

Piggery to the south of Chapelgate, Sutton St James, Spalding, Lincolnshire, PE12 0EF

Phase 2 Intrusive Ground Works Factual Report

Report on behalf of Kirk Homes Ltd

July 2017
Final Report
R17053

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CONTENTS

1.0 INTRODUCTION 6
2.0 INTRUSIVE WORKS 8
3.0 LABORATORY TESTING SCOPE 12
4.0 CONTAMINATION RISK ASSESSMENT AND LABORATORY TESTING RESULTS 13
5.0 CONCLUSIONS AND RECOMMENDATIONS 17
6.0 REFERENCES 18

APPENDICES

Appendix A DRAWINGS
Appendix B INTRUSIVE WORKS PHOTOGRAPHS
Appendix C TRIAL PIT LOCATION PLAN AND EXPLORATORY LOGS
Appendix D GRANGE GEOCONSULTING LIMITED METHODOLOGY
Appendix E CONTAMINATION TESTING RESULTS

EXECUTIVE SUMMARY AND CONCEPTUAL SITE MODEL

SITE INFORMATION & SETTING	**Purpose of This Report**	Phase 2 Intrusive Works Factual Report
	Client	Kirk Homes Ltd
	Site	Piggery to the south of Chapelgate, Sutton St James, Spalding, Lincolnshire, PE12 0EF
	Site Location	Sited approximately 20km to the south-east of Spalding, the site is located to the south of Chapelgate (the B1165 road) within the village of Sutton St James. The approximate National Grid Reference for the site is 539040, 318060.
	Current Use & Description	The site covers approximately 1.8 hectares and is occupied by an active piggery. It includes working areas, yards, storage facilities and paddocks. At the time of writing in June 2017, the piggery remained active and animals were being kept at the site.
	Proposed Development	Forty-two new homes with residential gardens, parking facilities and soft landscaping are proposed at the site.
	Geology	Made Ground is anticipated to be present at the site, associated with the existing piggery, since the early 1970s. The site is underlain by Tidal Flat Deposits. They typically comprise beach deposits of shingle, Sand, Silt and Clay. The upper bedrock at the site is the West Walton Formation. This stratum is variable and contains calcareous Mudstones, silty Mudstone and Siltstone with fine-grained Sandstones and argillaceous Limestone (cementstone) or Siltstone nodules. Typically, it is a silty Mudstone with occasional Limestone bands. The stratum is typically 15m thick, although the thickness on site is anticipated to be less, due to the proximity of the outcropping Ampthill Clay Formation, which formers the deeper bedrock at the site, immediately to the east. The Ampthill Clay Formation is a grey Mudstone, with argillaceous Limestone (cementstone) nodules.
INTRUSIVE WORKS	**Overview of Grange Geo Intrusive Works**	The intrusive works comprised ten trial pits (to a maximum depth of 2.3m bgl) to obtain information on the ground and groundwater conditions at the site. The collection of samples for chemical analysis (soil and water) and in-situ testing (hand shear vane) was also carried out.
	Findings of the Intrusive Works	<u>Topsoil</u> Varied between a dark brown, slightly sandy, silty Clay with live roots and a stiff, dark brown, slightly gravelly Clay. The gravel was fine to medium, sub-angular Flint. <u>Made Ground</u> Typically comprised brown, grey and mottled, slightly sandy, occasionally gravelly, slightly silty Clay with abundant rootlets. The gravel present was fine to coarse sub-rounded to angular Flint, concrete and brick. Fragments of string, plastic and plastic bags, pig bones and iron were also present. <u>Tidal Flat Deposits</u> Stiff, brown and grey mottled, silty Clay. A thin layer of peat was observed in TP10. Silty sandy layers also noted. With depth, the deposits were often orange or blue to grey in colour and logged as soft, silty Clay. To the eastern half of the site the Tidal Flat Deposits were typically comprised of a fine silty SAND. <u>Evidence of contamination</u> Evidence of plastic bags and occasional pig bones was encountered in TP4 between 0.6m and 1.2m bgl. Evidence of plastic, iron, brick and string from ground level to 0.9m bgl was noted in TP6 and string, brick, plastic and bone were observed in TP8 between 0.6m and 1.8m bgl. TP8. Evidence of rare plastic was found in TP9 from ground level to 0.6m bgl. No further visual or olfactory evidence of contamination was encountered in the shallow soils, this included evidence of hydrocarbon contamination and evidence of potentially asbestos-containing materials.

		Groundwater Groundwater seepages were recorded in five trial pits between 1.6m and 2m bgl. Strong groundwater inflow was recorded in TP8 inflow between 1.5m and 1.8m bgl. No visual or olfactory evidence of contamination was recorded in the groundwater.
ASSESSMENT & CONCLUSIONS	**Contamination Testing**	Eight soil samples were taken from the Topsoil and Made Ground. The testing results have been screened against Grange GeoConsulting Limited GAC screening values (provided in Appendix E) to carry out an assessment of potential risks associated with contamination. One sample from the Made Ground recorded a concentration of benzo(a)pyrene of 3.2 mg / kg marginally exceeding the GAC of 3 mg / kg. No GACs for nitrogen or ammonium for the residential with plant uptake scenario are available, though it was noted that extremely high concentrations of nitrogen and ammonium concentrations were noted. One sample was found to contain asbestos. Loose chrysotile (white asbestos) was detected at concentrations of <0.001% in the Made Ground. Extremely high concentrations of bacterial contaminants were recorded in the samples taken. A discussion with the biological laboratory confirmed that the concentrations recorded are tremendously high and indicate the presence of soils rich in faecal content and bacteria. The concentrations of Faecal Streptococci and Clostridia were noted to be exceptionally high. The laboratory noted that the concentrations of bacteria within these samples were so great that they exceeded the upper limits of detection of the laboratory apparatus. The presence of these contaminants indicates that the activities at the piggery have had a huge impact on the underlying soils and that they are impacted by animal waste and the historical burial of animals at the site. One marginally elevated concentration of copper in TP8 of 15 µg/kg was recorded in groundwater in one sample. This concentration exceeded the EQS threshold of 5 ug/kg. Seven contaminants were recorded in groundwater at concentrations above the UK drinking water standards in one or more samples. Significant exceedances of the UK DWS were recorded for some contaminants.
	Conclusions	The ground conditions across the site, as proven during the intrusive works, are in general accordance with the published geological literature. Limited thicknesses of Topsoil and Made Ground overlie Tidal Flat Deposits. Elevated concentrations of contaminants (particularly biological and nutrient-rich contaminants) were observed in soils and the groundwater. Asbestos was also observed in one location at the site. Based on the programme of intrusive works undertaken to date, it is recommended that additional intrusive works are undertaken to confirm and define the ground and groundwater conditions present. A second phase of intrusive works should be undertaken and include both targeted and non-targeted trial pits and window sample boreholes. It is also recommended that a programme of gas and groundwater monitoring is undertaken to support these intrusive works. Due to the high nutrient content of the soil and presence of large quantities of biological contaminants there is a high probability that the soils are producing quantities of both methane and carbon monoxide (and potentially carbon dioxide) due to the anaerobic conditions associated with high the presence of soils rich in faecal content and bacteria. Specialist advice will need to be sought regarding the recommended testing for salmonella and anthrax and the supplementary biological testing.

This Executive Summary forms part of Grange GeoConsulting Limited report number R17053/002 (Issue 1) and should not be used as a separate document.

1.0 INTRODUCTION

1.1 Terms of Reference

Grange GeoConsulting Limited was commissioned by Kirk Homes Ltd to undertake intrusive works, associated with the redevelopment of the piggery to the south of Chapelgate in Sutton St James, Spalding, Lincolnshire. The proposed development comprises forty-two new homes (to include two bungalows and forty houses) with residential gardens, parking facilities and associated soft landscaping.

Ten trial pits (TP1 to TP10) were advanced to obtain information on the ground and groundwater conditions to support the proposed redevelopment plans. At the time of the intrusive works in June 2017, the piggery remained active and many animals were being kept at the site.

This report summarises the findings of the intrusive works carried out in June 2017 by Grange GeoConsulting Limited and the laboratory testing undertaken. Authorisation to proceed with this Factual Report was given by Kirk Homes Ltd via email.

The site is located on the western side of the village of Sutton St James and to the south of Chapelgate (the B1165 road) in the South Holland district of Lincolnshire. Sutton St James is a small village, located in a rural area. The site is within the Lincolnshire Fens, approximately 20km to the south-east of Spalding. The site covers approximately 1.8 hectares and is occupied by an active piggery. It includes working areas, yards, storage facilities and paddocks. A Site Location Plan (Drawing R17053-DWG1) and a Proposed Development Layout (Drawing R17053-DWG2), are presented in Appendix A.

1.2 Objectives

The objective of the intrusive works was to characterize the underlying ground conditions and assess the environmental quality of the soils and their potential to adversely impact on human health and the wider environment. This included an assessment of the level of contamination at the site.

1.3 Scope of Works

The scope of works, as outlined in the Grange Geoconsulting Limited proposal, dated 16th June 2017, is summarised below:

- One day of machine-excavated trial pits (up to ten) across the site to enable the logging of the soils encountered and the collection of soil samples for chemical analysis;
- Chemical (contamination analysis) testing of soils and groundwater; and
- Collaboration of the findings within a Factual Report.

1.4 Provided Information

The following has been provided to Grange GeoConsulting Consulting Ltd by Mr Steven Thorne for use in the preparation of this report:

- Landmark Information Group Sitecheck Combined Report dated 7th June 2017;
- Proposed Residential to the rear of Havencombe, Chapelgate, Sutton St James for Mr & Mrs Heanes (reference S015-040/1) dated February 2016; and
- Topographical Survey for the land to the rear of Avalon and Havencombe, Chapelgate, Sutton St James (reference 37815/02) dated December 2015

2.0 INTRUSIVE WORKS

2.1 Intrusive Works Rationale

The intrusive works rationale summarised below is based on NMC Nomenca Ltd requirements.

Table 2.1: Intrusive Works Rationale

Exploratory Hole	Purpose
TP1 to TP10 To a maximum depth of 2.3m below ground level (bgl)	To enable the logging of the soils encountered and assess soil and groundwater conditions and to allow the collection of soil and groundwater samples for chemical analysis

2.2 Works Undertaken

The intrusive works were undertaken on 23rd June 2017. The approximate positions of the trial pits were surveyed using a tape measure, with distances measured from features present on or adjacent to the site. The locations of the trial pits are shown in the Trial Pit Location Plan (Drawing R17053_DWG3) provided in Appendix C.

