the same time.

However, there will be some cost saving where stockpile sampling is undertaken at the same time as trial pitting (we can use the same excavator and engineer).

The Remediation Strategy and Validation report will be provided as a single document as groundwork has already been undertaken at the site. Hopefully the supplementary trial pitting will show there are no obstructions or any residual contamination remaining in the ground and no further remedial works would be required.

Prior to commencing fieldwork (groundwater well installation and trial pitting) we would need to confirm access.

If you have any questions, please give me a call.

Thanks
Alan

Alan Swales
Associate Director
Lithos Consulting Ltd
Alan@lithos.co.uk
www.lithos.co.uk
Parkhill
Walton Road
Wetherby, LS22 5DZ

M 07548 570 320
DD 01937 545335

Appendix D

Trial Pit Logs

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP101
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489818.29 - 334509.88 Level: 70.45	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6 Depth 1.60	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	70.35		MADE GROUND: Yellowish brown sandy subangular fine to coarse GRAVEL of limestone. (SUB-BASE)
			HVP=40				Stiff dark orangish brown sandy slightly gravelly CLAY. Gravel is subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
							At 0.4m electric cable in south wall, pit extended to avoid damage.
				0.80	69.65		Stiff brownish grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=40	1.60	68.85		End of pit at 1.60 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP102
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489774.59 - 334509.92 Level: 70.55	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6, Depth 1.80	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.70	J,K&T		1.10	69.45		MADE GROUND: Light brown slightly clayey slightly sandy subangular tabular fine to coarse GRAVEL of limestone with rare large fragments of metal and plastic. Low subangular cobble content of limestone. (GRANULAR MADE GROUND)
							Stiff brownish grey CLAY. (COHESIVE RESIDUAL SOIL)
							At 1.4m minor spalling due to cobbles.
				1.80	68.75		End of pit at 1.80 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP103**

Sheet 1 of 1

Project Name:	Turnpike Close, Grantham	Project No. 3546	Co-ords: 489744.33 - 334478.50 Level: 69.25
Location:	Lincolnshire	Dimensions (m): Depth 1.80	2 × 0.6
Client:	South Kesteven District Council		

Date 26/02/2024

Scale 1:20

Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.35	68.90		MADE GROUND: Yellowish brown sandy subangular fine to coarse GRAVEL of limestone. (SUB-BASE)
	0.45	J,K&T	HVP=108				Stiff to very stiff orangish brown slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL) *Between 0.35m and 0.4m, pocket of green staining with slight organic odour in east wall. Spot sample taken.*
	0.70	J,K&T	HVP=98				
				1.40	67.85		Stiff dark orangish brown sandy CLAY. (COHESIVE RESIDUAL SOIL)
				1.70	67.55		Strong purplish red LIMESTONE recovered as angular medium to coarse gravel. (MARLSTONE ROCK FORMATION)
				1.80	67.45		End of pit at 1.80 m

1 2 3 4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP104
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489720.00 - 334483.54 Level: 69.50	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6, Depth 1.80	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	J,K&T		0.40	69.10		MADE GROUND: Light brown sandy angular fine to coarse GRAVEL of predominately concrete with rare metal and gravel-sized fragments of plastic. (GRANULAR MADE GROUND)
				0.80	68.70		MADE GROUND: Yellowish brown slightly sandy subangular medium to coarse GRAVEL of limestone. (SUB-BASE) *At 0.8m, geotextile below the layer of sub-base.*
			HVP=40	1.60	67.90		Firm dark orangish brown sandy CLAY. (COHESIVE RESIDUAL SOIL)
			HVP=87	1.80	67.70		Stiff light brown CLAY. (COHESIVE RESIDUAL SOIL) End of pit at 1.80 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP105
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489705.14 - 334526.15 Level: 69.65	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): Depth 2.40, 2, 0.6	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.40	J,K&T					MADE GROUND: Light brown sandy subangular to angular fine to coarse GRAVEL of predominately concrete and tarmac with rare metal rebar, plasic and wood. (GRANULAR MADE GROUND)
							Between 0.5m and 1.7m, difficult to excavate due to boulders (200mm to 500mm across) of concrete.
							At 1.5m, minor spalling of sidewalls in made ground.
				1.70	67.95		Stiff light brown CLAY. (COHESIVE RESIDUAL SOIL)
▼							*At 2.3m, water present at the base of the pit on completion of excvation.*
				2.40	67.25		End of pit at 2.40 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 2.3m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 0.5m and 1.7m depth during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP106
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489739.37 - 334546.98 Level: 70.65	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6, Depth 1.60	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.50	J,K&T		0.60	70.05		MADE GROUND: Light brown sandy rounded to subangular fine to coarse GRAVEL of limestone and concrete with some cobble-sized fragments of metal and plastic. (GRANULAR MADE GROUND)
			HVP=88	1.50	69.15		Stiff orangish brown slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
				1.60	69.05		Very stiff brownish grey slightly gravelly CLAY recovered as angular medium to coarse gravel. Gravel is subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
							End of pit at 1.60 m