The intrusive works are summarised in Table 2.2. The trial pit logs, including details of ground conditions, soil and groundwater sampling, water strikes, any visual or olfactory evidence of contamination and in-situ testing, are presented in Appendix C.

Table 2.2: Summary of Site Works

Exploratory Hole	Method	Trial Pit Depth (m)	In-situ testing	Comments and Installations
TP1	Machine-excavated trial pit	1.9m bgl	None undertaken.	No groundwater encountered. No visual or olfactory evidence of contamination noted.
TP2	Machine-excavated trial pit	2m bgl	None undertaken.	No groundwater encountered. No visual or olfactory evidence of contamination noted.
TP3	Machine-excavated trial pit	1.8m bgl	None undertaken.	Slight seepage of groundwater below 1.7m bgl. No visual or olfactory evidence of contamination noted.
TP4	Machine-excavated trial pit	2.2m bgl	None undertaken.	No groundwater encountered. Evidence of plastic bags and occasional pig bones between 0.6m and 1.2m bgl.
TP5	Machine-excavated trial pit	2.3m bgl	Hand shear vane readings at 0.5m (70Kpa), 1m (85Kpa) and 1.2m bgl (55Kpa).	Slight seepage of groundwater below 1.8m bgl. No visual or olfactory evidence of contamination noted.
TP6	Machine-excavated trial pit	2m bgl	Hand shear vane reading at 1.2m bgl (48Kpa).	TP Evidence of plastic, iron, brick and string from ground level to 0.9m bgl.

Exploratory Hole	Method	Trial Pit Depth (m)	In-situ testing	Comments and Installations
TP7	Machine-excavated trial pit	2m bgl	None undertaken.	Slight seepage of groundwater below 1.8m bgl. No visual or olfactory evidence of contamination noted.
TP8	Machine-excavated trial pit	2m bgl	None undertaken.	Strong groundwater inflow between 1.5m and 1.8m bgl. Evidence of string, brick, plastic and bone between 0.6m and 1.8m bgl.
TP9	Machine-excavated trial pit	1.7m bgl	None undertaken.	Slight seepage of groundwater below 1.6m bgl. Evidence of rare plastic from ground level to 0.6m bgl.
TP10	Machine-excavated trial pit	2m bgl	Hand shear vane readings at 0.5m (100Kpa), 1m (50Kpa), 1.5m (35Kpa) and 2m bgl (15Kpa).	No groundwater encountered. No visual or olfactory evidence of contamination noted.

2.3 Ground Conditions

The ground conditions, as proven during the intrusive works, are in general accordance with the published geological literature. The ground conditions are presented in the borehole log in Appendix C and summarised in Table 2.3.

Table 2.3: Strata Encountered

Stratum Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Topsoil – varied between a dark brown, slightly sandy, silty Clay with live roots and a stiff, dark brown, slightly gravelly Clay. The gravel was fine to medium, sub-angular Flint.	0m bgl	0.3m bgl	0.2m to 0.3m
Made Ground – typically comprised brown, grey and mottled, slightly sandy, occasionally gravelly, slightly silty Clay with abundant rootlets. The gravel present was fine to coarse sub-rounded to angular Flint, concrete and brick. Fragments of string, plastic and plastic bags, pig bones and iron were also present.	0m bgl	0.6m to 1.8m bgl	0.6m to 1.8m
Tidal Flat Deposits – stiff, brown and grey mottled, silty Clay. A thin layer of peat was observed in TP10. Silty sandy layers also noted. With depth, the deposits were often orange or blue to grey in colour and logged as soft, silty Clay. To the eastern half of the site the Tidal Flat Deposits were typically comprised of a fine silty SAND. Occasional shell fragments noted.	0.2m to 1.8m bgl	Unproven (present at 2.3m bgl in WS5)	Not proven (present at 2.3m bgl in WS5)

2.3.1 Topsoil

Topsoil was present at ground level in five of the trial pits on site (TP1, TP2, TP3, TP5 and TP10). The Topsoil encountered in TP1, TP2, TP3 and TP10 was logged as a dark brown,

slightly sandy, silty Clay with live roots. The thickness varied between 0.2m and 0.3m. In TP5, the Topsoil was logged as stiff, dark brown, slightly gravelly Clay. The gravel was fine to medium, sub-angular Flint. It was present from ground level to 0.3m bgl.

2.3.2 Made Ground

Made Ground was present from ground level in five trial pits on site (TP4, TP6, TP7, TP8 and TP9). TP4, TP6 and TP8 were all located at the south of the site, while TP9 was located within the central portion of the site. The Made Ground typically comprised brown, grey and mottled, slightly sandy, occasionally gravelly, slightly silty Clay with abundant rootlets. The gravel present was fine to coarse sub-rounded to angular Flint, concrete and brick.

The thickness of the Made Ground varied between 0.6m and 1.8m thick. The greatest thickness of Made Ground was recorded in TP8. The lower layer of the Made Ground was predominantly brown Clay and contained fragments of string, brick, plastic, bone and pockets of black organic matter and was present to 1.8m bgl. In TP4 the Made Ground contained plastic bags and occasional pig bones between 0.6m and 1.2m bgl. Fragments of plastic, iron, string and brick were present to 0.9m bgl in TP6. Rare plastic was observed to 0.6m bgl in TP9.

2.3.3 Tidal Flat Deposits

The Tidal Flat Deposits observed at the site were described as stiff, brown and grey mottled, silty Clay. A thin layer of peat (0.1m thick) was observed in TP10 at 1.6m bgl within the deposits. Silty sandy layers were also noted. With depth, the deposits were often orange or blue to grey in colour and logged as soft, silty Clay. Occasional shell fragments were noted. To the eastern half of the site the Tidal Flat Deposits were typically comprised of a fine silty SAND. The Tidal Flat Deposits were present to the base of all trial pits.

The underlying bedrock was not encountered at the site.

2.3.4 Trial Pit Stability

In TP4, the pit began to collapse between 0.3m and 1.6m bgl. No further signs of instability were noted during the excavation of the trial pits.

2.4 Visual and Olfactory Evidence of Contamination

Evidence of plastic bags and occasional pig bones was encountered in TP4 between 0.6m and 1.2m bgl. Evidence of plastic, iron, brick and string from ground level to 0.9m bgl was noted in TP6 and string, brick, plastic and bone were observed in TP8 between 0.6m and 1.8m bgl. TP8. Evidence of rare plastic was found in TP9 from ground level to 0.6m bgl. No further visual or olfactory evidence of contamination was encountered in the shallow soils, this included evidence of hydrocarbon contamination and evidence of potentially asbestos-containing materials.

2.5 Groundwater

2.5.1 Groundwater Strikes

The groundwater strikes encountered during the excavation of the trial pits are summarised in Table 2.4. No visual or olfactory evidence of contamination was recorded in the groundwater in any of the trial pits.

Two groundwater samples were taken following the excavation of the trial pits and sent for laboratory analysis, the results of which are discussed in Section 4 of this report.

Table 2.4: Groundwater Strikes

Exploratory Hole	Date	Depth to Groundwater (m bgl)	Description
TP3	23/06/2017	1.7m bgl	Slight seepage of groundwater below 1.7m bgl.
TP5	23/06/2017	1.8m bgl	Slight seepage of groundwater below 1.8m bgl.
TP6	23/06/2017	1.9m bgl	Slight seepage of groundwater below 1.9m bgl.
TP7	23/06/2017	2m bgl	Slight seepage of groundwater below 1.8m bgl.
TP8	23/06/2017	1.5m bgl	Strong groundwater inflow between 1.5m and 1.8m bgl.
TP9	23/06/2017	1.6m bgl	Slight seepage of groundwater below 1.6m bgl.

3.0 LABORATORY TESTING SCOPE

3.1 Chemical (Contamination Analysis) Testing

3.1.1 Sampling Strategy

The following samples were taken by Grange GeoConsulting on 23rd June 2017:

- 4 No. samples from the Topsoil;
- 4 No. sample from the Made Ground; and
- 2 No. sample of groundwater (following the excavation of the trial pits).

The samples were taken, stored, and transported in general accordance with the British Standard 10175: 2011 Code of Practice for Investigation of Potentially Contaminated sites, and transported by courier to I2 Analytical Services; a UKAS accredited laboratory.

3.1.2 Laboratory Analyses Undertaken

The following analyses were undertaken:

Soils

Arsenic (As), Boron (B) (water soluble), Beryllium (Be), Cadmium (Cd), Hexavalent and Total Chromium (Cr II and VI), Copper (Cu), Lead (Pb), Inorganic Mercury (Hg), Nickel (Ni), Selenium (Se), Vanadium (V), Zinc (Zn), Total Cyanide, pH, Sulphide and Elemental Sulphur, Organic Matter, Sulphate, Ammonium, Nitrogen, Asbestos Screen, Speciated Total Poly-Aromatic Hydrocarbons (PAHs) and total phenols.

Testing for bacterial (microbial) contaminants including Total Coliforms, E.coli, Faecal Streptococci and Clostridia was also carried out.

Groundwater

Silver (Ag), Aluminium (Al), Arsenic (As), Boron (B) (water soluble), Barium (Ba), Cadmium (Cd), Cobalt (Co), Hexavalent and Total Chromium (Cr II and VI), Copper (Cu), Iron (Fe), Mercury (Hg), Magnesium (Mg), Manganese (Mn), Molybdenum (Mo), Sodium (Na), Nickel (Ni), Lead (Pb), Antimony (Sb), Selenium (Se), Tin (Sn), Vanadium (V), Zinc (Zn), Free and Total Cyanide, pH, Total Phenols, Ammonium, Fluoride, Chloride, Sulphate, Bromate, Nitrate, Nitrite and Speciated Poly-Aromatic Hydrocarbons (PAHs).

4.0 CONTAMINATION RISK ASSESSMENT AND LABORATORY TESTING RESULTS

A risk-based approach is used for the assessment of contamination. This requires identification of a contaminant source, a receptor, and a realistic pathway via which the contaminant may reach the receptor. The key receptors considered in this assessment are human health (site end users and ground workers) and controlled waters (due to the presence of Unproductive Strata beneath the site, the vicinity is drained via a network of culverts, streams and field drains. The closest surface water features are listed as field drains on the eastern, western and southern site boundaries).

The Risk Assessment is a two-stage process. The first stage is to perform a Generic Quantitative Risk Assessment (GQRA) - the soil test results have been compared against the relevant Generic Assessment Criteria (GAC). In the absence of a complete regulatory set of screening values, derived using the CLEA Framework, Grange GeoConsulting Limited GAC screening values have been utilised and are based on the following:

- Category 4 Screening Levels (C4SLs) published by DEFRA;
- The 2014 Land Quality Management (LQM) / Chartered Institute of Environmental Health (CIEH) Suitable for Use Levels for Human Health Risk Assessment (S4ULs); and
- Guidance values produced by the Environmental Industries Commission (EIC), the Association of Geotechnical and Geoenvironmental Specialists (AGS), and Contaminated Land: Application in Real Environments (CL:AIRE) in December 2009.

The second stage of the Risk Assessment process is risk evaluation, which comprises an authoritative review of the findings with other pertinent information in cases where the GACs are exceeded, to consider if exceedances may be acceptable in the context of the site.

4.1 Human Health

This is a Tier 2 assessment, using GAC soil screening values, and involves generic human health risk assessment for the CLEA scenario: **Residential with plant uptake.** This scenario is considered appropriate given the proposed use of the site.

The Soil Organic Matter Content (SOM) of the soils varied between 2.9% and 17%. The average SOM was 7.79%. Therefore, GACs based on a SOM of 6% have been utilised.

Four samples were taken from the Made Ground and four from the Topsoil. The chemical testing results have been screened against Grange GeoConsulting Limited GAC screening values (provided in Appendix E) to carry out an assessment of potential risks associated with contamination. Justification for the criteria adopted for this Risk Assessment is given in Appendix D. In cases where the sample tested for a given substance was below the GACs, no further consideration is necessary for that substance.

As part of the chemical testing undertaken three samples were also tested for bacterial (microbial) contaminants (TP4, TP6 and TP8). GAC screening values for bacterial contaminants are not available, though a qualitative assessment has been undertaken. A discussion with the biological laboratory (a sub-contractor of I2 Analytical Services) who have

undertaken the testing to obtain advice and guidance relating to the results has also been carried out.

4.1.1 Controlled Waters

Two groundwater samples were taken following the excavation of the trial pits on site. The water pooled at the base of the pits were collected and sent for analysis at approximately 2.2m bgl in TP5 and approximately 1.8m bgl in TP8. The risks to groundwater and surface water from contaminants on site have been assessed against the Environment Agency (2006) Remedial Targets Methodology (RTM). Pollutants from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC), and as such are regulated under the Agency's 'limit' pollution objective.

Acceptable Water Quality Targets (WQT) are defined for protection of human health (based on UK Drinking Water Standards (DWS)) and for the protection of aquatic ecosystems (Environmental Quality Standards (EQS)). World Health Organisation drinking water standards can also be used for the protection of human health.

4.2 Risk Evaluation

4.2.1 Human Health

The sample taken from TP8 at 1.8m bgl in the Made Ground recorded a concentration of benzo(a)pyrene of 3.2 mg /kg marginally exceeding the GAC of 3 mg / kg.

No GACs for nitrogen or ammonium for the residential with plant uptake scenario are available, though it was noted that extremely high concentrations of nitrogen (including 450 mg / kg in TP4, 3,500 mg / kg in TP6 and 2,800 mg /kg in TP8) were recorded. Similarly, very high ammonium concentrations (including 55 mg / kg in TP4 and 40 mg /kg in TP8) were recorded. These high levels of nitrogen and ammonium in the site soils are associated with the use of the site as a piggery and these soils are likely to be impacted by animal sewage, waste and animal burials associated with site operations.

One sample, taken from TP7 at 0.2m bgl was found to contain asbestos. Loose chrysotile (white asbestos) was detected at concentrations of <0.001% in the Made Ground. No further samples were found to contain asbestos.

A summary of the concentrations of bacterial contaminants recorded in the soil samples collected at the site is provided in Table 4.1.

Table 4.1: Bacterial contaminant concentrations in soils

Contaminant	Concentration recorded in TP4	Concentration recorded in TP6	Concentration recorded in TP8
Total Coliforms	> 242,000 mpn / gram	> 242,000 mpn / gram	> 242,000 mpn / gram
E. Coli	600 mpn / gram	600 mpn / gram	1,000 mpn / gram
Faecal Streptococci	> 8,000 mpn / gram	> 8,000 mpn / gram	> 8,000 mpn / gram

Contaminant	Concentration recorded in TP4	Concentration recorded in TP6	Concentration recorded in TP8
Clostridia	> 8,000 mpn / gram	> 8,000 mpn / gram	> 8,000 mpn / gram

Extremely high concentrations of all four of the bacterial contaminants were recorded in the samples taken at the site. A discussion with the biological laboratory confirmed that the concentrations recorded are extremely high and indicate the presence of soils rich in faecal content and bacteria. The concentrations of Faecal Streptococci and Clostridia were noted to be particularly high. The laboratory noted that the concentrations of bacteria within these samples were so high that they exceeded the upper limits of detection of the laboratory apparatus were exceeded.

The presence of high concentrations of total coliforms (which refers to a large group of bacteria typically associated with faecal origin), Clostridia and Faecal Streptococci (both evidence of faecal contamination) indicate that the activities at the piggery have had a huge impact on the underlying soils (with high levels of bacterial contamination observed to a depth of 1.8m bgl in TP8) and that they are impacted by animal waste (and slurry) and the historical burial of animals at the site. The laboratory indicated that the levels of bacterial spores in the soils are at a level where they are likely to require removal to ensure safe occupation of the site for use as residential properties in the future. The laboratory has recommended that prior to this, additional testing be undertaken to determine the extent of this contamination across the site. The laboratory also advised that based on the biological results obtained to date, there is the potential for salmonella and anthrax to impact the site and that further testing should be undertaken.

4.2.2 Controlled Waters

The samples of groundwater taken from TP5 and TP8 were not found to contain any contaminant concentrations exceeding the Environmental Quality Stands (EQS), except for a marginally elevated concentration of copper in TP8 of 15 µg/kg. This concentration exceeded the threshold of 5 ug/kg. Copper is an essential nutrient at low concentrations, but is toxic to aquatic organisms at higher concentrations. This concentration in groundwater is not considered to pose a risk to human health.

Seven contaminants were recorded in groundwater at concentrations above the UK Drinking Water Standards (DWS) in one or more samples. Significant exceedances of the UK DWS were recorded for some contaminants. These exceedances are summarised in Table 4.2. It should be noted that the use of drinking water standards to undertake a risk assessment for the site is a very conservative approach, particularly as the water within the trial pits will not be used as a potable water supply.

Table 4.2: Groundwater exceedances of UK drinking water standards

Contaminant	Exceedance recorded in TP5 groundwater sample	Exceedance recorded in TP8 groundwater sample	UK drinking water standard
Sulphate as SO_4	330 mg / litre	640 mg / litre	250 mg / litre

Contaminant	Exceedance recorded in TP5 groundwater sample	Exceedance recorded in TP8 groundwater sample	UK drinking water standard
Nitrate as NO_3	74.3 mg / litre	354 mg / litre	0.5 mg / litre
Nitrite as NO_2	0.87 mg / litre	3 mg / litre	0.5 mg / litre
Manganese	0.25 mg / litre	0.09 mg / litre	0.05 mg / litre
Ammonium as NH_4	No exceedance	9000 mg / litre	0.5 mg / litre
Sodium	No exceedance	260 mg / litre	200 mg / litre

A slightly elevated concentration of sulphate (as SO_4) of 330 mg / kg was recorded in TP5. A concentration of sulphate over twice the UK DWS of 640 mg / litre was recorded in TP8. High concentrations of nitrite as NO_2 were also recorded, up to six times the UK DWS. Slightly elevated concentrations of manganese were recorded in TP5 and TP8. TP8 also recorded a slightly raised concentration of sodium.

Significantly elevated concentrations of ammonium (as NH_4) some 18,000 times the UK DWS were recorded in TP8. Nitrate as NO_3 concentrations recorded in TP5 and TP8 were some 150 and 700 times the UK DWS for this component. These extremely elevated concentrations of ammonium and nitrate are associated with the use of the site for agricultural purposes and the presence of large concentrations of animal waste (and slurry), the historical burial of animals and the potential use of fertilisers and pesticides etc. The soils impacted by these activities will therefore that a high organic and nutrient content.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Ground Conditions

The ground conditions across the site, as proven during the intrusive works, are in general accordance with the published geological literature. Topsoil is present in some areas of the site and variable thicknesses of Made Ground up to 1.8m thick (particularly in the south of the site) are present. The Tidal Flat Deposits underlie the Topsoil and the Made Ground.

5.2 Groundwater

Perched groundwater is present within the Made Ground and Tidal Flat Deposits at the site.

5.3 Contamination Testing

Elevated concentrations of contaminants (particularly biological and nutrient-rich contaminants) were observed in the soils and the groundwater at the site. Asbestos was also observed in one location.

Based on the intrusive works undertaken to date, it is recommended that additional intrusive works are carried out at the site to confirm and define the ground and groundwater conditions. The second phase of intrusive works should include both targeted and non-targeted trial pits and window sample boreholes. It is also recommended that a programme of gas and groundwater monitoring is undertaken to support the intrusive works. Due to the high nutrient content of the soils at the site and the presence of large quantities of bacterial contaminants there is a high probability that the soils are producing methane and carbon monoxide (and potentially carbon dioxide) due to the anaerobic conditions associated with high the presence of soils rich in faecal content and bacteria.

Specialist advice will need to be sought regarding the recommended testing for salmonella and anthrax and the supplementary biological testing.