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Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP107
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489711.44 - 334568.79 Level: 70.55	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6, Depth 1.40	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J,K&T					MADE GROUND: Light brown slightly clayey slightly sandy subangular fine to coarse GRAVEL mixed lithologies, predominantly concrete, with some fragments of metal and plastic. (GRANULAR MADE GROUND) *Minor spalling with cobbles of reinforced concrete.*
				0.50	70.05		Stiff orangish brown mottled grey slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.40	69.15		End of pit at 1.40 m

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4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 0m and 0.5m depth during excavation.

AGS

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Trial Pit Log

Trialpit No
TP108
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489670.08 - 334585.89 Level: 70.15	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6, Depth 1.80	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.50	J,K&T					MADE GROUND: Light brown slightly clayey slightly sandy subangular fine to coarse GRAVEL of sandstone and concrete. (GRANULAR MADE GROUND)
	0.65	J,K&T					*At 0.5m, dark brown pockets of clay in the north wall, spot sample taken.*
				0.60	69.55		Stiff orangish brown and light brown mottled slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
▼							*At 1.8m, water at the base of the pit.*
				1.80	68.35		End of pit at 1.80 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 1.8m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP109
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489739.76 - 334610.68 Level: 70.55	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6, Depth 1.50	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J,K&T					MADE GROUND: Firm light brown gravelly CLAY. Gravel is subangular fine to coarse of concrete and mixed lithologies. (COHESIVE MADE GROUND)
	0.40	J,K&T	HVP=102	0.30	70.25		Stiff brownish grey mottled silty CLAY with low rounded cobble content of sandstone. (COHESIVE RESIDUAL SOIL)
				1.50	69.05		*Below 1.4m, recovered as angular tabular coarse gravel size lithorelicts of very stiff clay.* End of pit at 1.50 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP110
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489736.28 - 334587.10 Level: 70.45	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6, Depth 1.50	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.80	J,K&T		0.90	69.55		MADE GROUND: Light brown sandy subangular to subrounded fine to coarse GRAVEL of concrete and mixed lithologies. (GRANULAR MADE GROUND)
				1.30	69.15		Multi-coloured subangular to subrounded fine GRAVEL of mixed lithologies. (PEA GRAVEL) *At 1.0m, large diameter ceramic (drainage?) pipe encountered.* *At 1.1m, spalling between 0.9m and 1.1m with some overbreak.*
				1.50	68.95		Very stiff brownish grey mottled orangish brown CLAY with rare decomposed plant matter. (COHESIVE RESIDUAL SOIL) End of pit at 1.50 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between 0.9m and 1.3m depth during excavation with complete collapse at 1.5m.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP111
Sheet 1 of 1

Project Name: Turnpike Close, Grantham	Project No. 3546	Co-ords: 489803.28 - 334566.26 Level: 70.20	Date 26/02/2024
Location: Lincolnshire		Dimensions (m): 2 × 0.6 Depth 1.60	Scale 1:20
Client: South Kesteven District Council			Logged ET

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.50	T					MADE GROUND: Firm light brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including concrete and tarmac. (COHESIVE MADE GROUND)
				1.20	69.00		Very stiff brownish grey CLAY. (COHESIVE RESIDUAL SOIL)
				1.50	68.70		Strong reddish brown fossiliferous SANDSTONE recovered as subrounded medium to coarse gravel. (MARLSTONE ROCK FORMATION)
				1.60	68.60		End of pit at 1.60 m

1
2
3
4

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

Appendix D

Chemical Results

Certificate of Analysis

Certificate Number 24-04358 *Issued:* 12-Mar-24

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference 24-04358

Client Reference ~ 3546

Order No ~ PO22006

Contract Title ~ Turnpike Close, Grantham

Description 13 Soil samples.