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APPENDICES

Appendix A DRAWINGS

Appendix B INTRUSIVE WORKS PHOTOGRAPHS

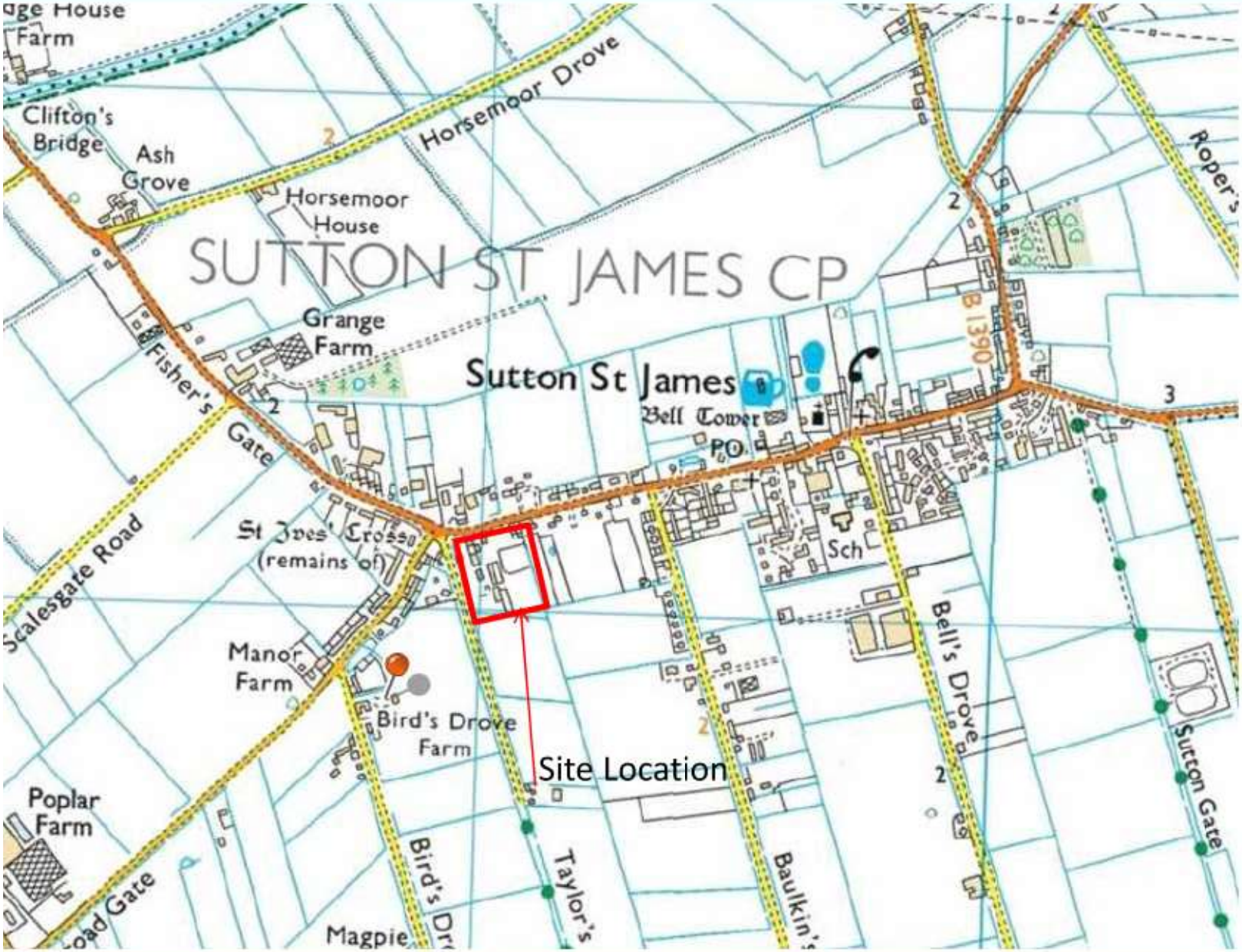
Appendix C TRIAL PIT LOCATION PLAN AND EXPLORATORY LOGS

Appendix D GRANGE GEOCONSULTING LIMITED METHODOLOGY

Appendix E CONTAMINATION TESTING RESULTS

Appendix A

DRAWINGS



Grange Geo	Sutton St James Site location plan	Client- Kirk Homes Ltd Date- July 2017	North	Drawing- R17053-DWG1

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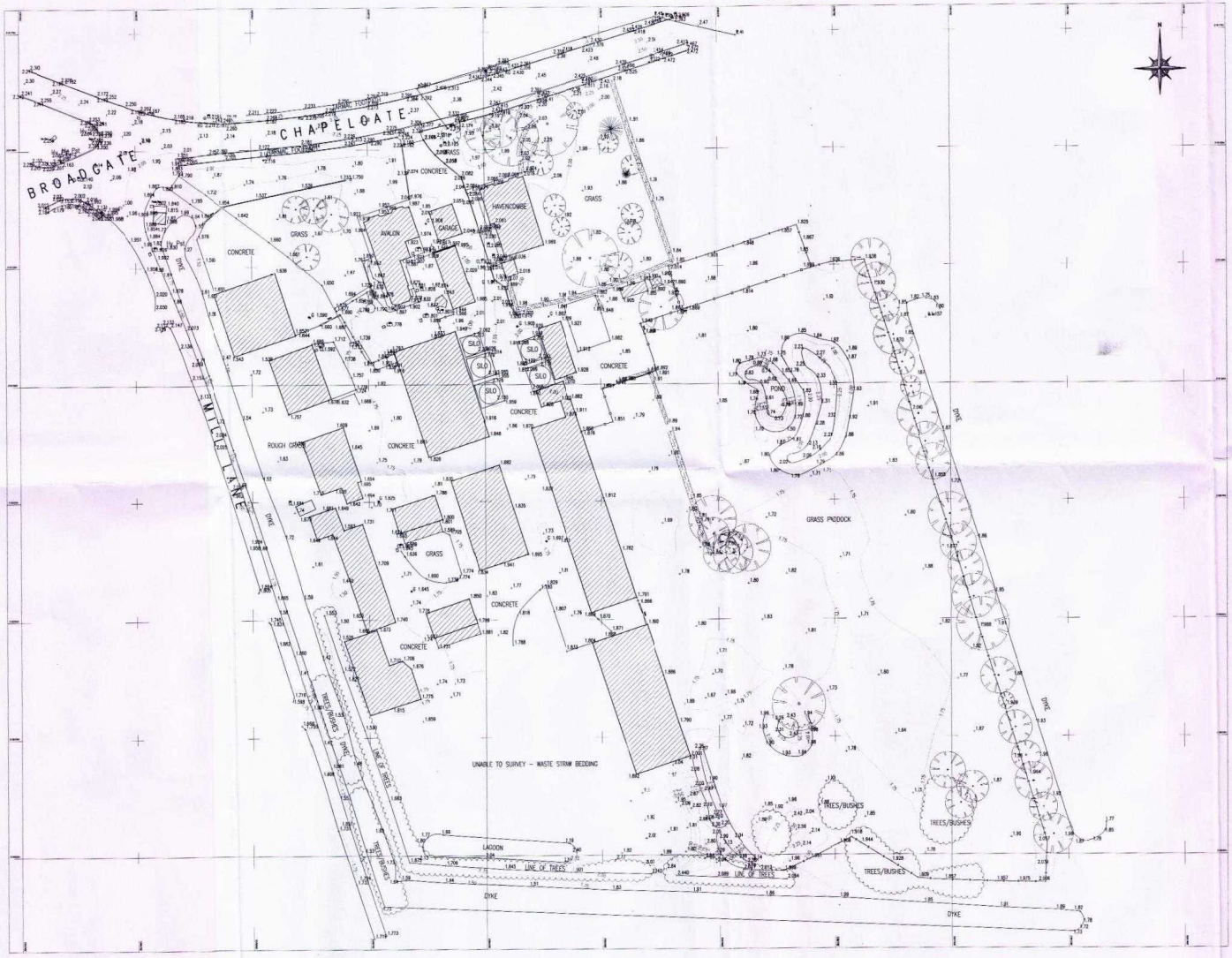
SURVEY STATIONS				
Name	Easting	Northing	Heigh	Remark
S N H1	518790.783	415299.927	2.43	P-K Nail
S N H2	518742.356	415328.873	2.05	Nail
S N H3	518798.548	415294.983	2.46	Nail

The survey grid is the National Grid obtained from ETRS89 GPS Coordinates with OSTN02 transformation. Levels shown to Ordnance Survey datum using ETRS89 GPS with OSGM02 transformation.

Surveyed boundary features are not necessarily legal boundaries.

All utilities have been identified to the best of the surveyors knowledge. The correct identification can not be 100% guaranteed and should be independently verified prior to use in any design or building works.

Services may be obscured by parked cars, leaf litter or building materials etc.



Rev	Date	Remarks

Status: FOR INFORMATION

SRC
SIDEBOTTOM RICHARDSON CHENG LTD
CONSULTING STRUCTURAL AND CIVIL ENGINEERS
13 High Street, Spalding, Lincs. PE11 1TW
Tel: 01775 712660
Fax: 01775 712635
Email: src@srcltd.com

Project: Survey at Land To Rear Of Avalon & Havencombe Chapelgate, Sutton St James Spalding, PE12 0EF

Title: Topographical Survey

Date	Dec. 2015	Scale	1:500 @A1
Drawn	AS	Checked	SRC
Design	-	File Name	37815-02

DRG No. 37815/02 Rev -

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General Notes

Do not scale from thisdrawing.

This drawing is copyright and may not be altered, traced, copied, photographed or used for any purpose other that that for which it is issued without written permission from Messrs Status Design.

The General Contractor is to check all dimensions on site and report discrepancies to the Architect.

All details shown on this drawing are based upon typical site conditions related to the area. No responsibility can be accepted for abnormal conditions unless reported to the Architects so that design amendments may be considered. Site soil surveys are recommended in respect of foundations to establish specific site conditions before foundation work is undertaken.

Please note this drawing is not a conveyance drawing.

Proposed on-site soakaways to be maintained by the owner for the life duration of the property.

This drawing is limited in the amount of information contained and does not purport to contain a full specification of the works. It is solely for the purpose of obtaining Planning and Building Regulations approvals. This drawing must not be used as a contract document alone. The works will not be supervised or inspected by Status Design unless specifically contracted to do so. It is the client or their agent's responsibility to control workmanship, substitution of materials, adherence is specification, variations to contract, etc.

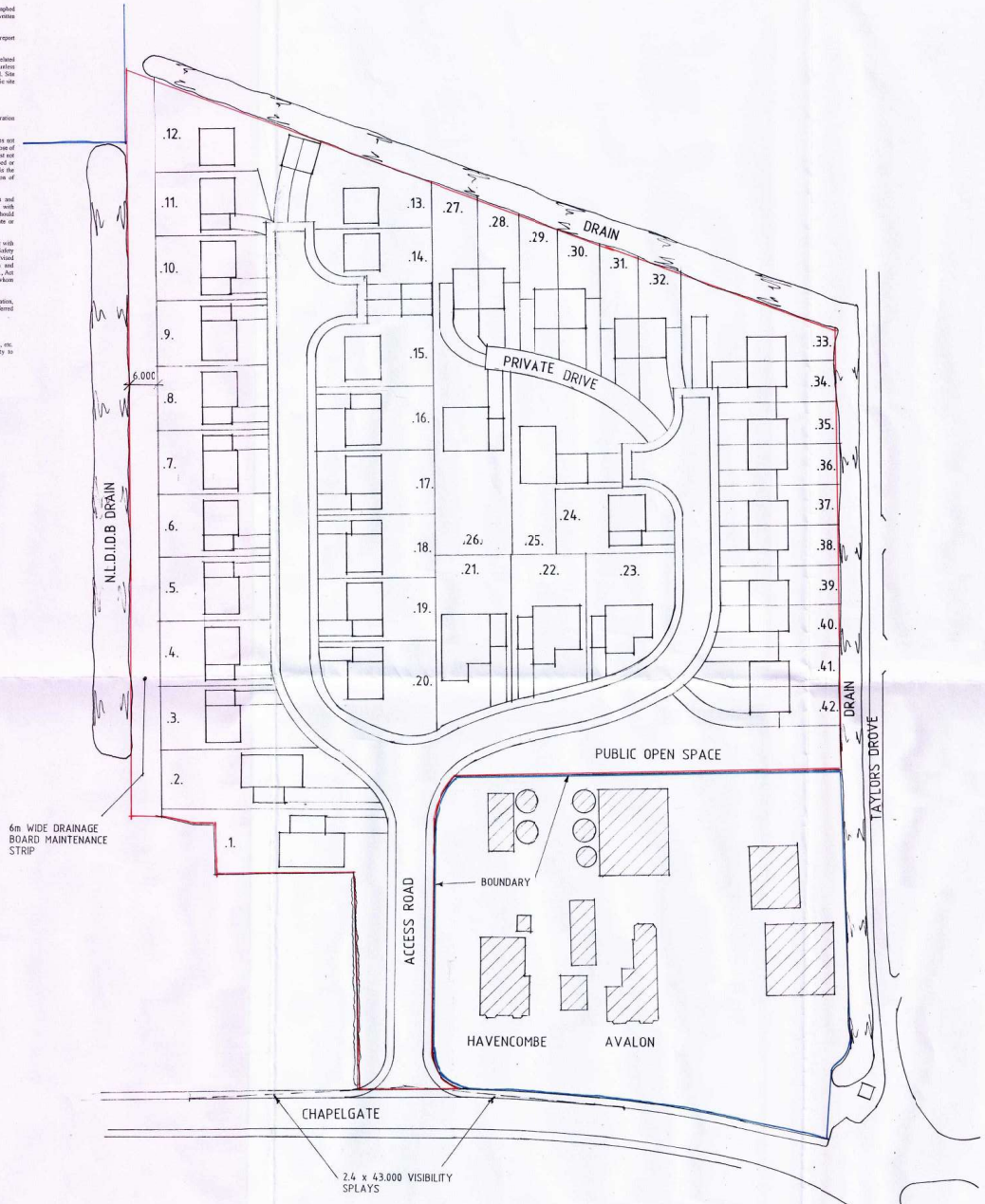
All materials to be new unless stated otherwise and all components and materials, etc. to be used, fitted and installed, etc. in strict accordance with manufacturers' instructions and relevant Code of Practice. Materials should conform to appropriate British Standard specification or BBA Certificate or European Code equivalent.

The Employer/Client shall ensure that the selected contractor is conversant with and adopts all measures necessary to achieve compliance with Health and Safety Legislation for Building Sites and Work Places. The Employer/Client is advised that should the works need to comply with the Construction Design and Management Regulations 1994 (CDM) and Health and Safety at Work, etc., Act 1974 (HSW Act) an independent Planning Supervisor will be required, whom should be supplied with a set of all relevant drawings, etc.

The works shall comprise of all that shown on the drawings and information, etc. Works that may not specifically be shown but may be reasonably inferred as necessary to carry out the works shall be deemed to be included.

These notes relate to this drawing and all associated drawings.

It is the property/landowner's responsibility to be aware of the Party Wall, etc. Act 1996 when building or carrying out alterations in close proximity to adjoining neighbour's boundaries.



SITE LAYOUT

THIS DRG. TO BE READ IN CONJUNCTION WITH 37815/02

NOTE

THIS IS AN INDICATIVE LAYOUT ONLY

DWELLINGS

PLOTS 1 & 2 TO BE BUNGALOWS

PLOTS 3 TO 42 TO BE HOUSES

AMENDED PLAN
Ref. A2

SHDC
Planning & Development
13 JAN 2016
Ref: 0284-16

B - ALTS - 30.11.16
A - ALTS - 16.3.16

Status DESIGN
CONSULTANTS IN ARCHITECTURE & PLANNING

PROPOSED RESIDENTIAL TO THE REAR OF HAVENCOMBE, CHAPELGATE, SUTTON ST. JAMES FOR

MR. & MRS. P. HEANES.

INDICATIVE SITE PLAN

1:500 | SD15-040/1

FEB-16 | B.GILHAM.

2 Edinburgh Walk, Holbeach,
Spalding, Lincs. PE12 7AP
Tel: 01406 424343 Fax: 01406 490702

Appendix B

INTRUSIVE WORKS PHOTOGRAPHS



Figure 1: Excavated soil containing waste materials on site



Figure 2: Pooling of water at the base of a trial pit on site



Figure 3: Plastic within excavated materials at the site



Figure 4: Excavation of Tidal Flat Deposits on site

Appendix C

INTRUSIVE WORKS PLAN AND EXPLORATORY LOGS



Grange Geo	Trial Hole Locations	Client- Mr James Kirk Date- Jun 2017	North	Drawing- R17053-DWG1

Trial Pit Log

TP No: 1

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Topsoil, dark brown, slightly sandy, silty CLAY. Live roots to 0.40m.		
			Stiff, brown and grey mottled, silty CLAY. (Tidal Flat Deposits)		
0.50				0.50	
1.00			Light brown and grey mottled, silty, fine SAND. (Tidal Flat Deposits)	1.00	
1.50				1.50	
2.00			End of trial hole.	2.00	

General Comments:

1. Pit walls stable
2. No groundwater encountered.
3. No visible or olfactory evidence of contamination

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 2

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Topsoil, dark brown, slightly sandy, silty CLAY. Live roots to 0.40m.		
			Stiff, brown and grey mottled, silty CLAY. (Tidal Flat Deposits)		
0.50				0.50	
			Orange brown and grey mottled, silty SAND. (Tidal Flat Deposits)		
1.00				1.00	
1.50				1.50	
2.00				2.00	
			End of trial hole.		

General Comments:

1. Pit walls stable
2. No groundwater encountered
3. No visible or olfactory evidence of contamination

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 3

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Sample Depth (m)	Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Topsoil, dark brown, slightly sandy, silty CLAY. Live roots to 0.40m.		
0.50			Light brown, sandy, silty CLAY. (Tidal Flat Deposits)	0.50	
			Light brown and grey mottled, silty, fine SAND. (Tidal Flat Deposits)		
1.00				1.00	
1.50				1.50	
			End of trial hole.		
2.00				2.00	

General Comments:

1. Pit walls stable
2. Slight groundwater seepage below 1.70m.
3. No visible or olfactory evidence of contamination

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 4

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Made Ground, dark brown, slightly sandy, silty CLAY. Abundant live roots.		
			Made Ground, brown, silty CLAY.		
0.50				0.50	
			Made Ground, dark brown, silty CLAY with abundant plastic bags and occasional pig bones.		
1.00				1.00	
			Grey, silty fine SAND. (Tidal Flat Deposits)		
1.50				1.50	
2.00				2.00	
			End of trial hole.		

General Comments:

1. Pit walls collapsing from 0.30 to 1.60mbgl.
2. No groundwater encountered
3. Evidence of plastic and animal bone from 0.60 to 1.20mbgl

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 5

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Topsoil, stiff, dark brown, slightly gravelly, CLAY. Gravel of fine to medium, sub angular flint. Live roots to 0.50m.		
0.50	HSV	70Kpa	Brown, stiff, silty CLAY. (Tidal Flat Deposits)	0.50	
1.00	HSV	85Kpa		1.00	
1.20	HSV	55Kpa			
1.50			Light brown, silty, fine SAND. (Tidal Flat Deposits)	1.50	
2.00				2.00	
			End of trial hole.		

General Comments:

1. Pit walls stable
2. Slight groundwater seepage below 1.80m.
3. No visible or olfactory evidence of contamination

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 6

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Made Ground, dark brown, slightly sandy, silty CLAY with fragments of plastic, iron, brick, string.		
0.50				0.50	
1.00			Soft, to firm, grey and brown mottled, silty CLAY. (Tidal Flat Deposits)	1.00	
1.20	HSV	48Kpa			
1.50				1.50	
2.00			End of trial hole.	2.00	

General Comments:

1. Pit walls stable
2. Slight groundwater seepage below 1.90mbgl.
3. Evidence of contamination from ground level to 0.90mbgl.

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 7

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Made Ground, dark brown, slightly gravelly, CLAY. Gravels of fine to medium, sub angular flint.		
0.50			Firm, brown, silty CLAY. (Tidal Flat Deposits)	0.50	
			Dark grey with some brown mottling, silty CLAY. (Tidal Flat Deposits)		
1.00				1.00	
1.50			Brown and orange brown mottled, silty, fine SAND. (Tidal Flat Deposits)	1.50	
2.00			End of trial hole.	2.00	

General Comments:

1. Pit walls stable
2. Groundwater seepage below 1.80mbgl.
3. No visible or olfactory evidence of contamination

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 8

Client: Kirk Homes ltd

Sheet: 1 of 1

Project: Sutton St James

Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Made Ground, brown and grey mottled, slightly gravelly, silty CLAY. Gravel of fine to coarse, sub angular flint and brick.		
0.50				0.50	
			Made Ground, brown and grey mottled CLAY, with fragments of string, brick, plastic, bone and pockets of black organic matter.		
1.00				1.00	
1.50				1.50	
			Soft, brown and grey silty CLAY.		
2.00			(Tidal Flat Deposits)	2.00	
			End of trial hole.		