Date Received 29-Feb-24

Date Started 29-Feb-24

Date Completed 12-Mar-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager

2139

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04358
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

			Lab No	2306348	2306349	2306350	2306351	2306352	2306353	2306354
			Sample ID ~	TP109	TP111	TP103	TP103	TP108	TP109	TP102
			Depth ~	0.20	0.50	0.45	0.70	0.55	0.40	0.70
			Other ID ~							
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Preparation										
Stones >10mm	DETSC 1003*	1	% m/m	31	29	< 1.0	< 1.0	< 1.0	< 1.0	24
Moisture Content	DETSC 1004	0.1	%	14	15	15	15	13	15	14
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg	63	46	71				45
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.7	0.4	0.5				0.4
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.2	0.2				0.2
Chromium	DETSC 2301#	0.15	mg/kg	35	37	95				45
Chromium III	DETSC 2301*	0.15	mg/kg	35	37	95				45
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0				< 1.0
Copper	DETSC 2301#	0.2	mg/kg	18	23	15				13
Lead	DETSC 2301#	0.3	mg/kg	16	14	20				14
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05				< 0.05
Nickel	DETSC 2301#	1	mg/kg	29	31	54				34
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5				< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	82	54	180				83
Zinc	DETSC 2301#	1	mg/kg	99	93	130				99
Inorganics										
pH	DETSC 2008#		pH	9.3	11.3	7.7				10.6
Total Organic Carbon	DETSC 2084#	0.5	%	0.5		0.6	< 0.5	1.0	< 0.5	< 0.5
Petroleum Hydrocarbons										
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10		< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10		< 10	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10		< 10	< 10	< 10	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	14		< 10	< 10	< 10	< 10	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10		< 10	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	17		< 10	< 10	< 10	< 10	< 10
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04358
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

			Lab No	2306348	2306349	2306350	2306351	2306352	2306353	2306354
			Sample ID ~	TP109	TP111	TP103	TP103	TP108	TP109	TP102
			Depth ~	0.20	0.50	0.45	0.70	0.55	0.40	0.70
			Other ID ~							
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04358
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

			Lab No	2306355	2306356	2306357	2306358	2306359	2306360
			Sample ID ~	TP104	TP105	TP106	TP107	TP108	TP110
			Depth ~	0.40	0.40	0.50	0.20	0.50	0.80
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	27	30	34	31	19	32
Moisture Content	DETSC 1004	0.1	%	9.8	10	12	15	17	13
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	16	21	19	22	62	38
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.7	0.6	0.5	0.6	0.3	0.4
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.2	0.2	0.3	0.1	0.1
Chromium	DETSC 2301#	0.15	mg/kg	16	22	14	26	75	23
Chromium III	DETSC 2301*	0.15	mg/kg	16	22	14	26	75	23
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	9.0	9.1	6.0	10	13	10
Lead	DETSC 2301#	0.3	mg/kg	11	9.5	5.1	60	15	12
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	11	15	9.0	16	48	19
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	31	39	28	43	130	38
Zinc	DETSC 2301#	1	mg/kg	63	66	45	94	110	77
Inorganics									
pH	DETSC 2008#		pH	12.0	11.9	11.7	11.7	9.0	10.8
Total Organic Carbon	DETSC 2084#	0.5	%	0.9	0.8	1.9	1.6	< 0.5	1.7
Petroleum Hydrocarbons									
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	54	< 10	14	< 10	24
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	66	< 10	15	< 10	24
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

Key: ~ Sample details provided by client and can affect the validity of the results; * -not accredited.; # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04358
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