General Comments:

1. Pit walls stable
2. Strong groundwater inflow from 1.50 to 1.80mbgl.
3. Evidence of contamination between 0.60 and 1.80mbgl.

Date: 23/06/2017

Logged by: AH

Checked: AH

Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD

Tel: 07773529385

Trial Pit Log

TP No: 9

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Made Ground, brown, slightly gravelly, CLAY. Gravels of fine to course, angular to sub rounded brick, concrete and rare plastic.		
0.50				0.50	
			Firm, becoming soft, blue grey and brown mottled, silty CLAY. Occasional shell fragments. (Tidal Flat Deposits)		
1.00				1.00	
1.50				1.50	
			End of trial hole.		

General Comments:

1. Pit walls stable
2. Slight groundwater seepage below 1.60mbgl.
3. Evidence of plastci fragments from 0.00 to 0.60mbgl.

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Trial Pit Log

TP No: 10

Client: Kirk Homes ltd
Project: Sutton St James

Sheet: 1 of 1
Method: 7t tracked excavator

Grange Geo

Sample Depth (m)	Sample Type	S. Vane kN/m²	Description	Depth mBGL	Legend
			Topsoil, dark brown, slightly sandy, silty CLAY. Live roots to 0.40m.		
			Stiff, brown and grey mottled, silty CLAY.		
0.50	HSV	100Kpa	(Tidal Flat Deposits)	0.50	
1.00	HSV	50Kpa		1.00	
1.50	HSV	35Kpa		1.50	
			PEAT		W W W W
			Blue grey, very soft, silty CLAY.		
			(Tidal Flat Deposits)		
2.00	HSV	15Kpa		2.00	
			End of trial hole.		

General Comments:

1. Pit walls stable
2. No groundwater encountered
3. No visible or olfactory evidence of contamination

Date: 23/06/2017
Logged by: AH
Checked: AH
Job No: R17053

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Appendix D

Grange GeoConsulting Limited Methodology

RISK ASSESSMENT RATIONALE

The work presented in this report has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in BS5930:1999 and BS10175:2001. Important aspects of the risk assessment process are transparency and justification. The rationale behind the risk assessments presented is given in this appendix.

A preliminary risk assessment is made of both geotechnical and geo-environmental hazards identified at the desk study stage and confirmed (or amended) at the ground investigation stage. This is based on a simple matrix of probability of occurrence versus the consequence, as explained below. In the case of geo-environmental hazards, the risk assessment process proceeds to the next level, the generic risk assessment, in which actual contaminant concentrations are considered.

Preliminary Risk Assessment (Geotechnical Risk Register)

The preliminary geotechnical risk register is compiled in accordance with the Highways Agency Design Manual for Roads and Bridges HD/02. This requires an estimation of the *probability* of an event happening multiplied by the *impact* or consequences of that event. Five levels of probability and impact are given scores and these are multiplied to give a risk rating and a qualitative risk level is assigned as in Table A, based on the terminology of Clayton (2001).

Table A: Geotechnical Risk Rating

Assessment of Geotechnical Risks (Risk Register)				
Probability (P)	**Impact (I)**	**Impact in terms of cost or time (% of construction cost or time)**	**Risk Rating (R = P x I)**	**Risk Level**
Very likely (5)	Very High (5)	>25%	17 to 25	Intolerable
Likely (4)	High (4)	10 to 25%	13 to 16	Intolerable
Probable (3)	Medium (3)	4 to 10%	9 to 12	Substantial
Unlikely (2)	Low (2)	1 to 4%	5 to 8	Tolerable
Negligible (1)	Very Low (1)	<1%	1 to 4	Trivial

Preliminary Risk Assessment (Geoenvironmental Consequences and Probability)

The Preliminary Risk Assessment includes a geo-environmental Hazard Identification, which seeks to list all the suspected contaminant **sources**, the **receptors** that might be harmed by those sources and the **pathways** via which the sources might reach the receptors to cause the harm. The source-pathway-receptor concept is known as a pollution linkage, and only when a linkage is complete is there any possibility of risk of harm arising.

The Hazard Identification evaluates all the **possible** pollution linkages in tabular form. Professional judgement is then used to evaluate which of these pollution linkages may be considered as **plausible**. Plausible pollution linkages are unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and the chemical analysis of soil and water samples.

Where no plausible linkage identified, the linkage is classed as 'no linkage' in the summary table and no further action is required. If a linkage is plausible, a comparison is made of consequence against probability in general accordance with the guidance given in CIRIA Report C552 (Rudland *et al* 2001). Classification of consequences and probability are given in CIRIA C552 Tables 6.3 and 6.4, respectively, but there are several inconsistencies in the original Table 6.3, in particular relating to 'significant harm or significant possibility of significant harm' (SH/SPOSH). Consequently, the table has been updated by Grange Geo in line with current practice and is given in Table B below. Also added are scores from 1 to 4 for each category.

The basis of the classification is that 'severe' and 'major' are likely to result in SH/SPOSH as defined by the EPA 1990, Part 2A, with 'severe' resulting in acute harm. 'Moderate' lies below the level of SH/SPOSH but above the level of 'no harm' as implied by the relevant Generic assessment criterion (GAC, see below). Minor lies below the 'no harm' level.

Table B: Classification of Consequences of Geoenvironmental Risks

Classification of Consequences for Geoenvironmental Risks		
Classification	**Definition**	**Examples**
Severe (4 points)	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. I.e. >>SH/SPOSH, concentrations are high enough to cause acute (short-term) effects.	Human health: short-term (acute) effects likely to result in significant harm. E.g. high conc. of cyanide at the surface of an informal recreational area. Planting: complete and rapid die-back of landscaped areas. Controlled waters: short-term pollution, e.g. major spillage into controlled water. Buildings etc.: catastrophic damage, e.g. explosion causing collapse. Ecosystems: short-term risk to an ecosystem or organism forming part of that ecosystem in a designated protected area, e.g. by contamination spillage. Site workers: risk assessment required to determine PPE and this may involve USEPA Level A, B or C protection.
Major (3 points)	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. I.e. >SH/SPOSH.	Human health: long-term (chronic) effects likely to result in significant harm. E.g. high conc. of contaminants close to the surface of a development site. Planting: stressed or dead plants in landscaped areas. Controlled waters: pollution of sensitive water resources, e.g. leaching into major or minor aquifers or rivers. Buildings etc.: damage renders unsafe to occupy. Ecosystems: death of species in an ecosystem in a designated protected area, e.g. by contamination spillage. Site workers: risk assessment required to determine PPE and this may involve USEPA Level B, C or D protection.
Moderate (2 points)	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of no harm but not unacceptable intake or contact. I.e. >SVG/GAC but <SH/SPOSH.	Human health: harm but probably not significant harm unless particularly sensitive individual within the receptor group. May be aesthetic/olfactory impacts. Planting: damage to plants in landscaped areas, e.g. stunted growth, discoloration. Controlled waters: pollution of non-sensitive water bodies e.g. leaching into non-classified groundwater or minor ditches. Buildings etc.: damage to sensitive buildings etc. Ecosystems: minor change in an ecosystem in a designated protected area, but not significant harm. Site workers: risk assessment required to determine PPE and this may involve USEPA Level C or D protection.

Classification of Consequences for Geoenvironmental Risks		
Classification	**Definition**	**Examples**
Minor (1 point)	Concentration of contaminants is likely to (or is known from previous data to) be less than that indicative of no harm. I.e. <SGV/GAC.	No measurable effects, but simple PPE required (USEPA Level D protection, i.e. overalls, boots, goggles, hard hat).

CIRIA Table 6.4 is reproduced as Table C below, but also with the addition of scores from 1 to 4. This provides an estimate of the probability that the event described by the pollution linkage will occur. For example, the likelihood that pollution of groundwater will occur by leaching of metals into the aquifer.

Table C: Classification of Probability of Geoenvironmental Risks

Classification of Probability of Geoenvironmental Risks	
Classification	**Definition**
High (4 points)	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Medium (3 points)	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event in not inevitable, but possible in the short term and likely over the long term.
Low (2 points)	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is no means certain that even over a longer period such event could take place, and is less likely in the shorter term.
Unlikely (1 point)	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

The perceived level of risk for each pathway is then derived from the probability versus consequences matrix, modified after CIRIA C552 Table 6.5, given in Table D below. The scores are summed accordingly and the result assigned a risk level by dividing the range between the minimum score of 1 and the maximum score of 16 equally into 5 categories i.e. 1 to <4 is very low risk, 4 to <7 is low risk, 7 to <10 is moderate risk, 10 to <13 is high risk and 13 to 16 is very high risk.

Table D: Qualitative Risk Level from Consequence and Probability

		Consequence			
	product	**Severe (4)**	**Major (3)**	**Moderate (2)**	**Minor (1)**
Probability	**High (4)**	16 = Very high risk	12 = High risk	8 = Moderate risk	4 = Low risk
	Medium (3)	12 = High risk	9 = Moderate risk	6 = Low risk	3 = Very low risk
	Low (2)	8 = Moderate risk	6 = Low risk	4 = Low risk	2 = Very low risk
	Unlikely (1)	4 = Low risk	3 = Very low risk	2 = Very low risk	1 = Very low risk

This approach assumes an equivalence between probability and consequences and ignores the difficulty that can arise where to probability of occurrence appears to be almost negligible but the consequences are very severe. In such conditions, there is a degree of subjectivity in assessing the level of risk and it could be low, moderate or high. Such risks may require specialist consideration beyond the scope of this standard report.

A description of the classified risks and the likely action required can be determined from Table E.

Table E: Description of the Classified Risks and Likely Action Required

Description of Classified Risks and Likely Action Required	
Very High Risk	A significant pollution linkage, including actual evidence of significant harm or significant possibility and significant harm, is clearly identifiable at the site (e.g. from visual or documentary evidence) under current conditions, with potential for legal and/or financial consequences for the site owner or other Responsible Person. Remediation advisable based on acute impacts being likely. Immediate action should be considered.
High Risk	A pollution linkage is identifiable at the site under current and future use conditions. Although likely, there is no obvious actual evidence of significant harm or significant possibility and significant harm under current conditions. Extent of risk is therefore subject to confirmation by investigation and risk assessment and most likely to be deemed significant. Remediation required for redevelopment and may also be required under Part 2A for existing receptors.
Moderate Risk	A pollution linkage is identifiable at the site under current and future use conditions. However, it is not likely to be a significant linkage under current conditions. Actual extent of risk subject to confirmation by additional investigation and risk assessment and most likely to lie between no possibility of harm (under current conditions) and significant possibility of significant harm (under conditions created by new use). Remediation may be required for redevelopment.
Low risk	Potential pathways and receptors exist but history of contaminative use or site conditions indicates that contamination is likely to be of limited extent and below the level of no possibility of harm. Precautionary investigations and risk assessment advisable on change of use.
Very Low Risk	No pollution linkage likely to exist under current or future conditions. Site not capable of being determined under Part 2A (in accordance with PPS23) where the Local Authority inspects the site. No further action recommended.

Contaminant Analysis of Samples

CLR 8 (Environment Agency 2002b), the DoE Industry Profile documents and ISO10381-5 provide good summaries of priority pollutants for UK sites. Additionally, the Environment Agency has produced a list of priority pollutants for ecological risk assessment in a consultation document (Environment Agency 2003a). These documents have been used, with the findings of the Phase 1 investigation, to scope the analyses of chemicals of potential concern.

Grange Geo considers there to be a minimum requirement for soil chemical analysis, even for Greenfield sites, to satisfy the 'suitable for use' criterion of the planning regime. The GACs adopted by Grange Geo for the Site are given in the following table.

There is no safe acceptable level for asbestos in soils, detect or non-detect is recorded with asbestos quantification undertaken on samples found to contain asbestos.

Select ->	SOM	6
Select ->	Scenario 1	Residential with Plant Uptake

	SGV / GAC	C4SL	S4UL
Cyanide	4.6		
Arsenic	32	37	37
Barium			
Beryllium	51		1.7
Boron	291		290
Cadmium	10	26	11
Chromium	627		910
Chromium VI	4.3	21	6
Copper	2330		2400
Lead		200	
Mercury (elemental)	1		1.2
Mercury (inorganic)	170		40
Nickel	130		130
Selenium	350		250
Vanadium	75		410
Zinc	3800		3700
TPH			
Benzene	0.33	0.87	0.37
Toluene	610		660
Ethyl Benzene	350		260
m/p Xylenes	230		310
o Xylenes	250		330
Xylenes	230		310
MTBE			
Naphthalene	8.7		13
Acenaphthylene	850		920
Acenaphthene	1000		1100
Fluorene	780		860
Phenanthrene	380		440
Anthracene	9200		11000
Fluoranthene	670		890
Pyrene	1600		2000
Benzo[a]anthracene	5.9		13
Chrysene	9.3		27
Benzo[b]fluoranthene	7		3.7
Benzo[k]fluoranthene	10		100
Benzo[a]pyrene	1	5	3
Indeno[123-cd]pyrene	4.2		41
Dibenzo[ah]anthracene	0.9		0.3
Benzo[ghi]perylene	47		350
Total USEPA 16 PAHs			

Aliphatic C5 - C6	110	160
Aliphatic C6 - C8	370	530
Aliphatic C8 - C10	110	150
Aliphatic C10 - C12	490	760
Aliphatic C12 - C16	2300	4300
Aliphatic C16 - C21	76000	110000
Aliphatic C21 - C35	76000	110000
Total Aliphatic		
Aromatic C5 - C7	0.33	300
Aromatic C7 - 8	610	660
Aromatic C8 - C10	120	190
Aromatic C10 - 12	290	380
Aromatic C12 - C16	570	660
Aromatic C16 - C21	770	930
Aromatic C21 - C35	1200	1700
Total Aromatic		
Total Aliphatic and Aromatic		

Appendix E

Contamination Testing Results

BACTERIOLOGICAL TEST REPORT

STANSTED LABORATORIES

Client: **I2 Analytical LTD**
Address: 7 Woodshots Meadow
Croxley Green Business Park
Croxley Green
Hertfordshire
WD18 8YS
Site: 17-52806 (Sutton St James)
FAO: Trevor Hill
Order No: 9022, 17-52806

Job Number: **M/182/48591**
Report No.: **51021.1**
Date Taken: Fri, 23rd Jun 2017 00:00
Date Rec'd: Thu, 29th Jun 2017

UKAS TESTING
2266

Stansted Laboratories LTD
Unit 9-10, Riverside Industrial Estate
27 Thames Road
Barking, Essex
IG11 0ND
Tel: +44 (0)20 8594 5104
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sales@stanstedlabs.co.uk
www.stanstedlabs.co.uk
Directors: B. Patel, K.Patel

Items Marked ¤ are not included in the UKAS Schedule

Sample ID	Description & Temperatures			Analysis	Result	Tested	Notes / Species
SL221087 *Soil*	773644 Init Temp ¤	Temp > 1 Min ¤	Temp > 2 Min ¤	Coliforms ¤	>242000 MPN/g	29/06/2017	
				E.Coli ¤	600 MPN/g	29/06/2017	
				Enterococci ¤	>8000 cfu/g	29/06/2017	
				Clostridium perfringens ¤	>8000 cfu/g	29/06/2017	
SL221088 *Soil*	773646 Init Temp ¤	Temp > 1 Min ¤	Temp > 2 Min ¤	Coliforms ¤	>242000 MPN/g	29/06/2017	
				E.Coli ¤	1000 MPN/g	29/06/2017	
				Enterococci ¤	>8000 cfu/g	29/06/2017	
				Clostridium perfringens ¤	>8000 cfu/g	29/06/2017	
SL221089 *Soil*	773649 Init Temp ¤	Temp > 1 Min ¤	Temp > 2 Min ¤	Coliforms ¤	>242000 MPN/g	29/06/2017	
				E.Coli ¤	600 MPN/g	29/06/2017	
				Enterococci ¤	>8000 cfu/g	29/06/2017	
				Clostridium perfringens ¤	>8000 cfu/g	29/06/2017	

Method Codes
SLM/B312/M - Coliforms and Escherichia coli
SLM/B316/M - Clostridium perfringens
SLM/B370/M - Enterococci

Legend & Footnotes
cfu = Colony Forming Units
mpn = Most Probable Number
TNTC = Too Numerous to Count

Sampling is not included in our UKAS Schedule.
All Samples Analysed as received.

Test report authorised by :
B.Patel

Director
Date: 03/07/2017 15:58:24

Test Report checked by : Theepa Supikaran
03/07/2017 15:02:05

Disclaimer
Results relate to water samples tested and should not be reproduced except in full, without the written approval of the laboratory. Interpretations and opinions are not included in our UKAS schedule.
00:00 means time not declared.

BACTERIOLOGICAL TEST REPORT

Client:	**I2 Analytical LTD**
Address:	7 Woodshots Meadow Croxley Green Business Park Croxley Green Hertfordshire WD18 8YS
Site:	17-52806 (Sutton St James)
FAO:	Trevor Hill
Order No:	9022, 17-52806

Job Number:	**M/182/48591**
Report No.:	**51021.1**
Date Taken:	Fri, 23rd Jun 2017 00:00
Date Rec'd:	Thu, 29th Jun 2017

UKAS TESTING
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Directors: B. Patel, K.Patel

------- END OF REPORT -------

Reg. Office: Unit 9-10 Riverside Ind. Estate, 27 Thames Road, Barking, Essex, IG11 0ND
Reg. in England No. 7270283

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e: reception@i2analytical.com

Analytical Report Number : 17-52806

Replaces Analytical Report Number : 17-52806, issue no. 1

Project / Site name:	Sutton St James	**Samples received on:**	26/06/2017
Your job number:	R17053	**Samples instructed on:**	28/06/2017
Your order number:		**Analysis completed by:**	10/07/2017
Report Issue Number:	2	**Report issued on:**	11/07/2017
Samples Analysed:	8 soil samples - 2 water samples		

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 17-52806

Project / Site name: Sutton St James

Lab Sample Number				773644	773645	773646	773647	773648
Sample Reference				TP4	TP5	TP8	TP7	TP10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.80	0.10	1.80	0.20	0.10
Date Sampled				23/06/2017	23/06/2017	23/06/2017	23/06/2017	23/06/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	23	16	33	4.9	45
Total mass of sample received	kg	0.001	NONE	1.1	0.36	1.0	0.38	0.35
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	Chrysotile	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	< 0.001	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	< 0.001	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.3	7.9	8.4	7.6	6.3
Ammonium as NH_4	mg/kg	0.5	MCERTS	55	-	40	-	-
Total Nitrogen (Kjeldahl)	mg/kg	5	NONE	450	-	2800	-	-
Organic Matter	%	0.1	MCERTS	2.9	7.9	7.8	8.8	17
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.17	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.0	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.30	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.9	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	11	0.25	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	4.9	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.29	10	0.69	0.27
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.26	7.9	0.62	0.23
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.13	4.2	0.41	0.18
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.16	2.9	0.39	0.17
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.16	3.3	0.54	0.28
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.12	2.4	0.23	0.10
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.15	3.2	0.42	0.16
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.5	0.21	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.27	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.4	0.32	0.18
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	1.27	56.5	4.08	1.57
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	6.5	13	15	15	8.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	0.4
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	10	21	24	26	13
Copper (aqua regia extractable)	mg/kg	1	MCERTS	12	30	93	34	160
Lead (aqua regia extractable)	mg/kg	1	MCERTS	9.2	26	42	30	20
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.3	< 0.3	0.4
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	11	23	21	21	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	3.3
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	17	36	33	41	19
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	32	77	140	92	530

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 17-52806

Project / Site name: Sutton St James

Lab Sample Number				773644	773645	773646	773647	773648
Sample Reference				TP4	TP5	TP8	TP7	TP10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.80	0.10	1.80	0.20	0.10
Date Sampled				23/06/2017	23/06/2017	23/06/2017	23/06/2017	23/06/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Microbiological (Subcontracted)								
Total Coliforms	mpn/g	N/A	NONE	> 242000	-	> 242000	-	-
E. Coli	mpn/g	1	NONE	600	-	1000	-	-
Faecal Streptococci	cfu/g	N/A	NONE	> 8000	-	> 8000	-	-
Clostridia	cfu/g	N/A	NONE	> 8000	-	> 8000	-	-