			Lab No	2306355	2306356	2306357	2306358	2306359	2306360
			Sample ID ~	TP104	TP105	TP106	TP107	TP108	TP110
			Depth ~	0.40	0.40	0.50	0.20	0.50	0.80
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Asbestos Analysis
Soil Samples

Our Ref 24-04358
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2306348	TP109 0.20	SOIL	NAD	none	Ben Rose
2306349	TP111 0.50	SOIL	NAD	none	Ben Rose
2306350	TP103 0.45	SOIL	NAD	none	Ben Rose
2306354	TP102 0.70	SOIL	NAD	none	Ben Rose
2306355	TP104 0.40	SOIL	NAD	none	Ben Rose
2306356	TP105 0.40	SOIL	NAD	none	Ben Rose
2306357	TP106 0.50	SOIL	NAD	none	Ben Rose
2306358	TP107 0.20	SOIL	NAD	none	Ben Rose
2306359	TP108 0.50	SOIL	NAD	none	Ben Rose
2306360	TP110 0.80	SOIL	NAD	none	Ben Rose

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Key: ~ Sample details provided by client and can affect the validity of the results

Information in Support of the Analytical Results

Our Ref 24-04358
Client Ref ~ 3546
Contract ~ Turnpike Close, Grantham

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2306348	TP109 0.20 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306349	TP111 0.50 SOIL	26/02/24	GJ 250ml, PT 1L		
2306350	TP103 0.45 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306351	TP103 0.70 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306352	TP108 0.55 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306353	TP109 0.40 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306354	TP102 0.70 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306355	TP104 0.40 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306356	TP105 0.40 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306357	TP106 0.50 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306358	TP107 0.20 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306359	TP108 0.50 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		
2306360	TP110 0.80 SOIL	26/02/24	GJ 250ml, GJ 60ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

Certificate of Analysis

Certificate Number 24-04357 *Issued:* 12-Mar-24

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference 24-04357

Client Reference ~ 3546

Order No ~ PO22007

Contract Title ~ Turnpike Close, Grantham

Description 17 Soil samples.

Date Received 29-Feb-24

Date Started 29-Feb-24

Date Completed 12-Mar-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager

2139

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04357
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

	Lab No	2306331	2306332	2306333	2306334	2306335	2306336
	Sample ID ~	Stockpile 1 Sample 1	Stockpile 1 Sample 2	Stockpile 1 Sample 3	Stockpile 1 Sample 4	Stockpile 1 Sample 5	Stockpile 2 Sample 1
	Depth ~						
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Preparation							
Stones >10mm	DETSC 1003*	1	% m/m	100	100	100	100	100	2.0
Moisture Content	DETSC 1004	0.1	%	< 0.10	0.16	0.32	0.29	0.17	13
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	0.6	4.0	1.4	1.4	5.8	10
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2	0.2	1.0
Cadmium	DETSC 2301#	0.1	mg/kg	1.8	0.3	1.2	0.9	0.1	0.6
Chromium	DETSC 2301#	0.15	mg/kg	2.4	6.5	19	2.8	7.7	21
Chromium III	DETSC 2301*	0.15	mg/kg	2.4	6.5	19	2.8	7.7	21
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	3.2	27	15	4.4	37	30
Lead	DETSC 2301#	0.3	mg/kg	7.7	8.4	4.5	26	7.7	41
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	2.4	6.3	3.1	3.6	5.5	16
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	6.8	42	19	12	45	42
Zinc	DETSC 2301#	1	mg/kg	38	50	60	47	72	540
Inorganics							
pH	DETSC 2008#		pH	9.3	9.1	10.9	9.2	9.6	11.2
Total Organic Carbon	DETSC 2084#	0.5	%						1.5
Petroleum Hydrocarbons							
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg						< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg						< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg						< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg						16
EPH (C21-C35)	DETSC 3311	10	mg/kg						57
EPH (C35-C40)	DETSC 3311	10	mg/kg						< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg						82
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	0.33	< 0.30	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03

Sample details provided by client and can affect the validity of the results: * - not accredited ; # - MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04357
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

	Lab No	2306331	2306332	2306333	2306334	2306335	2306336
	Sample ID ~	Stockpile 1 Sample 1	Stockpile 1 Sample 2	Stockpile 1 Sample 3	Stockpile 1 Sample 4	Stockpile 1 Sample 5	Stockpile 2 Sample 1
	Depth ~						
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	0.33	< 0.10	< 0.10

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04357
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

	Lab No	2306337	2306338	2306339	2306340	2306341	2306342
	Sample ID ~	Stockpile 2 Sample 2	Stockpile 2 Sample 3	Stockpile 2 Sample 4	Stockpile 2 Sample 5	Stockpile 2 Sample 6	Stockpile 3 Sample 1
	Depth ~						
	Other ID ~						
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method** / **LOD** / **Units**						
Preparation							
Stones >10mm	DETSC 1003* / 1 / % m/m	5.0	6.0	4.0	5.0	3.0	7.0
Moisture Content	DETSC 1004 / 0.1 / %	15	15	15	16	13	11
Metals							
Arsenic	DETSC 2301# / 0.2 / mg/kg	9.5	13	9.8	9.7	9.9	17
Boron, Water Soluble (2.5:1)	DETSC 2311# / 0.2 / mg/kg	1.4	1.5	1.2	1.6	1.2	0.6
Cadmium	DETSC 2301# / 0.1 / mg/kg	0.3	1.0	0.5	0.2	0.3	0.2
Chromium	DETSC 2301# / 0.15 / mg/kg	15	16	15	15	21	21
Chromium III	DETSC 2301* / 0.15 / mg/kg	15	16	15	15	21	21
Chromium, Hexavalent	DETSC 2204* / 1 / mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301# / 0.2 / mg/kg	21	270	27	20	32	11
Lead	DETSC 2301# / 0.3 / mg/kg	52	33	26	16	22	11
Mercury	DETSC 2325# / 0.05 / mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301# / 1 / mg/kg	13	11	13	12	17	15
Selenium	DETSC 2301# / 0.5 / mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301# / 0.8 / mg/kg	25	21	23	22	23	35
Zinc	DETSC 2301# / 1 / mg/kg	280	240	260	220	260	74
Inorganics							
pH	DETSC 2008# / / pH	10.8	10.6	11.0	10.5	11.0	11.6
Total Organic Carbon	DETSC 2084# / 0.5 / %	1.1	1.1	1.2	1.3	1.2	0.5
Petroleum Hydrocarbons							
VPH (C6-C10)	DETSC 3321* / 0.1 / mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311 / 10 / mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311 / 10 / mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311 / 10 / mg/kg	< 10	< 10	< 10	< 10	15	< 10
EPH (C21-C35)	DETSC 3311 / 10 / mg/kg	50	45	35	37	81	57
EPH (C35-C40)	DETSC 3311 / 10 / mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311# / 10 / mg/kg	64	58	48	46	100	62
PAHs							
Naphthalene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303 / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303 / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303 / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303# / 0.03 / mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

(Sample details provided by client and can affect the validity of the results: * - not accredited ; # - MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04357
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

			Lab No	2306337	2306338	2306339	2306340	2306341	2306342
			Sample ID ~	Stockpile 2 Sample 2	Stockpile 2 Sample 3	Stockpile 2 Sample 4	Stockpile 2 Sample 5	Stockpile 2 Sample 6	Stockpile 3 Sample 1
			Depth ~						
			Other ID ~						
			Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
			Sampling Time ~	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04357
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

	Lab No	2306343	2306344	2306345	2306346	2306347
	Sample ID ~	Stockpile 3 Sample 2	Stockpile 3 Sample 3	Stockpile 3 Sample 4	Stockpile 3 Sample 5	Stockpile 3 Sample 6
	Depth ~					
	Other ID ~					
	Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
	Sampling Time ~	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	9.0	6.0	5.0	4.0	8.0
Moisture Content	DETSC 1004	0.1	%	10	11	11	12	9.5
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	13	14	10	11	11
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.5	0.6	0.5	0.5	0.6
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.1	0.1	0.1	0.1
Chromium	DETSC 2301#	0.15	mg/kg	17	15	13	13	13
Chromium III	DETSC 2301*	0.15	mg/kg	17	15	13	13	13
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	10	9.9	7.4	7.6	7.5
Lead	DETSC 2301#	0.3	mg/kg	8.4	8.8	6.7	6.4	6.2
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	12	12	9.1	9.6	8.9
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	24	24	21	21	21
Zinc	DETSC 2301#	1	mg/kg	67	53	47	48	44
Inorganics								
pH	DETSC 2008#		pH	11.9	12.0	12.0	12.1	12.1
Total Organic Carbon	DETSC 2084#	0.5	%	< 0.5	< 0.5	0.7	< 0.5	< 0.5
Petroleum Hydrocarbons								
VPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	12	62	10
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	22	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	16	88	17
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

(Sample details provided by client and can affect the validity of the results: * - not accredited ; # - MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04357
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

				Lab No	2306343	2306344	2306345	2306346	2306347
				Sample ID ~	Stockpile 3 Sample 2	Stockpile 3 Sample 3	Stockpile 3 Sample 4	Stockpile 3 Sample 5	Stockpile 3 Sample 6
				Depth ~					
				Other ID ~					
				Sample Type ~	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date ~	26/02/2024	26/02/2024	26/02/2024	26/02/2024	26/02/2024
				Sampling Time ~	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg		< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Key: ~ Sample details provided by client and can affect the validity of the results: * -not accredited.: # -MCERTS (accreditation only applies if report carries the MCERTS logo).

: n/s -not

Summary of Asbestos Analysis
Soil Samples

Our Ref 24-04357
Client Ref ~ 3546
Contract Title ~ Turnpike Close, Grantham

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2306336	Stockpile 2 Sample 1	SOIL	NAD	none	Ben Rose
2306337	Stockpile 2 Sample 2	SOIL	NAD	none	Ben Rose
2306338	Stockpile 2 Sample 3	SOIL	NAD	none	Ben Rose
2306339	Stockpile 2 Sample 4	SOIL	NAD	none	Ben Rose
2306340	Stockpile 2 Sample 5	SOIL	NAD	none	Ben Rose
2306341	Stockpile 2 Sample 6	SOIL	NAD	none	Ben Rose
2306342	Stockpile 3 Sample 1	SOIL	NAD	none	Ben Rose
2306343	Stockpile 3 Sample 2	SOIL	NAD	none	Ben Rose
2306344	Stockpile 3 Sample 3	SOIL	NAD	none	Ben Rose
2306345	Stockpile 3 Sample 4	SOIL	NAD	none	Ben Rose
2306346	Stockpile 3 Sample 5	SOIL	NAD	none	Ben Rose
2306347	Stockpile 3 Sample 6	SOIL	NAD	none	Ben Rose

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 24-04357
Client Ref ~ 3546
Contract ~ Turnpike Close, Grantham

Containers Received & Deviating Samples

Lab No	Sample ID ~	Date Sampled ~	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2306331	Stockpile 1 Sample 1 SOIL	26/02/24	GJ 250ml, PT 1L		
2306332	Stockpile 1 Sample 2 SOIL	26/02/24	GJ 250ml, PT 1L		
2306333	Stockpile 1 Sample 3 SOIL	26/02/24	GJ 250ml, PT 1L		
2306334	Stockpile 1 Sample 4 SOIL	26/02/24	GJ 250ml, PT 1L		
2306335	Stockpile 1 Sample 5 SOIL	26/02/24	GJ 250ml, PT 1L		
2306336	Stockpile 2 Sample 1 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306337	Stockpile 2 Sample 2 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306338	Stockpile 2 Sample 3 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306339	Stockpile 2 Sample 4 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306340	Stockpile 2 Sample 5 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306341	Stockpile 2 Sample 6 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306342	Stockpile 3 Sample 1 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306343	Stockpile 3 Sample 2 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306344	Stockpile 3 Sample 3 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306345	Stockpile 3 Sample 4 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306346	Stockpile 3 Sample 5 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10
2306347	Stockpile 3 Sample 6 SOIL	26/02/24	GJ 250ml, PT 1L		BTEX / C5-C10

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Information in Support of the Analytical Results

Our Ref 24-04357
Client Ref ~ 3546
Contract ~ Turnpike Close, Grantham

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

Key: ~ Sample details provided by client and can affect the validity of the results