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Analytical Report Number: 17-52806

Project / Site name: Sutton St James

Lab Sample Number				773649	773650	773651		
Sample Reference				TP6	TP9	TP3		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.60	0.40	0.20		
Date Sampled				23/06/2017	23/06/2017	23/06/2017		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	14	11	14		
Total mass of sample received	kg	0.001	NONE	0.87	0.39	0.35		
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-		
Asbestos in Soil	Type	N/A	ISO 17025	-	Not-detected	Not-detected		
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-		
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-		
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	-	7.9	7.8		
Ammonium as NH_4	mg/kg	0.5	MCERTS	< 0.5	-	-		
Total Nitrogen (Kjeldahl)	mg/kg	5	NONE	3500	-	-		
Organic Matter	%	0.1	MCERTS	-	3.5	6.6		
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05		
Acenaphthylene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05		
Acenaphthene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05		
Fluorene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05		
Phenanthrene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05		
Anthracene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05		
Fluoranthene	mg/kg	0.05	MCERTS	-	0.45	< 0.05		
Pyrene	mg/kg	0.05	MCERTS	-	0.43	< 0.05		
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	0.27	< 0.05		
Chrysene	mg/kg	0.05	MCERTS	-	0.28	< 0.05		
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	0.41	< 0.05		
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	0.14	< 0.05		
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	0.31	< 0.05		
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	0.18	< 0.05		
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	< 0.05	< 0.05		
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	0.22	< 0.05		
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	2.69	< 0.80		
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	16	19		
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	< 0.2	< 0.2		
Chromium (hexavalent)	mg/kg	4	MCERTS	-	< 4.0	< 4.0		
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	25	29		
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	46	30		
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	37	27		
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	0.3	0.6		
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	22	28		
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	< 1.0		
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	39	51		
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	99	73		

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Analytical Report Number: 17-52806

Project / Site name: Sutton St James

Lab Sample Number				773649	773650	773651		
Sample Reference				TP6	TP9	TP3		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.60	0.40	0.20		
Date Sampled				23/06/2017	23/06/2017	23/06/2017		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Microbiological (Subcontracted)								
Total Coliforms	mpn/g	N/A	NONE	> 242000	-	-		
E. Coli	mpn/g	1	NONE	600	-	-		
Faecal Streptococci	cfu/g	N/A	NONE	> 8000	-	-		
Clostridia	cfu/g	N/A	NONE	> 8000	-	-		

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Analytical Report Number: 17-52806
Project / Site name: Sutton St James
Your Order No:

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
773647	TP7	0.20	139	Loose Fibres	**Chrysotile**	< 0.001	**< 0.001**

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 17-52806

Project / Site name: Sutton St James

Lab Sample Number				773652	773653			
Sample Reference				TP5	TP8			
Sample Number				None Supplied	None Supplied			
Depth (m)				2.20	1.80			
Date Sampled				23/06/2017	23/06/2017			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH	pH Units	N/A	ISO 17025	7.2	7.3			
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10			
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10			
Sulphate as SO_4	µg/l	45	ISO 17025	333000	780000			
Sulphate as SO_4	mg/l	0.045	ISO 17025	330	780			
Chloride	mg/l	0.15	ISO 17025	370	640			
Fluoride	µg/l	50	ISO 17025	450	430			
Ammonium as NH_4	µg/l	15	ISO 17025	330	9000			
Total Organic Carbon (TOC)	mg/l	0.1	ISO 17025	7.94	46.9			
Nitrate as N	mg/l	0.01	ISO 17025	16.8	79.9			
Nitrate as NO_3	mg/l	0.05	ISO 17025	74.3	354			
Nitrite as N	µg/l	1	ISO 17025	270	920			
Nitrite as NO_2	µg/l	5	ISO 17025	870	3000			
Hardness - Total	mgCaCO3/l	1	ISO 17025	1140	1140			
Bromate by IC	mg/l	0.002	ISO 17025	< 0.002	< 0.002			
Total Phenols								
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10			
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01			
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01			
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01			
Total PAH								
Total EPA-16 PAHs	µg/l	0.16	NONE	< 0.16	< 0.16			

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Analytical Report Number: 17-52806

Project / Site name: Sutton St James

Lab Sample Number				773652	773653			
Sample Reference				TP5	TP8			
Sample Number				None Supplied	None Supplied			
Depth (m)				2.20	1.80			
Date Sampled				23/06/2017	23/06/2017			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Boron (dissolved)	µg/l	10	ISO 17025	130	220			
Calcium (dissolved)	mg/l	0.012	ISO 17025	340	330			
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0			
Chromium (III)	µg/l	1	NONE	< 1.0	< 1.0			
Iron (dissolved)	mg/l	0.004	ISO 17025	0.89	0.24			
Magnesium (dissolved)	mg/l	0.005	ISO 17025	70	80			
Silver (dissolved)	µg/l	1	NONE	< 1.0	< 1.0			
Sodium (dissolved)	mg/l	0.01	ISO 17025	120	260			
Zinc (total)	µg/l	0.5	ISO 17025	11	55			
Aluminium (dissolved)	mg/l	0.001	ISO 17025	0.0045	0.0916			
Antimony (dissolved)	µg/l	0.4	ISO 17025	0.6	1.3			
Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.17	3.92			
Barium (dissolved)	µg/l	0.06	ISO 17025	97	75			
Boron (dissolved)	µg/l	10	ISO 17025	130	220			
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.02	0.03			
Calcium (dissolved)	mg/l	0.012	ISO 17025	340	330			
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0			
Chromium (III)	µg/l	1	NONE	< 1.0	< 1.0			
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.3	0.5			
Cobalt (dissolved)	µg/l	0.2	ISO 17025	0.6	2.3			
Copper (dissolved)	µg/l	0.5	ISO 17025	3.8	15			
Iron (dissolved)	mg/l	0.004	ISO 17025	0.89	0.24			
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.4			
Magnesium (dissolved)	mg/l	0.005	ISO 17025	70	80			
Manganese (dissolved)	µg/l	0.05	ISO 17025	250	91			
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	0.12			
Molybdenum (dissolved)	µg/l	0.05	ISO 17025	0.97	15			
Nickel (dissolved)	µg/l	0.5	ISO 17025	4.4	12			
Selenium (dissolved)	µg/l	0.6	ISO 17025	3.6	7.9			
Sodium (dissolved)	mg/l	0.01	ISO 17025	120	260			
Tin (dissolved)	µg/l	0.2	ISO 17025	0.33	< 0.20			
Vanadium (dissolved)	µg/l	0.2	ISO 17025	0.3	3.8			
Zinc (dissolved)	µg/l	0.5	ISO 17025	2.8	7.9			

U/S = Unsuitable Sample I/S = Insufficient Sample

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Analytical Report Number : 17-52806

Project / Site name: Sutton St James

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
773644	TP4	None Supplied	0.80	Brown sandy clay with gravel.
773645	TP5	None Supplied	0.10	Brown loam and clay with gravel and vegetation.
773646	TP8	None Supplied	1.80	Grey clay and sand with vegetation.
773647	TP7	None Supplied	0.20	Brown loam and clay with gravel and vegetation.
773648	TP10	None Supplied	0.10	Brown clay and loam with vegetation.
773649	TP6	None Supplied	0.60	Brown loam and sand with vegetation.
773650	TP9	None Supplied	0.40	Brown loam and sand with gravel.
773651	TP3	None Supplied	0.20	Brown clay and loam with vegetation.

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Analytical Report Number : 17-52806

Project / Site name: Sutton St James

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammonium as NH4 in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	MCERTS
Ammonium as NH4 in water	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in ouse method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
Bromate in Water	Determination of bromate in waters based on ion chromatography. Accredited matrices GW, PW, SW.	In house method based on Standard Methods for the Analysis of Water and Waste Water, method 4500	L008-PL	W	ISO 17025
Chloride in water	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260. Accredited matrices: SW, PW, GW.	L082-PL	W	ISO 17025
Clostridia in soil Subcon to Stanstead Labs	Clostridia in Soils - Subcontracted Analysis	Subcontracted Analysis - See Attached Subcon Report.		D	NONE
Cr (III) in water	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
E. Coli in soil Subcon Stansted Labs	E.Coli in Soil - Subcontracted Analysis	Subcontracted Analysis - See Attached Subcon Report.		W	NONE
Faecal Streptococci in soil Subcon Stansted	Faecal Streptococci in Soil - Subcontracted Analysis	Subcontracted Analysis - See Attached Subcon Report.		W	NONE
Fluoride in water	Determination of fluoride in water by 1:1 ratio with a buffer solution followed by Ion Selective Electrode. Accredited matrices: SW, PW, GW.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033-PL	W	ISO 17025
Free cyanide in water	Determination of free cyanide by distillation followed by colorimetry.Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Kjeldahl nitrogen in soil	Determination of total nitrogen using the Kjeldahl-digestion method and colorimetric determination.	In house method based on BS 7755-3.7:1995 &	L087-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS

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Project / Site name: Sutton St James

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Nitrate as N in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrate in water	Determination of nitrate by reaction with sodium salicylate and colorimetry. Accredited matrices SW, GW, PW	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08,	L078-PL	W	ISO 17025
Nitrite as N in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry). Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Nitrite in water	Determination of nitrite in water by addition of sulphanilamide and NED followed by discrete analyser (colorimetry).Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
pH at 20oC in water (automated)	Determination of pH in water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L0102B-PL	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Total Coliforms Biology in soil Subcon Stansted La	Total Coliforms in Soil - Subcontracted Analysis	Subcontracted Analysis - See Attached Subcon Report.		W	NONE
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025

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Project / Site name: Sutton St James

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
Total organic carbon in water	Determination of dissolved organic carbon inlwater by TOC/DOC NDIR analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP5		W	17-52806	773652	c	Ammoniacal Nitrogen as N in water	L082-PL	c
TP5		W	17-52806	773652	c	Ammonium as NH4 in water	L082-PL	c
TP5		W	17-52806	773652	c	pH at 20oC in water (automated)	L099-PL	c
TP8		W	17-52806	773653	c	Ammoniacal Nitrogen as N in water	L082-PL	c
TP8		W	17-52806	773653	c	Ammonium as NH4 in water	L082-PL	c
TP8		W	17-52806	773653	c	pH at 20oC in water (automated)	L099-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature