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Site:	Kings Road, Spalding
Client:	Reliant Building Contractors Ltd.
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KINGS ROAD, SPALDING

SITE APPRAISAL REPORT
FOR
RELIANT BUILDING CONTRACTORS

Report Ref:
P7343

Date:
April 2016

Prepared for:
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This report has been prepared in accordance with GRM's Accredited Quality Procedures
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Site Appraisal for Kings Road, Spalding

SUMMARY OF RECOMMENDATIONS

Where further assessment is required it is indicated with a "Y" in the right hand column.		
Proposed Development	Residential properties with associated gardens, soft landscaping and infrastructure.	
CONTAMINATION ASSESSMENT - REMEDIATION / WASTE DISPOSAL		
End Users	Source removal of hydrocarbon contamination in the area of TP01 and removal and validation of underground fuel tanks.	Y
Site Workers	Removal of asbestos cement sheeting.	Y
Construction Materials	Appropriate concrete specification. Upgraded water supply pipes should be allowed for.	Y
Groundwater	No remediation required.	
Surface Water	Source removal of hydrocarbon contamination in TP01 and removal and validation of underground fuel tanks.	Y
Waste Disposal	Preliminary Waste Classification: Non-Hazardous for topsoil. Mostly Non-Hazardous for made ground and Hazardous for hydrocarbon impacted soils in TP01 and elevated TPH contamination in WS03. Inert for natural strata. Will need to be confirmed by receiving landfill.	Y
GEOTECHNICAL ASSESSMENT - FOUNDATIONS		
Ground Treatment Required	A working platform will be required for piling contractor.	Y
Main Bearing Strata	Oxford Clay at depth to be confirmed.	Y
Nett Allowable Bearing Pressure	To be confirmed by a piling specialist.	Y
Rockhead	Not encountered.	
Tree Influence	Moderate. Extent to be confirmed by a tree survey.	Y
Volume Change Potential	None.	
Likely Foundation Types	Either wide traditional, raft or piled foundations.	Y
Likely Foundation Depth Range	To be confirmed by piling contractor. Allow for 20m precast driven piles at this stage.	Y
Excavation Hazards	Sub-structures, buried services, shallow groundwater, buried fuel tanks.	
Floor Slab Types	Beam and block for traditional or piled foundations, or well reinforced cast in-situ monolithic raft with minimal service penetrations.	
Gas Protection Requirements Radon and/or Landfill	Gas protection measures should be allowed for. No radon protection required.	Y
GEOTECHNICAL ASSESSMENT - GENERAL		
Slope Stability Risk	Low.	
Soakaways Potential	Not suitable.	
New Access Roads	Observational CBRs 1% to 3% in natural soils.	
Buried Concrete Class	DS - 1; AC- 1. GEN-1, RC35.	
Retaining Walls and Boundary Features	No (existing or proposed).	
Further Assessment Targets	Inspection under existing buildings post demolition, removal and validation of buried fuel tanks, additional testing is required of the site won topsoil to assess its suitability for re-use in gardens.	Y
Other Comments	Asbestos sheeting identified adjacent TP07 requires removal from site, asbestos survey of existing buildings required, cable percussion boreholes required for pile design.	Y

This summary is based on the full report that provides the detailed assessment of the ground risks affecting the development and how to manage them. It should not be used in isolation.

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1 INTRODUCTION

1.1 PREAMBLE

GRM Development Solutions Limited (GRM) has been appointed by Reliant Building Contractors Ltd. (Client) to undertake a Phase II Site Appraisal. A previous desk study by Sub Surface South East Limited (Desk Study at Kings Road, Spalding, Ref: SE1144, dated December 2008) formed Phase I of the assessment and allowed the geotechnical and geo-environmental setting of the site to be determined and the identification of areas of particular concern that required targeted investigation. The Phase II works reported within this document comprise the intrusive ground investigation, geotechnical testing and chemical analysis. The information gained from the Phase II works will be used to refine the conceptual model for the site and determine the most cost-effective development solutions.

This document is intended to provide information that will assist decision making by identifying and recommending solutions to ground engineering and contamination issues.

GRM Standard Limitations of Reporting are provided in Appendix A of this report.

The Client proposes to develop the site with residential properties with associated gardens, soft landscaping and infrastructure. The outline development proposals provided by the Client are presented in Appendix B.

The Client has informed GRM of the following potential development hazards:

Part of the site is currently used as a BT storage depot.

Previously the northern half of the site had mature trees and dense vegetation that required clearance, which has been done recently.

1.2 OBJECTIVES OF THE SITE APPRAISAL

The principal aims of the Phase II Site Appraisal are as follows:

- a) Obtain information, from easily accessible sources, about the soil and groundwater conditions within the area of the site.
- b) Determine the possible ground-related geotechnical and contamination hazards within the site boundaries that may affect the proposed development.
- c) Provide preliminary development recommendations.
- d) Provide advice on further works required for the cost-effective reduction of risks to the development and procedures likely to satisfy regulators.

Whilst every effort has been made to pre-empt the likely requirements of the Local Authority and the Environment Agency, they are likely to have specific requirements that will need to be discussed and addressed at a later date.

2 PHASE I DESK STUDY SUMMARY

Project Name.	Kings Road, Spalding
Project Reference.	Sub Surface South East Limited - SE1144
Client.	Reliant Building Contractors Ltd.
Site Location (address).	Off Kings Road, Spalding. A site location plan is presented in Appendix C.
National Grid Reference.	TL 276,963
Site Area (Ha).	1.23Ha
Summary of Proposed Development.	Residential properties, with soft landscaping consisting of gardens and infrastructure.
Client Supplied Information.	Phase I Desk Study, location of the site, proposed development layout and buried services.
Site Setting.	The southern half of the site is currently used as a BT storage depot with associated buildings and extensive areas of hard standing. The northern half of the site has previously been heavily vegetated with mature trees. This has since been recently cleared, with a number of the large trees still present. The western site boundary abuts against railway land with lines beyond. The land beyond the northern site boundary is used as car garages.
Site History.	The earliest map reviewed (1889) shows the site to be largely undeveloped with only the single residential property along the southern boundary. The land to the west of the site is shown to be railway tracks with the closest line being 12m away from site. The land to the east is shown to be partially developed with residential properties. Two land drains are shown crossing the site running parallel trending east to west. In the intervening time up to 1950 several small scale developments in the surrounding area are now shown. By the map for 1950, the BT depot that currently exists is now shown on site, with the land drains now indicated to be culverted. The land adjacent to the northern site boundary is now shown to be a garage and other storage yard. There are no significant changes to the site to the present day.
Geology.	The site is recorded to be underlain by superficial deposits of the Terrington Beds (tidal flats deposits consisting of sand, clay and sandy silt. The Terrington Beds are underlain by mudstone of the Oxford Clay Formation.
Groundwater and Surface Water.	There are surface water drains present on site, crossing from east to west, locally culverted. There is a recorded groundwater abstraction recorded located 999m away from the site. The soils beneath the site are classified in the desk study as non-aquifers. An updated assessment

	using the Environment Agency website classifies the strata as unproductive.
Mining.	No issues identified.
Potential Soil Contamination Sources.	Adjacent railway, on-site fuel tanks, made ground soils, piles of construction type debris.
Potential Ground Gas Sources (including Radon).	Organic content within natural soils, made ground, fuel tanks.
Other	Active adjacent railway line is a potential source of noise and vibration. Suitable measures should be taken to not affect the end users of the proposed development.

The Phase I Ground Hazard Diagram is presented in Appendix D.

GRM were also supplied with additional drawings of the BT depot detailing the building uses, storage areas and underground services, including the fuel tanks. This was used with the desk study to design the Phase II investigation as outlined in Section 3. The drawings supplied are also presented in Appendix D.



2.1 PHASE I CONCEPTUAL SITE MODEL

HUMAN HEALTH			
Source	Pathway	Receptor	Level of Risk
Potentially contaminated made ground.	Indoor and outdoor inhalation of soil dust, the ingestion of, and dermal contact with, contaminated soil and soil dust, ingestion of vegetables that have taken up contamination and contaminated soil attached to vegetables.	End users, <i>Site Operatives, Vegetation, Controlled Waters and Structures and services.</i>	Medium.
Past site usage as an unspecified depot – potential fuel/oil spillages.	As Above.	As Above.	High.
Adjacent current and historical land use.	As Above.	As Above.	Medium.
Asbestos in insulation and roofing materials.	Inhalation of asbestos fibres.	End users and site operatives.	Medium.

3 PHASE II GROUND INVESTIGATION

3.1 FIELDWORK

The ground investigation has been designed in accordance with the general comments outlined in Appendix A (iv).

The ground investigation fieldwork was conducted on 25th and 26th February 2016. A total of 15 exploratory holes (9 trial pits, 6 windowless sample boreholes) were progressed, to a maximum depth of 4.0m below existing ground level (begl). The exploratory hole location plan and exploratory hole logs are presented in Appendix E and Appendix F respectively.

The investigation has targeted particular sources as identified in the Phase I Ground Hazard Diagram, presented in Appendix D.

The rationale for the positioning of the individual exploratory holes is illustrated in the table below:

LIST OF TARGETED EXPLORATORY HOLES	
Exploratory Hole	Reason for Location and Type
WS02 & WS03	Investigation of buried fuel tanks.
WS04	Investigation of telegraph pole storage area.
TP08 & TP09	Delineation of identified deep made ground in TP01.
Remaining	General Grid.
TP = Trial Pit, WS = Window Sample Hole.	

Areas not accessible at the time of the ground investigation include, beneath the existing buildings present in the BT storage depot. The areas where further investigation is recommended are illustrated on the Constraints / Phase 2 Hazards Plan presented in Appendix G.

3.2 PROVEN GROUND

The following ground conditions were encountered during the investigation fieldwork:

- Topsoil
- Made Ground
- Terrington Beds

3.2.1 Topsoil

Topsoil was encountered as a soft brown slightly gravelly sandy CLAY in TP02, TP03, TP04, TP05, TP06 and TP07 ranging in thickness from 0.20m to 0.40m with a general thickness of 0.30m.

3.2.2 Made Ground

Various types of made ground were observed:

- Brown slightly clayey gravelly fine to coarse SAND. Generally only found in the south western corner, in TP01, to depths of up to 2.60m begl and was generally 2.50m thick. This made ground is likely to be site generated materials from the vegetation clearance that has taken place recently and confined to a small area of the site. Generally, for the remainder of the site area, made ground was encountered to a shallower depth of less than 1.0m begl.
- Black and grey sandy GRAVEL of ash, clinker and coal fragments. Generally only found in the north western area of site, TP05 and WS06, to depths of up to 0.70m begl and was generally 0.50m thick. This made ground is likely to be waste generated from the adjacent railway to the west.

3.2.3 Terrington Beds

These deposits generally comprised, soft (approx. low strength) grey brown slightly clayey slightly sandy SILT. Organic material was observed within the shallow natural soils.

These soils were found across the site, in all exploratory holes, to depths of up to 4.0 m begl.

Standard Penetration Test N-values generally ranged from 2 to 5 at 1m depth, 2 to 5 at 2m depth, and 1 to 3 at 3m depth; indicating a low strength at 1m depth, a low strength at 2m, and a low strength at 3m.

3.2.4 Solid Geology

No solid geology was encountered in the investigation.

3.3 CONTAMINATION OBSERVATIONS

The following visual and olfactory evidence of potential contamination was encountered during the fieldwork and monitoring. In addition, potential sources of ground gas were observed with some decomposing wooden fragments identified in the shallow natural soils.

Location	Depth	Description of contamination and strata affected
TP01	2.60m	Strong hydrocarbon odour and sheen on water surface recorded at the interface of made ground with natural strata. The natural soils also recorded evidence of hydrocarbon contamination with strong odour and rainbow discolouration.

Visual evidence of hydrocarbon contamination was also recorded within ash and clinker observed within TP05 along the western boundary, and within WS06 in the north west corner of the BT compound. It is anticipated that ash and clinker will be presented along the western boundary with the adjacent railway land beyond.

3.4 GROUNDWATER OBSERVATIONS

Groundwater seepage was observed in most of the exploratory holes. However, the exploratory techniques used were rapid and may have masked small water seepages.

Groundwater was struck in TP01 at 2.80m begl, TP02 at 2.20m, TP03 at 1.20m, TP04 at 1.0m, TP05 at 1.80m, TP06 at 1.40m, TP07 at 1.50m, TP08 at 2.50m, WS02 at 1.30m, WS03 at 1.50m, WS04 at 1.80m, WS05 at 1.80m and WS06 at 0.80m. The flows recorded varied between damp strata/seepage and medium flow.

Long term monitoring of groundwater levels has not been conducted as part of this investigation and interpreted levels are approximate and may be dependent on seasonal variations.

Due to the lack of groundwater data for the site it has not been possible to accurately determine the groundwater flow direction beneath the site.

3.5 GROUND GAS AND VAPOURS

Ground gases are discussed in full in Section 6, gas and groundwater monitoring has not been undertaken as part of this report.

3.6 SUMMARY OF FIELDWORK OBSERVATIONS

The fieldwork has revealed/confirmed the following:

Significant Features identified during fieldwork
Buried fuel tanks – potential source of hydrocarbon contamination. Locally deep made ground – foundation requirements. Trees – deepened foundations (in association with cohesive strata). Variable Strata – geotechnical hazard. Existing buildings – requires asbestos survey and subsequent demolition. Piles of construction debris – require clearance. Buried services – require disconnection or diversion. Hydrocarbon contamination in TP01 – development hazard / remediation required. Extensive tarmac hardstanding – development hazard / potential source of contamination. Organic materials within natural soils – potential source of ground gas. Shallow groundwater – construction hazard. Made ground – potential source of soil contamination and ground gas.

4 LABORATORY ANALYSES RATIONALE

4.1 CHEMICAL LABORATORY ANALYSIS

Samples not used for testing will be stored for a month after issue of this report and then disposed of, unless the client requests in writing that they be kept.

Chemical laboratory analyses were selected to provide the parameters necessary to make an initial assessment of potentially contaminated soils and/or waters, for the budgetary design of the development. The choice of contamination testing was based on the Phase I assessment, identified past uses of the site, site observations and comprised:

- 7 samples (5 of made ground, 1 of topsoil and 1 of Terrington Beds) were analysed for a general suite of contaminants (metals, inorganics and speciated PAH).
- 7 samples (4 of made ground, 3 of Terrington Beds) were analysed for speciated petroleum hydrocarbons (TPHCWG).
- 1 sample of natural soil was analysed for SVOCs.
- 8 samples (7 of made ground soils and 1 sheeting sample) have been screened for the presence of asbestos.

Whilst made ground/hydrocarbon impacted soils have been identified at the site a viable pathway to the identified controlled waters receptors has not been identified and so soil leachate analysis has not been undertaken.

The chemical analysis results are presented in Appendix H.

4.2 GEOTECHNICAL LABORATORY TESTING

No geotechnical soil testing has been undertaken as part of the ground investigation.

5 QUANTITATIVE RISK ASSESSMENT – HUMAN HEALTH (SOIL)

5.1 INTRODUCTION

The Client proposes to develop the site with residential properties with associated gardens, soft landscaping and infrastructure.

Various sources of contamination have been put forward in earlier text and summarised in the Phase I conceptual model. The material on site identified as being the most likely to be contaminated is the made ground.

Representative samples of all strata and those considered to be potentially contaminated by virtue of the desk study and/or based on site observations were collected for further examination and/or potential testing.

The rationale for the end use specific *Tier 1 Acceptance Criteria* (TAC) used by GRM is outlined in Appendix A (vi) and for this site the chemical analysis results are being compared against the TAC for residential end use with plant uptake. *In order to adopt a conservative approach a Soil Organic Matter (SOM) content of 1% has been used to assess the made ground, as this reflects the lowest SOM recorded in each material.*

To provide an initial assessment, benzo(a)pyrene has been used as a surrogate marker compound for genotoxic PAHs with the exception of naphthalene. A copy of the thresholds used in this assessment is presented in Appendix I.

5.2 RISK TO END USERS

The chemical analysis results are presented in Appendix H.

Whilst the number of samples tested is considered sufficient to characterise the made ground it is not considered appropriate to carry out statistical analysis on this data set. Therefore the results have been compared directly against the TAC. The results of the hydrocarbons have also been assessed separately.

5.2.1 Analysis of Soil Contamination Data

GRM General Suite – Made Ground

The results for all contaminants are below the relevant 'Critical Concentrations' (i.e. TAC) for residential end use with plant uptake.

GRM General Suite – Natural Strata

The results for all contaminants are below the relevant 'Critical Concentrations' (i.e. TAC) for residential end use with plant uptake.

Petroleum Hydrocarbons

Evidence of potential petroleum hydrocarbon contamination was observed in TP01. Samples of made ground impacted by petroleum hydrocarbons were tested for speciated TPH so that the risk to end users could be assessed.

The samples analysed from WS03 at 0.25m revealed concentrations of petroleum hydrocarbons in excess of the TAC for the following three hydrocarbon bands:

- Aromatic C12-C16 (313mg/kg) exceeds the TAC of 141mg/kg.
- Aromatic C16-C21 (839mg/kg) exceeds the TAC of 264mg/kg.
- Aromatic C21-C35 (1378mg/kg) exceeds the TAC of 1,120mg/kg.

Asbestos

Evidence of potential asbestos cement sheeting was observed within piles of general construction rubble in close proximity to exploratory hole TP07. A sample of this was screened so that the risk to end users could be assessed. The sample recorded the presence of chrysotile asbestos fibres. Therefore this material should be removed from site. To prevent additional disposal costs, this material should be separated at an early stage of the development process to prevent it mixing with other soils.

5.2.2 Water Supply Pipes

The investigation has identified an actual area of hydrocarbon contamination and further areas of potential hydrocarbon contamination (buried fuel tanks) that potentially pose a risk to water supply pipes. Accordingly, appropriate remediation is recommended, as outlined in Section 8.1.4.

It is considered that, based on the UKWIR guidance, the concentrations of contaminants recorded to date are such that PE water supply pipes are potentially suitable for the site. However; given the identified hydrocarbon contamination, at this stage it is recommended that upgraded water pipes are allowed for.

It is recommended that the local water supply company be contacted to confirm their requirements with regard to pipe materials.

5.2.3 Summary of Risk to End Users

Due to the mobile nature of the identified hydrocarbon contamination in TP01 and the largely granular nature of the natural soils beneath site, there is potential for the migration across site and for it to impact near surface soils. During the development process there is a risk of disturbance and mobilisation of the contaminants. Therefore, also remedial works with respect to hydrocarbon contamination is considered to be necessary to protect end users.

5.3 RISK TO SITE WORKERS

The investigation has not revealed any specific risk to site workers; however, the general comments outlined in Appendix A (vii) should be considered when site specific risk assessments are completed.

The identified asbestos sheeting adjacent to TP07 should be removed from site by a suitably qualified contractor before site works begin.

6 QUANTITATIVE RISK ASSESSMENT – HUMAN HEALTH (GROUND GAS)

The gas risk assessment methodology used by GRM is outlined in Appendix A (v).

Given the site has limited thicknesses of made ground, with only small isolated sources of contamination (that will be removed by remediation, see Section 8.1.3), gas monitoring has not been undertaken. However; given the recorded presence of organic material (thought to be decomposing wood etc.) within the shallow natural soils, at this stage it is recommended that gas protection measures are allowed for.

Therefore, currently the site should be assessed as 'Characteristic Situation 2' as outlined in BS8485:2015, for which gas protection measures are required and that an allowance is made for the incorporation of gas precautions.

Gas precautions are required, refer to Section 8.1.1 for details.

The desk study risk assessment determined that no radon protection measures are required.

6.1 SUMMARY OF RISK FROM GAS

The investigation has revealed a potential risk to end users from ground gas and accordingly it is recommended at this stage gas protection measures should be allowed for.

7 QUANTITATIVE RISK ASSESSMENT - CONTROLLED WATERS

The methodology, rationale and guidance GRM have used to assess the risk to controlled waters is set out in Appendix A (viii).

The primary receptors for this site have been identified as the culverted drain (surface water feature) running through the centre of the site. The primary pathways are lateral migration, infiltration and surface run-off.

The made ground and hydrocarbon impacted soils found in TP01 has been identified as a potential risk for controlled waters. However; as this will need to be removed from site for protection of human health, soil leachate testing has not been undertaken.

7.1 INTERPRETATION OF GROUNDWATER OBSERVATIONS AND MONITORING

Groundwater was struck in TP01 at 2.80m begl, TP02 at 2.20m, TP03 at 1.20m, TP04 at 1.0m, TP05 at 1.80m, TP06 at 1.40m, TP07 at 1.50m, TP08 at 2.50m, WS02 at 1.30m, WS03 at 1.50m, WS04 at 1.80m, WS05 at 1.80m and WS06 at 0.80m. The flows recorded varied between damp strata/seepage and medium flow.

No gas and groundwater monitoring has been undertaken as part of this report therefore levels to standing water are not available. However; given the local natural geology and varying amounts of clay present within the shallow soils, the groundwater table is likely to vary laterally and vertically across the site.

7.2 SUMMARY OF RISK TO CONTROLLED WATERS

The risk to nearby surface waters from the identified and potential soil contamination is moderate.

7.3 PHASE II CONCEPTUAL SITE MODEL

HUMAN HEALTH			
Source	Pathway	Receptor	Remedial Solution
Locally elevated levels of hydrocarbons in made ground and locally in natural strata and buried fuel tanks.	Indoor and outdoor inhalation of soil/soil dust and vapours, ingestion of, and dermal contact with contaminated soil and soil dust, ingestion of vegetables that have taken up contamination and contaminated soil attached to vegetables.	End users.	Source removal of contaminated soils.
		Construction workers.	
Made ground, organic material within natural strata.	Inhalation of carbon dioxide and methane.	End users.	Allow for gas protection measures to be required (Scope to be confirmed).
Potential asbestos containing materials existing with buildings and identified sheeting adjacent TP07.	Inhalation.	Construction workers and end users.	Survey and removal by specialist contractor.
Elevated levels of hydrocarbons in made ground.	Migration of contamination through leaks and joints, degradation of water pipe materials.	End Users.	PE water supply pipes and clean backfill required post removal of contamination sources (to be confirmed by water supply company).
CONTROLLED WATERS			
Elevated levels of hydrocarbons in made ground and locally natural soils and underground fuel tanks.	Leaching of contaminants and lateral migration to the surface water.	Drain (surface water).	Source removal of contamination identified in TP01 and removal and validation of fuel tanks.

8 REMEDIATION

8.1 RECOMMENDED REMEDIAL MEASURES AND VALIDATION REQUIREMENTS

8.1.1 Protection of End Users

Soil Contamination

The chemical analysis shows the existing topsoil to be uncontaminated and potentially suitable for use as a growing medium in private gardens and soft landscaping. However due to the potential for cross contamination during the development process, all site won topsoil should be excavated and stockpiled separately to prevent mixing with contaminated soils/ made ground to enable it to be fully assessed by additional chemical analysis and determine its suitability for re-use on site.

If there is insufficient topsoil to complete the proposed development, then some will need to be imported. Any topsoil imported for use to construct the growing medium will require chemical validation to confirm that it is suitable for use. Samples of this material will need to be analysed for a suite of contaminants including metals, inorganics, speciated PAHs and other contaminants such as, speciated hydrocarbons and asbestos depending on the source. The number of samples that require analysis will depend in the volume imported and the source of the materials. Typically an analysis rate of one sample per 50m³ and one sample per 250m³ (minimum of three samples per source and material type) applies for generated and virgin soils respectively.

The underground fuel tanks and associated infrastructure will require to be removed and the base and sides of the excavation validated. Once the excavations are complete and the tanks removed, the sides and base of them will need to be sampled to determine whether the source of contamination has been removed. The samples taken will need to be subject to analysis for the contaminants of concern (i.e. petroleum hydrocarbons). If the validation samples are confirmed clean, then the excavations can be backfilled with clean arisings. If they fail, the excavations will require extension and re-validating. The hydrocarbon contamination identified in TP01 will also require to be removed. This should be treated in the same way as outlined above.

The siteworks within the existing BT storage compound did identify significant areas of hardstanding, with some of this being tarmac. These areas containing tarmac as well as the sub-base material it has been laid on should be removed from site to prevent cross contamination with natural arisings.

In addition to the above general requirements, the following is also required to assess the final scope of the remediation works:

Following demolition of the existing buildings, an inspection should be undertaken under floor slabs to assess any potential risk of hydrocarbon contamination of the underlying soils. A Constraints / Phase 2 Ground Hazards Plan is presented in Appendix G.

Should any material suspected of being significantly contaminated be encountered during the redevelopment of the site, GRM can be contacted to undertake additional

investigation if necessary. The local Environmental Health Officer should be contacted and informed of any additional remedial work required.

Ground Gas

At this stage, it should be assumed that gas protection measures are required for the proposed development.

1) Piled or Traditional Foundations

The gas protection measures are to comprise the provision of a suitable gas resistant membrane (such as Monarflex Reflex Super), fully sealed at joints and service penetrations, and a beam and block floor slab. These would provide a score of 4.5 points under BS8545 and so will be suitable for the type of building proposed (Type A – private residential).

2) Raft Foundations

The gas protection measures are to comprise the provision of a gas resistant membrane (such as Monarflex Reflex Super), fully sealed at joints and service penetrations, and a well reinforced monolithic cast in-situ raft with minimal service penetrations. These would provide a score of 3.5 points under BS8545 and so will be suitable for the type of building proposed (Type A - residential).

More details would need to be provided in a Gas Protection Measures Verification Plan.

8.1.2 Protection of Site Workers

The risk to site workers from the identified soil contamination is negligible. The identified asbestos cement (chrysotile) sheeting adjacent to TP07 should be removed before siteworks begin. Accordingly, no remedial measures are required. However the use of suitable PPE should be enforced during the ground works stage of construction and suitable precautions should be taken during the removal of any asbestos containing materials or oil contaminated soils.

8.1.3 Protection of Controlled Waters

The recorded concentrations of hydrocarbon contamination in the soil are likely to pose a risk to controlled waters via the drain crossing site, and the following remedial measures are considered necessary to protect it:

- The mobile nature of the identified contamination combined with the characteristics of the underlying natural soils potentially poses a risk to end users and construction materials for the proposed development. Accordingly, the hydrocarbon contamination identified in the area of TP01 should be fully excavated and removed from site.
- The identified buried fuel tanks within the BT storage depot, should be fully removed and the surrounding soils chemically validated to ensure all traces of potential hydrocarbon contamination has been removed.

8.1.4 Protection of Construction Materials

The risk to construction materials from the identified soil contamination is negligible. Accordingly, the remedial measures detailed above are required to protect water supply pipes.

8.2 REMEDIATION METHOD STATEMENT

A Remediation Method Statement including a Gas Verification Plan will be required.

Following your review of this document, we would recommend that a copy of it be forwarded to the Local Authority for comment and approval, prior to commencing development of the site. The Local Authority may choose to include other consultees as part of the planning process (such as the Environment Agency).

Consultation should be undertaken at the earliest possible opportunity to avoid abortive or delayed works.

8.3 DISPOSAL AND CLASSIFICATION

Any topsoil removed from site will likely be classified as Non-Hazardous Waste.

Based on the Waste Classification Report (Appendix J) it is considered that the made ground will mostly not be classed as Hazardous Waste. However; samples tested from TP01 at 2.80m and WS03 at 0.25m will be classed as Hazardous Waste. All assessments are depending on the individual landfill site's criteria. At this stage, we would recommend allowing for the made ground to be disposed of as Non-Hazardous Waste since the sample from TP01 and WS03 will be removed from site as outlined in the remediation detailed in Section 8. However, early consultation with the relevant landfill sites over their particular acceptance criteria may produce cost savings. Reference should be made to the relevant notes presented in Appendix A (x).

The natural strata underlying the site is likely to be classified as Inert for disposal purposes, however, further testing will be required to confirm this. Natural soils may be suitable for re-use on-site as part of any capping layer and consideration should be given to retaining this material on-site. Alternatively, it may be sold as a commodity to off-set construction costs.

Care should be taken to keep natural arisings separate from the made ground and free from construction materials, as natural soils mixed with made ground and construction materials may attract additional disposal costs.

During the site works, visible asbestos containing materials (ACMs) we identified adjacent to TP07 and may result in the soils being classified as Hazardous Waste. Visible ACMs should be removed, employing appropriate health and safety protocols and where possible, prior to disposal. The residual soil will then require testing to confirm if further asbestos fibres are present, and any residual asbestos contamination soils disposed of appropriately.

It is recommended that any materials to be exported are stockpiled and tested to confirm disposal rates, as this may be more cost effective than using the results contained within this report.



9 GEOTECHNICAL ASSESSMENT

9.1 INTRODUCTION

The Client proposes to develop the site with residential properties with associated gardens, soft landscaping and infrastructure with associated soft landscaping and infrastructure. Finished floor levels and the levels of any underground engineering works have not been provided.

In addition to the site specific comments below reference should be made to the general comments relating to the Geotechnical Assessment listed in Appendix A (xi to xvi).

9.2 GEOTECHNICAL TESTING

Geotechnical testing has been carried out in-situ on site; the results of this testing are provided on the logs in Appendix F. These results are summarised in the tables below:

In-situ testing in natural soils:

Test Parameter	Range of Results
SPT 'N' values	0 to 6

9.3 ENGINEERING GROUND TREATMENT

The near surface soils were generally firm under foot during the intrusive investigation. It is therefore considered unlikely that pre-treatment of the surface soils will be required for any small plant/personnel movements. However, a working platform will be required for any piling plant. It is recommended that the design of the working platform is carried out as soon as possible. The working platform certificate requires signing by the Principal Contractor for the site. An allowance for this, and responsibility for the design of the platform (estimated at 500mm thick if constructed without reinforcement), should be made in tender packages and site programmes.

9.4 EXCAVATION CONDITIONS

Excavation of the materials encountered during the ground investigation should be easily achieved using conventional hydraulic excavation techniques. A breaker or similar plant may be required where hard standing or existing foundations are encountered.

From the ground investigation undertaken, it is likely that excavations will be generally stable in the short term. Some materials such as granular soils and made ground are liable to collapse without warning. This situation is likely to be exacerbated by water ingress.

It is considered unlikely that dewatering will be required for shallow short-term excavations.

Care should be taken to ensure that dewatering does not lead to settlement of soils below existing structures or services on or off-site.

9.5 EXISTING STRUCTURES / SUBSTRUCTURES

There are existing structures on the site including the buildings present within the BT storage depot; associated sub-structures include the underground fuel tanks, culverted drain crossing the site and other associated services.

It is thought that two fuel tanks exist beneath the pumps under a roof canopy, with a third being present approximately 5m to the north.

There may also be old foundations or other buried structures from the previous site use, that have not been identified from this investigation.

A variety of existing buried services within the BT storage depot are indicated on a plan supplied by BT to GRM and are presented in Appendix D.

9.6 FOUNDATIONS

Using the in-situ testing from the investigation undertaken, GRM have undertaken calculations to provide a bearing capacity for the shallow soils identified and to quantify anticipated settlements. The calculations analysis summary is presented in Appendix K. Accordingly, foundation options are presented below.

Vibro improvement is not considered suitable due to the presence of soft cohesive strata.

New foundations that are within the footprint of existing structures will require a degree of deepening, the extent of which can only be determined by post-demolition investigation.

Wide Traditional

Based on the information available, the shallow natural soils are of poor bearing capacity. Therefore, wide traditional foundations with suitable reinforcement are required in order to spread the load of the proposed structures.

Using 1.0m wide and 1m deep traditional foundations bearing onto the shallow natural soils, a bearing capacity of 85kN/m² with anticipated settlement of up to 20mm has been calculated using the Eurocode methodology and 40kN/m² with settlement of up to 20mm has been calculated using the British Standards methodology.

To confirm the calculated bearing capacities stated, it is recommended that further testing be carried out at anticipated bearing levels to confirm the allowable bearing capacity and settlement characteristics. Until this is done, 40kN/m² should be assumed for design purposes.

If traditional foundations are desired to be utilised, firstly, PI (Atterburg Limits) testing should be undertaken to determine the swell potential of the shallow soils and subsequent tree survey (if PI tests return anything other than non-plastic) is required to determine the tree influence.

Raft

Using a 1m deep reinforced raft foundation bearing onto the shallow natural soils, a bearing capacity of 70kN/m² with anticipated settlement of up to 30mm has been calculated using the Eurocode methodology and 35kN/m² with settlement of up to 30mm has been calculated using the British Standards methodology.

To reduce the risk of concentrated loads, it is recommended that flat rafts are used, rather than toed rafts.

The granular material used to raise site levels under the rafts would need to be consistent in thickness throughout the footprint of each individual raft.

Should rafts be used then the granular blanket under the raft will need to be a thickness equivalent to half the depth of tree influence.

Further tests are also recommended for this option to confirm bearing capacity and settlement characteristics. Until this has been done, 35kN/m² should be used for design purposes.

Piles

A piling specialist will need to be approached to provide pile dimensions and safe pile capacities. They are likely to require provision of cable percussion boreholes to provide information for detailed design. Consideration should be given to nearby structures and infrastructure when choosing the appropriate pile type. Due to the presence of poor near surface bearing strata the piles should be progressed to create a suitable rock socket.

Nearby BGS boreholes suggest that the Oxford Clay is encountered at approximately 18m depth.

Whilst piled foundations would end bear beneath the influence of trees, the piles and ring beams should be designed to resist potential heave, down-drag and negative skin friction. A tree survey is required to fully assess the influence of trees on the near surface soils.

A testing regime and objectives of the works will need agreeing with regulatory and warranting bodies prior to works.

It should be noted that a working platform will be required by the piling contractor.

Pile layouts and ground beams will need to be engineer designed.

Summary

Once the development plan and levels have been finalised, the projects structural engineer should consider the most appropriate foundation solution, taking into account the stability of the strata and proximity to boundaries/services/roads/ existing structures.

Consultation with the local building control is recommended to confirm the type of foundations typically used in the area as GRM understand that these are normally shallow traditional or rafts.

It may be possible to utilise wide shallow trenchfill foundations or rafts subject to additional works to prove the shallow strata have a sufficient bearing capacity to support the proposed development. If trenchfill or raft foundations are desired to be utilised for the proposed development, additional investigation in the form of CPT testing and in-situ plate bearing tests will be required to confirm suitability.

9.7 FLOOR SLABS

Due to the requirements for gas protection measures, it would be prudent for an allowance for all piled or traditional plots to be made for the use of beam and block floors throughout the development. If rafts are used, then these should be monolithic well reinforced and with minimal penetrations.

9.8 BURIED CONCRETE

Based on the recorded water soluble sulphate and pH levels in the soils below the site and assuming mobile groundwater conditions, in accordance with requirements of BRE Special Digest 1 (2005), 'Concrete in Aggressive Ground', the Design Sulphate Class for buried concrete at the site should be assumed as DS-1 and the ACEC Class as AC-1.

For unreinforced trench-fill foundations with a width of greater than 450mm, the classifications above equate to a concrete designated as GEN1 in BS8500 and RC35 for reinforced foundations.

The results of the water soluble sulphate and pH testing of are presented in Appendix H.

9.9 SLOPE STABILITY AND RETAINING STRUCTURES

The site is generally flat, and the area surrounding the site is flat. Therefore, there is no significant risk of slope instability occurring on the site at present gradients.

9.10 SOAKAWAY DRAINAGE

The strata encountered during the investigation are unlikely to be suitable for soakaway drainage and an alternative drainage system should be considered for the disposal of surface water.

9.11 NEW ACCESS ROADS

Site observations suggest that natural materials will have CBR values of between 1% and 3%, when suitably drained. Proof rolling and the improvement of soft spots may result in increased CBR values and the incorporation of a geotextile grid into sub-base layers may allow for reduced capping thickness.

Site observations should be confirmed by in situ or laboratory testing in accordance with the adopting Local Authority's preference.

10 FURTHER INVESTIGATION

Further investigation, to determine more accurately the effect of some of the identified hazards on the development, is recommended. This includes the following:

- Cable percussion boreholes for design of piled foundations if utilised.
- If wide traditional foundations are utilised, PI laboratory testing and plate bearing testing to confirm bearing capacity and settlement characteristics.
- If raft foundations are utilised, plate bearing tests are utilised, plate bearing tests are required to confirm bearing capacity and settlement characteristics.
- Pre-demolition asbestos survey of the existing buildings.
- Supervision and validation of buried fuel tanks removal.
- Delineation and removal of hydrocarbon contamination identified in TP01.
- Removal of asbestos sheeting identified adjacent to TP07.
- Tree survey required to assess the influence on shallow soils.
- Additional testing of the site won topsoil to assess its suitability for reuse.

A copy of this report should be submitted to the Planning Department of the Local Authority/Local Authority EHO for review, if planning conditions exist for this site. A copy should also be sent to the NHBC for their records.

11 CONCLUSIONS

Assuming compliance with all the recommendations contained within this report (for abridged version see 'Summary of Recommendations' table at the beginning of the report) the site is suitable for the proposed development.

Based on the evidence currently available the site is assessed as being of moderate risk for geotechnical hazards and medium risk for contamination hazards. These are summarised in the Post Ground Investigation Constraints and Hazard Plan (Ground Model) in Appendix G.



A P P E N D I X A

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GENERAL APPRAISAL COMMENTS

i INFORMATION SOURCES

Where available the following sources have been used for the identification and assessment of potential ground hazards:

- Relevant British Standards
- British Geological Survey (BGS) Geology Map Scale 1:10,000 for local area
- British Geological Survey (BGS) Geology Map Scale 1:50,000/1:63,320
- BGS Memoir
- BGS Borehole Records
- Environment Agency Groundwater Vulnerability Maps
- Historical Ordnance Survey (OS) Maps
- Environmental Data Report
- Environment Agency Website: <http://www.environment-agency.gov.uk/>
- Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, UKWIR, 2010.
- Coal Authority Records / Coal Mining Report
- DEFRA/Environment Agency Contaminated Land publications and DoE Industry Profiles
- BRE Guide BR211 (2007), 'Radon: Guidance on protective measures for new buildings'
- HPA-RPD-033 (2007), 'Indicative Atlas of Radon in England and Wales'
- NRPB Publication W26 (2002), 'Radon Atlas of England and Wales'
- CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings'
- Other technical references used throughout this document are detailed in the text.

ii CONTAMINANTS OF CONCERN

The DoE Industry Profiles are normally used to assess likely contaminants from past land use and potential nearby industrial sources. For land uses where no profile is available, likely contaminants of concern are selected by GRM based on past experience of similar sites, a general screening suite of contaminants covered by CLEA and common contaminants from the Industry Profiles.

- | | | |
|------------|-------------------|--|
| • Arsenic | • Copper | • Water soluble sulphate |
| • Cadmium | • Nickel | • PAH (polycyclic aromatic hydrocarbons) |
| • Chromium | • Zinc | |
| • Lead | • Phenols | |
| • Mercury | • cyanide (total) | |
| • Selenium | • pH | |

Asbestos and PCBs are listed in the vast majority of profiles. PCBs are listed as the profiles expect electricity substations and switch boxes on all industrial sites. There is the potential for asbestos containing material to be mixed up with made ground, following any demolition works.

iii CONCEPTUAL MODEL METHODOLOGY

The consideration of contamination is based upon the principles of risk assessment, using the 'source-pathway-receptor' model in order to establish the presence, or potential presence, of a pollutant linkage.

To create a risk, contamination must have the potential to cause harm to susceptible targets or receptors such as humans, the water environment or the built environment. The potential for harm to occur requires three conditions to be satisfied to form a pollutant linkage:

- The presence of substances that may cause harm (SOURCE).
- The presence of a target which may be harmed (RECEPTOR).
- The existence of a plausible migration route between the source and the receptor (PATHWAY).

In the absence of a plausible pollutant linkage there is no risk. Where a potential linkage is identified in order for it not to pose a risk to the identified receptor it must be broken.

iv INTRUSIVE INVESTIGATION SAMPLING METHODOLOGY

The ground investigation (including fieldwork, sampling, monitoring and laboratory analyses) has been designed to identify and assess potential ground related problems and to allow cost effective solutions to be advised. It has been planned on the basis of the desk study, site inspection and the proposed development layout (where available). All fieldwork and soil descriptions were carried out in general accordance with relevant British Standards.

The exploratory holes have been positioned and advanced to depths to determine the general ground/groundwater/gas conditions below the site. A general grid pattern has been adopted, where possible, to provide sufficient information based on the current proposed layout scheme. Some holes have been targeted at particular hazards identified in the Phase I assessment. The resultant exploratory hole density is considered to be commensurate with the complexity of the site conditions and detail of information required for this phase of the investigation.

v GROUND GAS RISK ASSESSMENT METHODOLOGY

Gas monitoring programmes undertaken by GRM are designed to broadly comply with the recommendations outlined in CIRIA Report C665 'Assessing risks posed by hazardous ground gas to buildings' (2007).

To assess the risks posed by ground gases such as radon, carbon dioxide and methane, the relevant current guidance has been used. For radon the site has been assessed following the guidelines in 'Radon: guidance on protective measures for new dwellings (BR211: 2007)'. For methane and carbon dioxide the primary guidance document used to determine if protection measures are required is CIRIA Report C665 'Assessing risks posed by hazardous ground gases to buildings' (2007). This uses Gas Screening Values (GSVs), which are gas concentrations multiplied by borehole flow rate, along with additional limiting factors (such as maximum methane concentrations) to classify the gas regime of a site.

The guidance document includes two methods of characterising a site. The main method 'Situation A' is based on work by Wilson and Card and is used for all types of development except low rise housing that meets the assumptions of 'Situation B'. The 'Situation B' method proposed by Boyle and Witherington for the NHBC assumes all properties have pre-cast suspended floors (beam and block) with ventilated underfloor voids.

Where flow is not recorded during the monitoring a default flow rate of 0.1l/hr will be used in the assessment to produce a positive result.

vi HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

Guidance contained in the Environment Agency's CLEA Report has been used to assess the risks posed to human health.

For residential developments that include domestic gardens the default Tier 1 Assessment Criteria (TAC) for 'residential land with plant uptake' are used, i.e. a female with a start age class of one and an end age class of six. All pathways are considered including the consumption of home-grown vegetables.

For residential developments that do not include domestic gardens the default Tier 1 Assessment Criteria (TAC) for 'residential land without plant uptake' are used, i.e. a female with a start age class of

one and an end age class of six. All pathways are considered except the consumption of home-grown vegetables.

For commercial/industrial developments the default Tier 1 Assessment Criteria (TAC) for 'commercial/industrial' are used, i.e. a female with a start age class of sixteen and an end age class of eighteen. All pathways are considered except the consumption of home-grown vegetables.

The TAC used by GRM include Soil Guideline Values (SGV) published by the EA, values calculated by GRM using the CLEA v1.06 risk assessment and values and chemical data developed by LQM/CIEH. The TAC used in the assessment are selected based on the lowest site specific SOM values returned as part of the chemical analysis.

Where soil chemical analysis results are found to exceed the TAC, Site-Specific Risk Assessments may be undertaken using the CLEA v1.06 risk assessment software using the age classes and pathways described above.

vii RISK TO SITE WORKERS – GENERAL COMMENTS

The risks to site workers are similar to those posed to site end users, although likely to be less severe due to the site workers' shorter exposure to the identified contamination. However, site workers (particularly groundworkers) are more likely to come into direct contact with contaminated soils due to the nature of their work. On this basis ground and construction workers should be provided with basic Personal Protective Equipment based on the site's general health and safety risk assessment, but including as a minimum safety footwear, gloves and overalls.

A site specific risk assessment should be carried out for all hazards identified within the ground investigation in accordance with current health and safety legislation. This assessment should identify any measures required to further reduce risks i.e. providing further Personal Protective Equipment, welfare facilities and if necessary preventing access to certain areas.

Demolition and dismantling of existing structures on the site must be carried out to a safe and acceptable standard, in accordance with current UK guidance and best practice. Whilst not ground related, asbestos and hazardous substances surveys should be conducted prior to any demolition.

Any unusual colours, odours and suspicious ground should be reported immediately to site management and then GRM.

Whilst this appraisal has considered the long-term effects of contamination, GRM can also help during the formulation of Health and Safety documentation, if required.

viii CONTROLLED WATERS RISK ASSESSMENT METHODOLOGY

Where the desk study and fieldwork do not reveal a potential source of contamination no leachate or groundwater testing will be performed. Where a potential source is identified the testing will comprise leachate testing on the material considered most likely to pose a risk, groundwater testing will be undertaken if water is present at shallow depth.

The UK Drinking Water Standards (UKDWS) or Environmental Quality Standards (EQS) are usually adopted for comparison with the leachate/groundwater test results. When the most sensitive receptor is considered to be the an aquifer (groundwater) UKDWS will be adopted as the Initial Tier 1 screening values. Where the most sensitive receptor is a surface water feature the EQS values will be used as Initial Tier I Screening values.

ix CONSTRUCTION MATERIALS RISK ASSESSMENT METHODOLOGY

The 'screening levels' adopted for the assessment of risk to construction materials are taken from the following documents:

- UK Water Industry Research (UKWIR) Contamination thresholds for sub-surface water pipes, for the protection of buried pipes.
- Building Research Establishment (BRE) Special Digest SD1 (2005), 'Concrete in Aggressive Ground', for the protection of buried concrete.

WASTE DISPOSAL AND SITE WASTE MANAGEMENT PLANS

Under current Waste Management Regulations, waste soil materials produced from the site will require characterisation to enable it to be disposed of correctly.

The chemical analysis results included in this report should be provided to the relevant landfill operators to establish the characterisation of the waste, confirm its suitability for landfill disposal and provide estimated costings. If material is classified as hazardous, then the site will need to be registered with the Environment Agency prior to the movement of the waste. Depending on the receiving landfill's current permit, further chemical analysis, incorporating Waste Acceptance Criteria (WAC) leachate analysis, may be required.

All materials removed from the site will be classified as 'waste' and therefore must be removed by a suitably licensed carrier of waste. This applies whether or not the waste is contaminated. All waste removed to landfill will attract Landfill Tax.

The developer/builder is likely to be classed as the waste producer and therefore, has a duty of care to ensure that all waste is disposed of appropriately. This includes ensuring the waste carrier is licensed and disposes of the waste to a suitably licensed landfill site. They are also required to keep a paper trail from 'cradle to grave' including copies of the waste disposal tickets.

Efficient materials management on site is recommended as it can lead to significant cost savings when compared to the traditional side casting or single stockpile of arisings. Likewise making the site as volume neutral as possible will reduce the costs of development.

Site Waste Management Plans allow better waste management practices, help to reduce the amount of waste produced and identify best environmental disposal options. Implementing a Site Waste Management Plan (SWMP) can reduce costs (increasing business profits) and maximise resource efficiency.

SWMPs are a legal requirement for all projects with an overall development cost of over £300k. GRM can assist in the production of SWMPs which comply with the Code of Practice and identify best environmental disposal options when dealing with waste.

GEOTECHNICAL ASSESSMENT GENERAL COMMENTS

Where finished floor levels of proposed structures have not been provided by the Client, then for the purposes of initial assessment, GRM will assume that finished levels will not vary appreciably from the existing ground levels. If the depths of any underground engineering works (i.e. sewers, pumping stations etc.) are unknown they will not be taken in to account in the assessment and it will be assumed that any such works will not compromise foundation or ground stability.

Should the development proposals or finished levels be different from these assumptions then the comments/recommendations in the Geotechnical Assessment may require revising.

It should be noted that the results of window sampling and/or cable percussive boreholes may not give a true indication of a soils actual engineering properties (i.e. stability, mass structure etc). GRM consider that that prior to development trial pitting should be undertaken to confirm the recommendations in the Geotechnical Assessment.

GEOTECHNICAL ASSESSMENT – ENGINEERING GROUND TREATMENT

Near surface soils have the potential to be disturbed by weathering and site traffic. Precautions should always be taken to avoid this, as excessive disturbance may leads to more onerous floor slab designs, road cap thickness and increased amounts of off site disposal etc.

Near surface soils may need treatment or reinforcing to allow safe movement of construction plant and labour. An assessment by the contractor should be undertaken once the type of machinery/plant needed to complete the development is known.

GEOTECHNICAL ASSESSMENT – EXCAVATIONS

Excavation instability (over-break) can result in damage to existing services or structures (e.g. foundations, roads or boundary walls/fences) both on and off-site, as well as increased foundation concrete costs. In order to minimise this, all excavations deeper than 1.2m deep (or any excavation within 1.5m of any existing structure or service) should be supported. Full support should be provided to the full depth of all near vertically sided excavations in made ground, soft and very soft clays and granular soils. A reduction to intermediate support should be acceptable within firm and stiffer natural clays.

Wherever possible, man entry into excavations should be prevented; however, where this is not possible, entry to, and time spent in, excavations should be kept to a minimum.

The build program should be tailored to reflect the impact that deep excavations through potentially unstable strata can have on adjacent properties, so that they are not undermined.

All excavations on site should be in accordance with HSE guidelines and stability should be practically maintained at all times. Reference should be made to HSE construction information sheet No. 8 (Revision 1) 'Safety in Excavations'.

Care should be taken to ensure that falls from excavation faces do not adversely affect the integrity of foundation concrete.

If contaminated water enters excavations it should be removed and transported to an appropriate treatment facility by a suitably licensed carrier before construction begins.

xiv

GEOTECHNICAL ASSESSMENT – SUBSTRUCTURES

Where practicable, existing buried construction should be fully removed; however, if this is not practicable all new foundations should be carried down to fully penetrate it and it should be broken well away from all new structures.

There may be existing structures and/or infrastructure in close proximity to the proposed development. New build foundations may be constructed next to pavements with existing underground services beneath them, or excavations may be required near existing footings associated with adjacent properties. These potential hazards need to be taken into consideration when designing foundations and the groundworker needs to be made aware of their potential impact during the redevelopment works. Foundations close to existing underground services or buildings may require alternative foundation techniques (such as piling) to protect the integrity of these structures.

The contractor for the works should carry them out in such a fashion so as to not cause excessive overbreak, concrete usage or undermine existing buildings/roads/ services that are to be retained.

xv

GEOTECHNICAL ASSESSMENT – SOAKAWAYS

Soakaway testing in trial pits by GRM is broadly carried out in accordance with BRE 365 (1991). The testing comprises the excavation of a test pit to a suitable depth, and the placement of water into the pit. The level of water present is then monitored over time. For borehole installations, the permeability testing (falling head/rising head) is undertaken in accordance with BS5930.

If it is decided to proceed with the use of soakaway drainage, then the following general points should be noted:

- Soakaways should not be placed so that water can be discharged through potentially contaminated made ground.
- The Environment Agency may require soakaways to be sealed systems such that only roof run off falls to soakaway.
- Interceptors are likely to be required for soakaways for highway drainage. The adopting authority for the highways should be consulted at the earliest opportunity regarding the use of soakaways for highways drainage.
- Consideration of site levels and slopes should be taken into account during the design.

- The construction of all soakaways should be in accordance with the current building regulations.
- Soakaways should not be placed within 5m of a proposed building.
- Placement of soakaways needs to be considered so as to avoid ponding of water down slope.
- The base of a soakaway should not be below the highest recorded water level.
- The Environment Agency prefer 1m of dry soil to be present between the base of a soakaway and the water table to provide attenuation for contamination.

xvi GEOTECHNICAL ASSESSMENT – FOUNDATIONS

If soft or hard spots are encountered during foundation excavation then they should be replaced with suitably compacted material or the footings deepened to suitable strata, to avoid differential settlement.

If strata of differing bearing character (e.g. sand and clay) are encountered at foundation levels within the excavations for a single plot then the excavation depths should be altered as appropriate to ensure the foundations rest on a single stratum, or strata that will not induce differential settlement. Where this is impractical then GRM should be contacted to assess a reinforced concrete detail or an alternative foundation solution (e.g. piles or vibro-replacement).



NOTES ON LIMITATIONS**General**

GRM Development Solutions Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement had been executed, or with whom an assignment had been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from GRM Development Solutions Limited; a charge may be levied against such approval.

GRM Development Solutions Limited accepts no responsibility or liability for:

- a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and
- b) the consequences of this document being used by any third party with whom an agreement has not been executed.

Phase I Environmental Audits/ Desk Studies

The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, GRM Development Solutions Limited reserves the right to review such information and as considered necessary and appropriate to modify the opinions accordingly. It should be noted that any risks identified in a Phase 1 report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Environmental Audits (Contamination Investigations)

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, ground and groundwater conditions to allow a reasonable risk assessment to be made. The objectives of the investigation have been limited to establishing the risks associated with potential human targets, building materials, and controlled waters.

The amount of exploratory work and chemical testing undertaken has necessarily been restricted by the short timescale available, and the locations of exploratory holes have been restricted to the areas unoccupied by the building(s) on the site and by buried services. A more comprehensive investigation may be required if the site is to be redeveloped as, in addition to risk assessment, a number of important engineering and environmental issues need to be resolved.

For these reasons if costs have been included in relation to site remediation these must be considered as provisional only and must, in any event, be confirmed by a commercial adviser.

The exploratory holes undertaken, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. Whilst exploratory testing is intended to gain an accurate representation of the site, the very nature of sampling and testing is such that it cannot ensure that all localised conditions are detected.

The risk assessment and opinions provided take in to consideration, inter alia, currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

Phase II Geo-environmental Investigations (Combined Geotechnical and Contamination Investigations)

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, geotechnical characteristics, and ground and groundwater conditions to provide a reasonable assessment of the environment risks together with engineering and development implications. If costs have been included in relation to site development a commercial adviser must confirm these.

The exploratory holes undertaken, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site for each of the exploratory holes. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations made at the time the site work was conducted. It should be noted that groundwater levels will vary owing to seasonal, tidal and weather related effects. The scope of the investigation was selected on the basis of the specific development proposed by the Client and may be inappropriate to another form of development or scheme.

The risk assessment and opinions provided take in to consideration, inter alia, currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.



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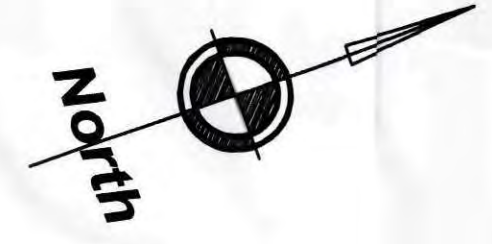
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BRITANNIA GARDENS



Key to Trees

- Existing trees to be retained
- Existing trees to be removed
- Proposed trees mature standards
- Proposed trees ornamental

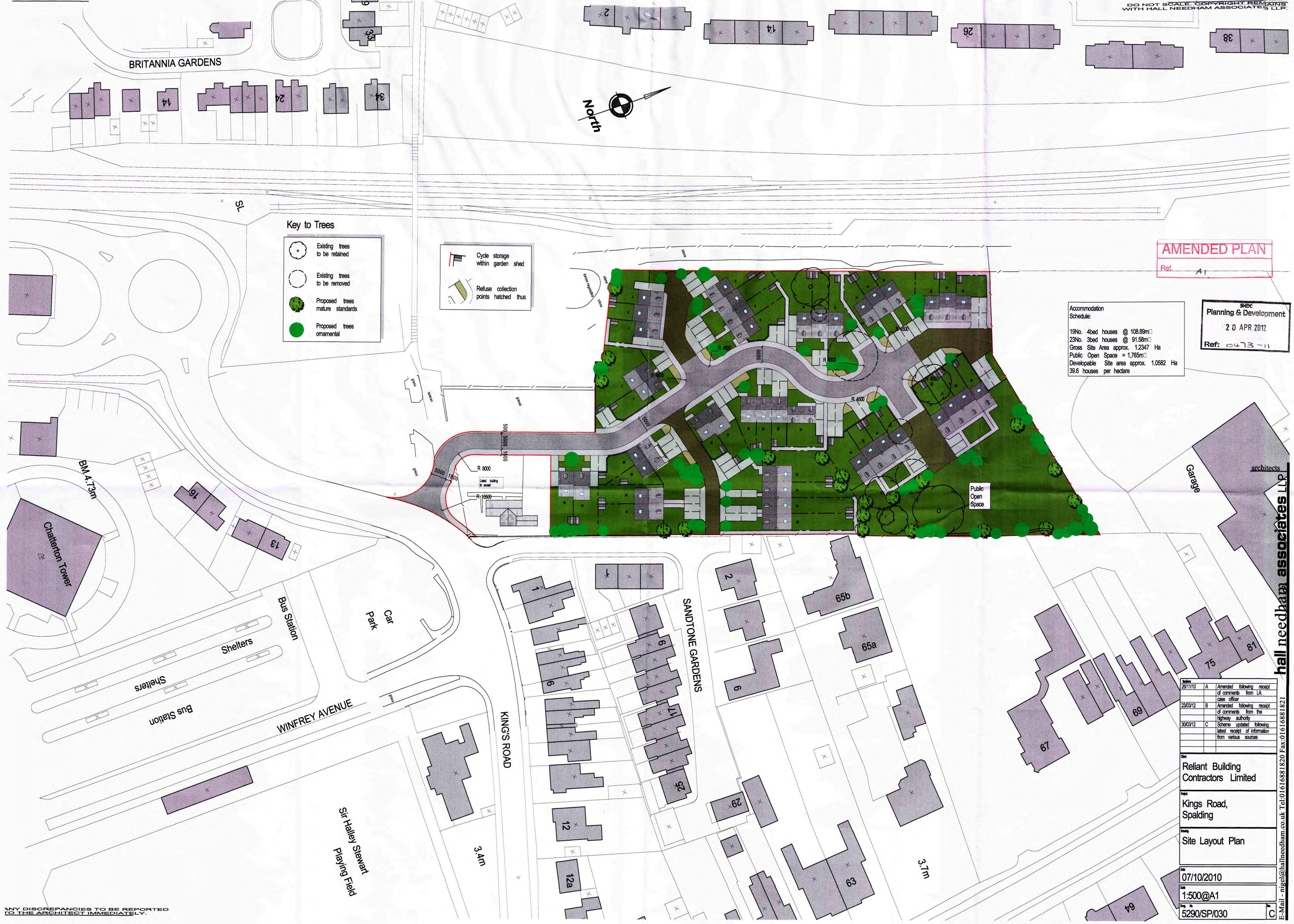
- Cycle storage within garden shed
- Refuse collection points hatched thus

AMENDED PLAN

Ref. A1

Accommodation Schedule:
 19No. 4bed houses @ 108.89m²
 23No. 3bed houses @ 91.58m²
 Gross Site Area approx. 1.2347 Ha
 Public Open Space = 1,765m²
 Developable Site area approx. 1.0582 Ha
 39.6 houses per hectare

SHDE
 Planning & Development
 20 APR 2012
 Ref: 0473-11



Date	Rev	Description
28/11/10	A	Amended following receipt of comments from LA case officer
23/03/12	B	Amended following receipt of comments from the highway authority
30/03/12	C	Scheme updated following latest receipt of information from various sources

Client
 Reliant Building Contractors Limited
 Project
 Kings Road, Spalding
 Drawing
 Site Layout Plan

Date
 07/10/2010

Scale
 1:500@A1

Drawn by
 5290/SP/030

hall needham associates LLP



A P P E N D I X C

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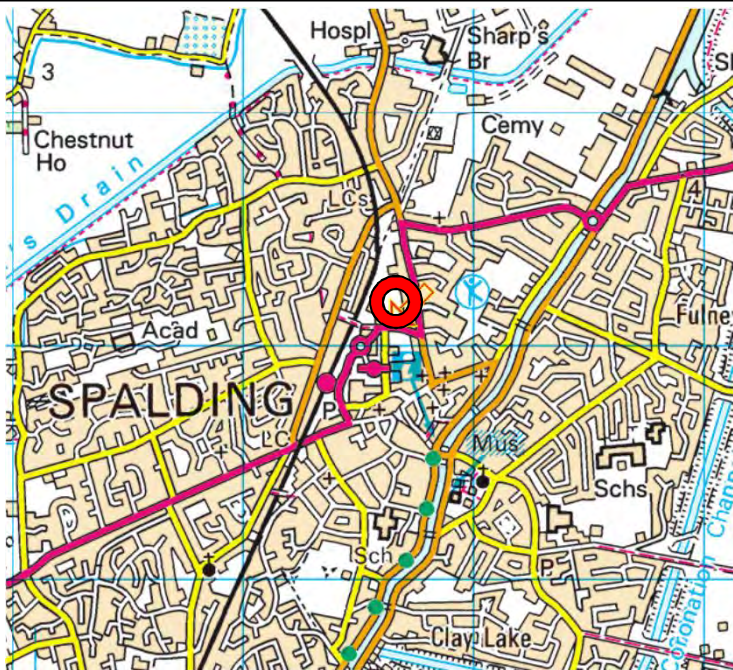
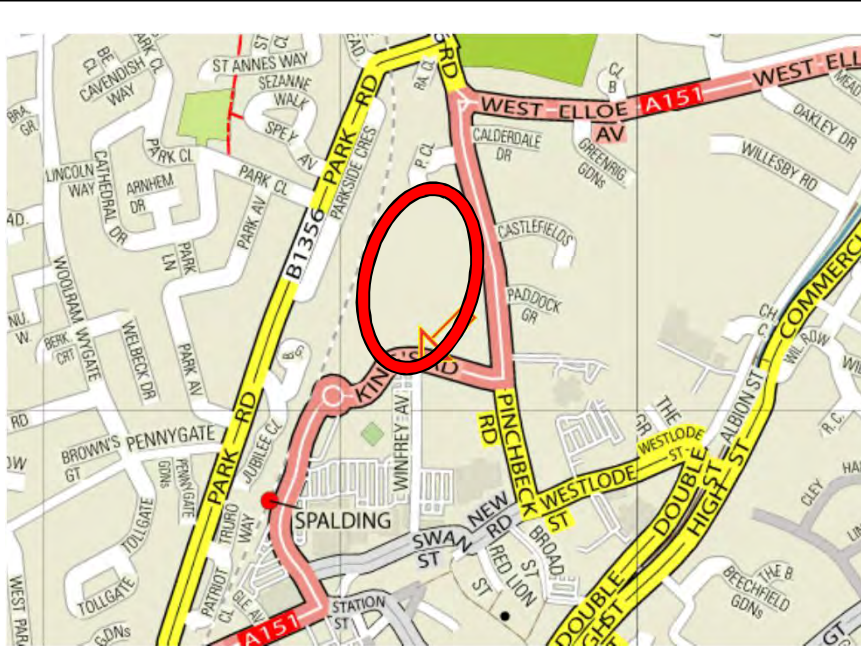
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info@grm-uk.com

Fax: 01283 211968

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DO NOT SCALE

NOTES:



Approx. site location



Approx. site boundary

Nearest Post Code:
PE11 1QJ



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CLIENT:

PROJECT:

Kings Road, Spalding

TITLE:

Site Location Plan

SCALE@SIZE:

NTS

ISSUE:

FINAL

DESIGN/DRAWN:

RJH

DATE:

02/2016

PROJECT No:

P7343

DRAWING No:

Fig 1

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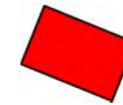
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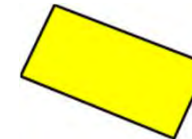
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Indicated buried fuel tanks.



Area adjacent to railway land with potential soil contamination.

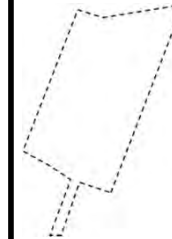


Existing buildings present.

Areas of mature trees.

DO NOT SCALE

NOTES:



Approximate site boundary.



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Kings Road, Spalding

TITLE:

Phase I Ground Hazard Diagram

SCALE@SIZE:

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ISSUE:

FINAL

DESIGN/DRAWN:

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03/2016

PROJECT No:

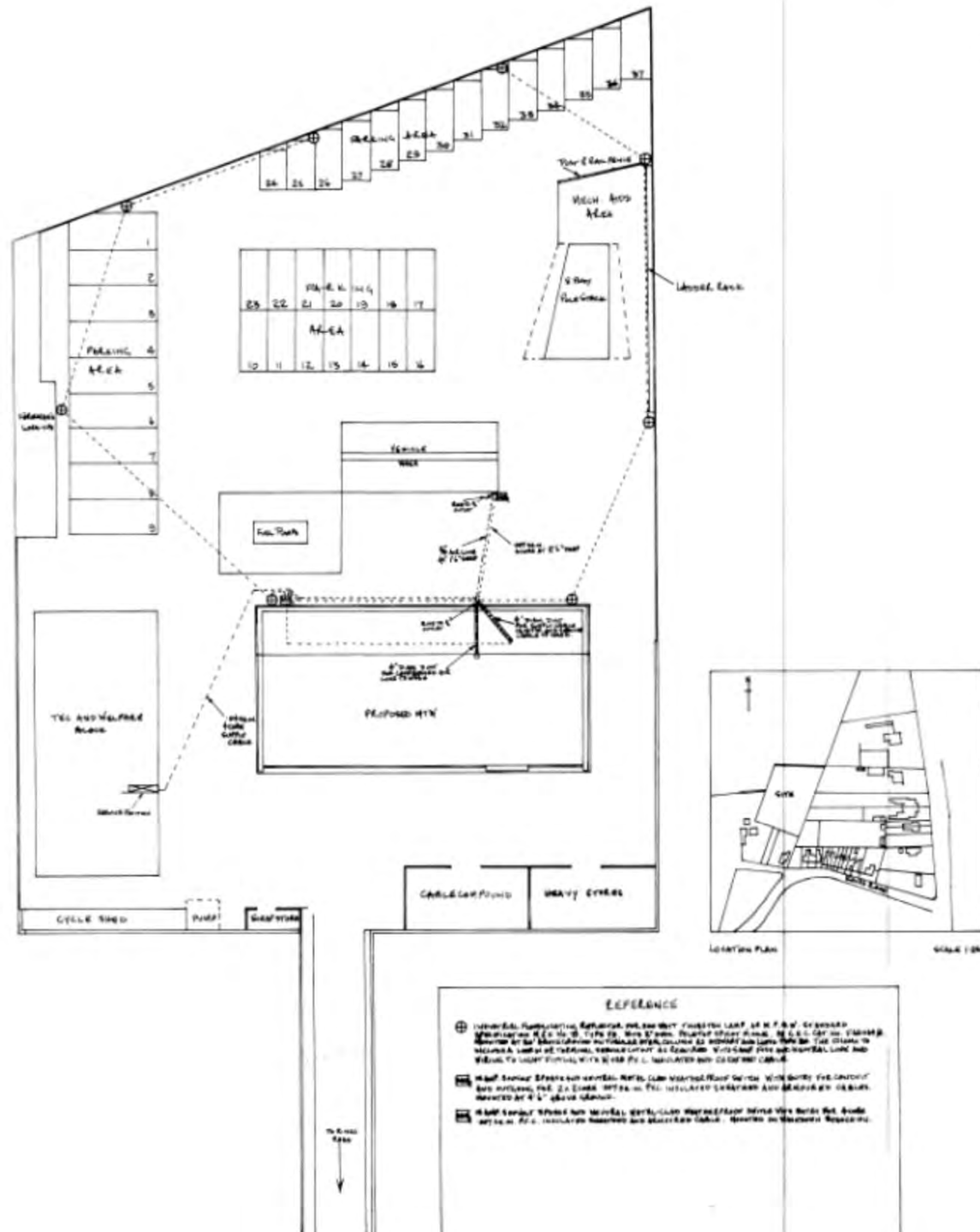
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Kings Road, Spalding

TITLE:

Supplied Drawings

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04/2016

PROJECT No:

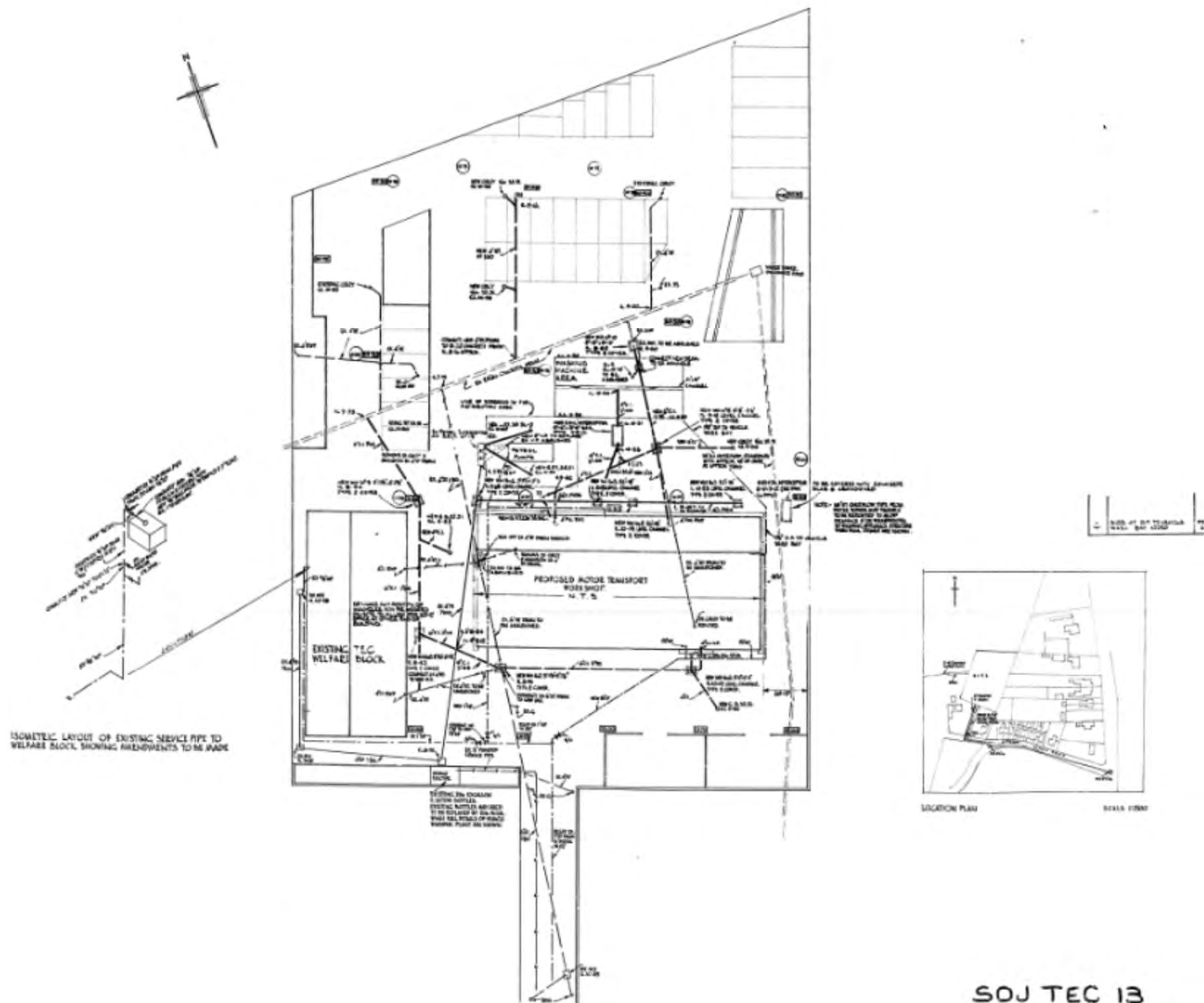
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PROJECT:

Kings Road, Spalding

TITLE:

Supplied Drawings

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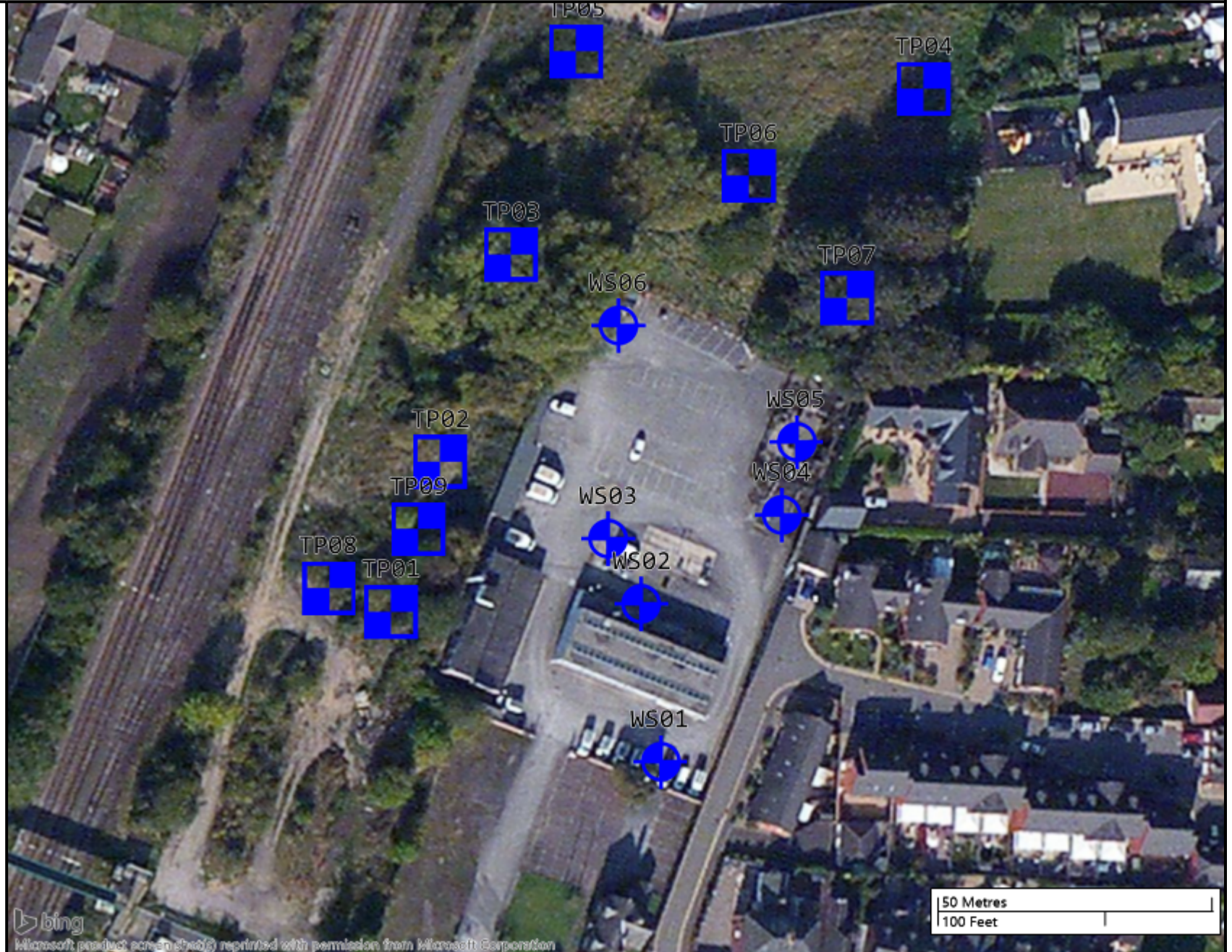
Project Id: P7343
Project Title: Kings Road, Spalding
Location:
Client: Reliant Building Contractors Ltd.

Title: Site Plan
Scale: 1:1000
Engineer: GRM Development Solutions Ltd
Contractor:



Legend Key

- Locations By Type - Empty
- Locations By Type - TP
- ⊕ Locations By Type - WLS





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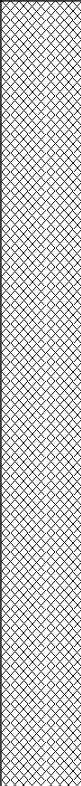
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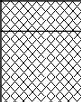
		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="margin: 0;">Trial Pit Log</h1>			Trial Pit No TP01 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524546 E 323162 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES					Loose to medium dense light and dark brown occasionally slightly clayey gravelly fine to coarse SAND with low cobble content. Gravel is fine to coarse angular to rounded sandstone, concrete, brick fragments, ceramic fragments, coal, iron slag and wood. MADE GROUND	1
	1.00	D						2
	1.80	D						3
	2.80	ES						4
				2.60			Soft very dark grey and very dark blue slightly clayey slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is fine to coarse subrounded quartzite. With strong hydrocarbon odour and sheen on water surface. TERRINGTON BEDS	3
				3.00			End of Pit at 3.00m	

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Medium flow at 2.80m.	
Shoring: NA		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Trial Pit Dimensions (m): <div style="display: flex; align-items: center; margin-top: 10px;"> 0.60 <div style="border: 2px solid black; width: 80px; height: 20px; position: relative;"> <div style="position: absolute; top: -5px; left: 0; right: 0; height: 2px; background: linear-gradient(to right, transparent 48%, black 48% 52%, black 52%, transparent 52%);"></div> </div> </div> <div style="margin-top: 5px; text-align: center;">2.50</div> </div> </div>	
Stability: Stable to 2.60m, unstable below.			
Plant Used: JCB 3CX			
Logged by: RJH			
Reason for termination of Trial Pit:			
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com			<h1 style="margin: 0;">Trial Pit Log</h1>		Trial Pit No TP02 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524555 E 323190 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	ES		0.10			Grass and scrub over soft dark brown slightly sandy gravelly CLAY with frequent rootlets. Gravel is fine to coarse angular to rounded sandstone, concrete, brick and wood. MADE GROUND	1
	0.60	D					Medium dense light and dark brown slightly gravelly clayey fine to coarse SAND with low cobble content. Gravel is fine to coarse subangular to rounded sandstone, concrete and brick fragments. Possible relict topsoil from 0.60-0.65m begl. MADE GROUND	
	1.10	D		1.00			Soft locally firm light and dark brown mottled pale blue and orange occasionally clayey sandy SILT. Sand is fine to coarse. With occasional decomposing reed stems. TERRINGTON BEDS	2
	1.40	B						
				2.85			End of Pit at 2.85m	
							4	

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Seepage encountered at 2.20m.	
Shoring: NA		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Trial Pit Dimensions (m): <div style="display: flex; align-items: center; margin-top: 10px;"> 0.60 <div style="border: 2px solid black; width: 80px; height: 20px; position: relative;"> <div style="position: absolute; top: -5px; left: 0; right: 0; height: 2px; background: black;"></div> </div> </div> <div style="text-align: center; margin-top: 5px;">2.50</div> </div> <div style="width: 50%;"> Reason for termination of Trial Pit: </div> </div>	
Stability: Stable			
Plant Used: JCB 3CX			
Logged by: RJH			
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="margin: 0;">Trial Pit Log</h1>		Trial Pit No TP03 Sheet 1 of 1	
Site Name: Kings Road, Spalding						Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.				GRM Project Ref: P7343		Coordinates 524567 E 323228 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼	0.15	ES		0.30		                  	Bark chippings and wood over soft very dark brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded sandstone. MADE GROUND Soft pale brown and grey slightly mottled pale blue and orange slightly clayey slightly sandy SILT locally clayey. Sand is fine to medium. With rootlets down to 1.0m begl. TERRINGTON BEDS ... with closely spaced lamination below 1.0m begl. ... damp strata below 1.20m begl. End of Pit at 2.70m	1
	0.80	D					2.70	2
	1.50	D					3	4

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Water encountered at 1.20m.	
Shoring: NA		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Trial Pit Dimensions (m): <div style="display: flex; align-items: center;"> 0.60 <div style="border: 2px solid black; width: 80px; height: 20px; position: relative;"> <div style="position: absolute; top: -5px; left: 5px; width: 100%; height: 100%; background: linear-gradient(to right, transparent 48%, black 48% 52%, black 52%);"></div> </div> </div> <div style="text-align: center; margin-top: 5px;">2.50</div> </div> <div style="width: 50%;"> Reason for termination of Trial Pit: </div> </div>	
Stability: Stable			
Plant Used: JCB 3CX			
Logged by: RJH			
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="text-align: center;">Trial Pit Log</h1>			Trial Pit No TP04 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524642 E 323260 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.35		 Soft dark brown sandy CLAY with frequent rootlets. Sand is fine to coarse. TOPSOIL		
	1.00	D				 Soft light brown light grey mottled light blue and orange occasionally slightly clayey slightly sandy SILT, locally clayey. Sand is fine to medium. TERRINGTON BEDS		
	2.00	D		2.55		 ... damp strata below 1.0m begl.	1	
						 ... faintly horizontally laminated below 1.80m begl.	2	
						End of Pit at 2.55m	3	
							4	

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Damp strata below 1.0m.	
Shoring: NA			
Stability: Stable			
Plant Used: JCB 3CX		Trial Pit Dimensions (m):	
Logged by: RJH		Reason for termination of Trial Pit:	
		0.60  2.50	
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="margin: 0;">Trial Pit Log</h1>		Trial Pit No TP05 Sheet 1 of 1	
Site Name: Kings Road, Spalding						Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.				GRM Project Ref: P7343		Coordinates 524578 E 323266 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			Soft dark brown sandy CLAY with frequent rootlets. MADE GROUND	
	0.40	ES					Medium dense black and grey sandy GRAVEL of ash, clinker and coal fragments. Sand is fine to coarse. MADE GROUND	
	0.80	D		0.70			Soft locally firm light brown light grey mottled pale blue and orange occasionally slightly clayey slightly sandy SILT, locally clayey. With occasional decomposing reed stems. TERRINGTON BEDS	1
								
								
								
							... damp below 1.50m begl.	
								
	2.00	D						2
								
								
				2.45			End of Pit at 2.45m	
								3
								4

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Seepage encountered at 1.80m.	
Shoring: NA		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Trial Pit Dimensions (m): <div style="display: flex; align-items: center;"> 0.60 <div style="border: 2px solid black; width: 80px; height: 20px; position: relative;"> <div style="position: absolute; top: -5px; left: 0; right: 0; height: 2px; background: black;"></div> </div> </div> <div style="text-align: center; margin-top: 5px;">2.50</div> </div> <div style="width: 50%;"> Reason for termination of Trial Pit: </div> </div>	
Stability: Stable			
Plant Used: JCB 3CX			
Logged by: RJH			
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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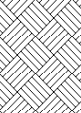
		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="margin: 0;">Trial Pit Log</h1>		Trial Pit No TP06 Sheet 1 of 1	
Site Name: Kings Road, Spalding						Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.				GRM Project Ref: P7343		Coordinates 524610 E 323244 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			Wood chippings. MADE GROUND Soft dark brown slightly sandy CLAY with frequent rootlets.	
				0.30			TOPSOIL Soft light brown light grey mottled pale blue and orange slightly clayey slightly sandy SILT, locally clayey.	
	0.40	D						
	0.80	D						
	2.00	D						
				2.30				
							<div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <i>... damp strata from 1.40m.</i> </div>	
							End of Pit at 2.30m	

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Damp strata below 1.40m.	
Shoring: NA		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Trial Pit Dimensions (m): <div style="display: flex; align-items: center; margin-top: 10px;"> 0.60 <div style="border: 2px solid black; width: 80px; height: 20px; position: relative;"> <div style="position: absolute; top: -5px; left: 0; right: 0; height: 2px; background: black;"></div> </div> </div> <p style="text-align: center; margin-top: 5px;">2.50</p> </div> <div style="width: 50%;"> Reason for termination of Trial Pit: </div> </div>	
Stability: Stable			
Plant Used: JCB 3CX			
Logged by: RJH			
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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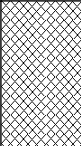
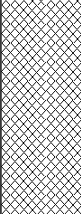
		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="text-align: center;">Trial Pit Log</h1>			Trial Pit No TP07 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524628 E 323222 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.40			Soft dark brown slightly gravelly sandy CLAY with frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse angular brick and concrete fragments. With frequent rootlets. TOPSOIL	
	0.70	D					Soft light brown light grey mottled pale blue and orange slightly clayey slightly sandy SILT, locally clayey. TERRINGTON BEDS	
	1.50	D					... damp below 1.50m begl. ... faintly horizontally laminated below 1.50m begl.	
				2.40			End of Pit at 2.40m	

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Damp strata below 1.50m.	
Shoring: NA			
Stability: Stable			
Plant Used: JCB 3CX		Trial Pit Dimensions (m): 0.60  2.50	
Logged by: RJH		Reason for termination of Trial Pit:	
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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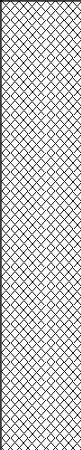
		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="margin: 0;">Trial Pit Log</h1>			Trial Pit No TP08 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524535 E 323166 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.50			Loose brown slightly clayey slightly gravelly fine to coarse SAND with low cobble and boulder content. Gravel is fine to coarse subangular to rounded quartzite, sandstone, concrete, bricks, iron slag, metal and wood. Cobbles and boulders are concrete. MADE GROUND	
	0.60	ES		0.70			Medium black dark brown sandy GRAVEL of coal, iron slag, ash, clinker limestone and sandstone. MADE GROUND	
	0.90	D					Loose to medium dense brown slightly clayey slightly gravelly fine to coarse SAND. Gravel is fine to coarse subangular to rounded quartzite, sandstone, concrete, bricks, iron slag, metal and wood. MADE GROUND	1
	1.50	D		1.45			Soft light brown and grey mottled light blue and orange occasionally slightly clayey slightly sandy SILT, locally clayey. TERRINGTON BEDS	2
				2.80			End of Pit at 2.80m	3
								4

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Damp strata below 2.50m.	
Shoring: NA		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Trial Pit Dimensions (m): <div style="display: flex; align-items: center; margin-top: 10px;"> 0.60 <div style="border: 2px solid black; width: 100px; height: 20px; position: relative;"> <div style="position: absolute; top: -5px; left: 0; right: 0; height: 2px; background: black;"></div> </div> </div> <p style="text-align: center; margin-top: 5px;">2.50</p> </div> <div style="width: 50%;"> Reason for termination of Trial Pit: </div> </div>	
Stability: Stable			
Plant Used: JCB 3CX			
Logged by: RJH			
General Remarks:			

Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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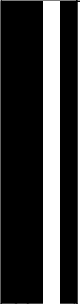
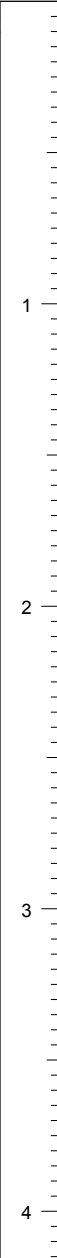
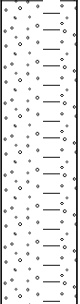
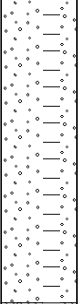
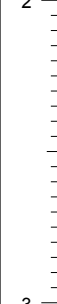
		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="margin: 0;">Trial Pit Log</h1>			Trial Pit No TP09 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524551 E 323178 N	

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
							Loose brown slightly clayey gravelly fine to coarse SAND with low cobble content. Gravel is fine to coarse, subangular to subrounded sandstone, coal, brick and concret fragments, iron slag and frequent wood. MADE GROUND	1
				1.50			Soft light brown light grey slightly clayey slightly sandy SILT. Sand is fine to coarse. With some decomposing reed stems. TERRINGTON BEDS	
				1.80			End of Pit at 1.80m	2
								3
								4

Date Excavated: 26/02/2016		Groundwater Observations:	
Date Backfilled:		Not encountered.	
Shoring:			
Stability:			
Plant Used:		Trial Pit Dimensions (m):	
Logged by:		Reason for termination of Trial Pit:	
General Remarks:			

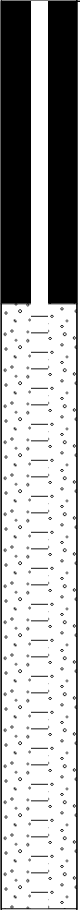
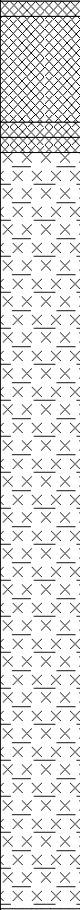
Strata consistencies/densities determined by observation only	Version: FINAL	Scale: 1:25
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		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="text-align: center;">Windowless Sample Borehole</h1>			Borehole No WS01 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.				GRM Project Ref: P7343			Coordinates 524596 E 323136 N	

Installation/ Backfill	Water Strike	Samples/Tests			Dynamic Probing (Blows per 100mm)	Depth (m)	Level (m)	Legend	Stratum Description	
		Depth	Type	Result						
		0.05				0.05			Tarmac	
		0.10				0.10			MADE GROUND	
		0.30	ES						Type 1 sub-base of sandstone.	
									MADE GROUND	
									Firm dark brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded tarmac, sandstone and brick fragments.	
									MADE GROUND	
		0.80	ES			0.70			Soft locally very soft slightly clayey slightly sandy SILT, locally a silty sand. Locally clayey.	
		1.00	S	N=5 (1,1/1,2,1,1)					TERRINGTON BEDS	
		1.50	D							
		2.00	S	N=4 (1,1/1,1,1,1)						
		3.00	S	N=1 (0,0/0,1,0,0)						
		4.00	S	N=2 (0,0/1,0,1,0)						
						3.80			Firm very dark brown and very dark grey sandy silty CLAY with organic odour.	
						4.00			TERRINGTON BEDS	
								End of Borehole at 4.00m		

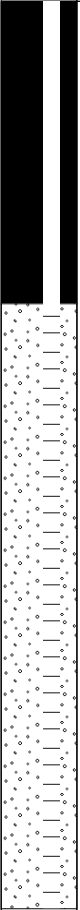
Crew: DS UK		Logger: RJH		Geotechnical Testing			
Equipment: Premier 110				Depth	Liquid Limit	Plasticity Index	Percentage <0.425mm
Reason for termination of borehole:							
Groundwater Remarks:				Geotechnical Chemistry Testing			
Not encountered.				Depth	Determinand Name	Result	Unit
General Remarks:							
Hole Started: 25/02/2016		Hole Complete:		Version: FINAL		Scale: 1:25	

		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="text-align: center;">Windowless Sample Borehole</h1>			Borehole No WS02 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.				GRM Project Ref: P7343			Coordinates 524592 E 323165 N	

Installation/ Backfill	Water Strike	Samples/Tests			Dynamic Probing (Blows per 100mm)	Depth (m)	Level (m)	Legend	Stratum Description	
		Depth	Type	Result						
						0.05			Tarmac MADE GROUND Type 1 Sub-base or sandstone MADE GROUND	
		0.45 - 0.50	ES			0.40 - 0.45			Broken Tarmac MADE GROUND	
		0.60	ES			0.50			Type 1 Sub-base of sandstone. MADE GROUND	
		1.00	S	N=3 (0,1/0,1,1,1)					Soft dark grey dark brown slightly sandy clayey SILT, locally a clayey sand and silty clay. With occasional decomposing wood fragments. TERRINGTON BEDS	1
		1.50	D							
		2.00	S	N=5 (1,0/1,1,2,1)						2
		3.00	S	N=2 (1,0/0,1,0,1)		3.00			End of Borehole at 3.00m	3
										4

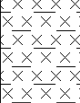
Crew: DS UK		Logger: RJH		Geotechnical Testing <table border="1"> <tr> <th>Depth</th> <th>Liquid Limit</th> <th>Plasticity Index</th> <th>Percentage <0.425mm</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>				Depth	Liquid Limit	Plasticity Index	Percentage <0.425mm				
Depth	Liquid Limit	Plasticity Index	Percentage <0.425mm												
Equipment: Premier 110				Geotechnical Chemistry Testing <table border="1"> <tr> <th>Depth</th> <th>Determinand Name</th> <th>Result</th> <th>Unit</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>				Depth	Determinand Name	Result	Unit				
Depth	Determinand Name	Result	Unit												
Reason for termination of borehole:															
Groundwater Remarks: Water at 1.30m.															
General Remarks:															
Hole Started: 25/02/2016		Hole Complete:		Version: FINAL		Scale: 1:25									

		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="text-align: center;">Windowless Sample Borehole</h1>			Borehole No WS03 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.				GRM Project Ref: P7343			Coordinates 524586 E 323177 N	

Installation/ Backfill	Water Strike	Samples/Tests			Dynamic Probing (Blows per 100mm)	Depth (m)	Level (m)	Legend	Stratum Description	
		Depth	Type	Result						
		0.08						 Tarmac  MADE GROUND		
		0.25	ES					 Type 1 Sub-base of sandstone with occasional tarmac and flints.  MADE GROUND		
		0.60	ES					 Soft with firm pockets very dark grey very dark brown slightly sandy very clayey SILT, locally silty clay. Sand is fine to coarse. With slight organic odour and occasional decomposing wood fragments.  TERRINGTON BEDS		
		1.00	S	N=4 (0,1/0,1,1,2)					1	
		1.50	D							
		2.00	S	N=2 (1,0/1,0,1,0)					2	
		3.00	S	N=3 (1,0/1,0,1,1)					3	
								... very wet and very soft from 2.0-3.0m begl.		
								End of Borehole at 3.00m	4	

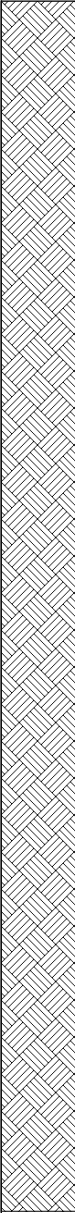
Crew: DS UK		Logger: RJH		Geotechnical Testing Depth Liquid Limit Plasticity Index Percentage <0.425mm			
Equipment: Premier 110							
Reason for termination of borehole:							
Groundwater Remarks: Water at 1.50m.				Geotechnical Chemistry Testing Depth Determinand Name Result Unit			
General Remarks:							
Hole Started: 25/02/2016		Hole Complete:		Version: FINAL		Scale: 1:25	

		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1>Windowless Sample Borehole</h1>			Borehole No WS04 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524618 E 323182 N	

Installation/ Backfill	Water Strike	Samples/Tests			Dynamic Probing (Blows per 100mm)	Depth (m)	Level (m)	Legend	Stratum Description		
		Depth	Type	Result							
		0.10	ES			0.05 0.10 0.15 0.25		 Tarmac MADE GROUND  Type 1 sub-base of sandstone. MADE GROUND  Tarmac MADE GROUND  Type 1 sub-base of sandstone. MADE GROUND			
		0.70	ES			0.50		 Firm dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded concrete and sandstone. MADE GROUND		1	
		1.00	S	N=4 (1,0/1,1,1,1)				 Soft brown grey slightly sandy clayey SILT locally silty clay. Sand is fine to coarse. TERRINGTON BEDS			
		1.60	D								
		2.00	S	N=2 (1,1/1,0,1,0)						2	
		3.00	S	N=2 (1,0/1,0,1,0)		3.00		End of Borehole at 3.00m		3	
										4	

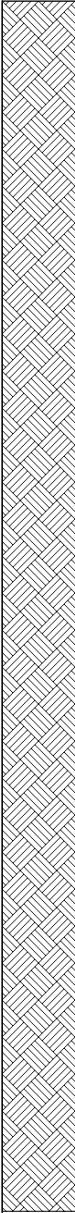
Crew: DS UK		Logger: RJH		Geotechnical Testing			
Equipment: Premier 110				Depth	Liquid Limit	Plasticity Index	Percentage <0.425mm
Reason for termination of borehole:							
Groundwater Remarks: Water at 1.80m.				Geotechnical Chemistry Testing			
General Remarks:				Depth	Determinand Name	Result	Unit
Hole Started: 25/02/2016		Hole Complete:		Version: FINAL		Scale: 1:25	

		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="text-align: center;">Windowless Sample Borehole</h1>				Borehole No WS05 Sheet 1 of 1	
Site Name: Kings Road, Spalding								Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.						GRM Project Ref: P7343		Coordinates 524620 E 323195 N	

Installation/ Backfill	Water Strike	Samples/Tests			Dynamic Probing (Blows per 100mm)	Depth (m)	Level (m)	Legend	Stratum Description	
		Depth	Type	Result						
						0.10			Concrete hardstanding. MADE GROUND	
						0.35			Type 1 sub-base of sandstone. MADE GROUND	
		0.40	ES			0.65			Firm very dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subangular sandstone, flint and coal fragments.	
		0.70	ES						MADE GROUND	
		1.00	S	N=2 (1,1/1,0,1,0)		0.90			Firm to stiff dark brown slightly sandy CLAY. Sand is fine to coarse. TERRINGTON BEDS	1
		1.60	D					Soft very dark grey very dark brown slightly sandy clayey SILT, locally silty clay. Sand is fine to coarse. TERRINGTON BEDS		
		2.00	S	N=6 (1,2/2,1,2,1)					2	
		3.00	S	N=2 (0,0/0,1,0,1)					3	
		4.00	S	N=3 (1,0/1,0,1,1)		4.00			4	
		End of Borehole at 4.00m								

Crew: DS UK		Logger: RJH		Geotechnical Testing			
Equipment: Premier 110		Reason for termination of borehole:		Depth	Liquid Limit	Plasticity Index	Percentage <0.425mm
Groundwater Remarks: Water at 1.80m.				Geotechnical Chemistry Testing			
				Depth	Determinand Name		Result
General Remarks:							
Hole Started: 25/02/2016		Hole Complete:		Version: FINAL		Scale: 1:25	

		GRM Development Solutions Ltd Laurus House, First Avenue, Centrum 100, Burton-on-Trent, DE14 2WH Tel (HQ): 01283 551249 Email: info@grm-uk.com		<h1 style="text-align: center;">Windowless Sample Borehole</h1>			Borehole No WS06 Sheet 1 of 1	
Site Name: Kings Road, Spalding							Ground Level (mAOD)	
Client: Reliant Building Contractors Ltd.					GRM Project Ref: P7343		Coordinates 524587 E 323216 N	

Installation/ Backfill	Water Strike	Samples/Tests			Dynamic Probing (Blows per 100mm)	Depth (m)	Level (m)	Legend	Stratum Description	
		Depth	Type	Result						
						0.05			Tarmac	
						0.30			MADE GROUND Type 1 sub-base of sandstone.	
						0.35			MADE GROUND Ash and clinker with organic odour.	
						0.60			MADE GROUND Soft to firm dark brown slightly sandy CLAY. Sand is fine to coarse.	
									TERRINGTON BEDS Soft dark grey dark brown slightly clayey sandy SILT locally silty sand. sand is fine to medium. Locally clayey. With some decomposing organic fragments.	
		0.40	ES							
		0.80	D							
		1.00	S	N=4 (1,1/1,1,1,1)						1
		1.50	D							
		2.00	S	N=5 (1,0/1,1,1,2)						2
		3.00	S	N=2 (0,0/0,1,1,0)						3
		4.00	S	N=4 (1,1/1,1,1,1)		4.00				4
		End of Borehole at 4.00m								

Crew: DS UK		Logger: RJH		Geotechnical Testing			
Equipment: Premier 110				Depth	Liquid Limit	Plasticity Index	Percentage <0.425mm
Reason for termination of borehole:							
Groundwater Remarks: Water at 0.80m.				Geotechnical Chemistry Testing			
General Remarks:				Depth	Determinand Name	Result	Unit
Hole Started: 25/02/2016		Hole Complete:		Version: FINAL		Scale: 1:25	



A P P E N D I X G

**GRM Development Solutions provides
multi-disciplinary consultancy services, UK-wide:**

- Geotechnical and Geo-environmental Services
- Civil and Infrastructure Services
- Structural Engineering Services
- Construction Management
- Site Services

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7 - 11 Harding Street
Leicester
LE1 4DH

GRM Development Solutions Ltd

Laurus House
First Avenue
Centrum 100
Burton on Trent
Staffordshire
DE14 2WH

Analytical Test Report: L16/0506/GRM/001

Your Project Reference:	Kings Road, Spalding	Samples Received on:	02.03.2016
Your Order Number:	P7343	Testing Instruction Received:	02.03.2016
Report Issue Number:	1	Sample Tested:	02 to 11.03.2016
Samples Analysed:	8 Soils 1 Slag 1 Cementitious Sheet	Report issued:	14.03.2016

Signed

James Gane
Manager - Data Logistics
Nicholls Colton Analytical

Notes:

General

Please refer to Methodologies tab for details pertaining to the analytical methods undertaken.

Samples will be retained for 14 days after issue of this report with the exception of the asbestos test portion which is held for 6 months unless otherwise requested.

Moisture Content was determined in accordance with NCA method statement MS - CL - Sample Prep, oven dried at <30°C.

Moisture Content is reported as a percentage of the dry mass of soil, this calculation is in accordance with BS1377, Part 2, 1990, Clause 3.2

Stone Content was determined in accordance with NCA method statement MS - CL - Sample Prep and refers to the percentage of stones retained on a 10mm BS test sieve.

With the exception of Sulphate, which is crushed over the 2mm test sieve, concentrations are reported as a percentage mass of the dry soil passing the 10mm BS test sieve. As received samples have been corrected for moisture content but not stone content.

Samples were supplied by customer.

Asbestos

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

Deviant Samples

Samples were received in suitable containers **Yes**

A date and time of sampling was provided **Yes**

Some sample handling times were exceeded prior to analysis of determinants **Yes**

Where samples do not meet one or more of the above criteria they will be classed as deviant, this means data may not be representative of the sample at the time of sampling and it is possible that results provided may be compromised.

Accreditation Key

UKAS = UKAS Accreditation, MCERTS = MCERTS Accreditation, u = Unaccredited

Please note MCERTS does not cover the 'Slag' matrix.



Nicholls Colton Analytical
7 - 11 Harding Street
Leicester
LE1 4DH

L16/0506/GRM/001

Project Reference - Kings Road, Spalding

Analytical Test Results - GRM Brownfield Suite

NCA Reference			16-6442	16-6443	16-6451	16-6445	16-6446	16-6447
Client Sample Reference			WS03	WS03	Adj TP07	TP07	WS05	WS06
Client Sample Location			WS03	WS03	Adj TP07	TP07	WS05	WS06
Depth (m)			0.25	0.60	Not provided	0.20	0.40	0.40
Date of Sampling			25.02.2016	25.02.2016	26.02.2016	26.02.2016	25.02.2016	25.02.20016
Time of Sampling			Not provided	Not provided	Not provided	Not provided	Not provided	Not provided
Sample Matrix			Sand	Clay	Bulk	Clay	Clay	Clay
Determinant	Units	Accreditation						
Arsenic	(mg/kg)	MCERTS	< 10	-	-	10.1	< 10	< 10
Cadmium	(mg/kg)	MCERTS	0.4	-	-	0.4	0.3	0.4
Chromium (Total)	(mg/kg)	UKAS	< 1	-	-	8.0	11.5	9.4
Copper	(mg/kg)	MCERTS	9.2	-	-	23.6	12.9	9.7
Lead	(mg/kg)	MCERTS	9.8	-	-	77.6	37.8	27.0
Mercury	(mg/kg)	UKAS	< 2.5	-	-	< 2.5	< 2.5	< 2.5
Nickel	(mg/kg)	MCERTS	3.4	-	-	14.1	17.5	19.7
Selenium	(mg/kg)	u	< 8	-	-	< 8	< 8	< 8
Zinc	(mg/kg)	MCERTS	14.4	-	-	76.3	50.8	45.2
Total Phenols	(mg/kg)	MCERTS	1.4	-	-	< 1	< 1	< 1
Cyanide (Total)	(mg/kg)	MCERTS	< 1	-	-	< 1	< 1	< 1
Chromium (Hexavalent)	(mg/kg)	u	< 1	-	-	< 1	< 1	< 1
pH	pH Units	u	6.2	-	-	6.5	6.8	8.5
SOM	(%)	UKAS	<1.7	-	-	4.3	<1.7	<1.7
Sulphate	(mg/l)	u	29	-	-	490	32	39
Acenaphthene	(mg/kg)	MCERTS	91.4	-	-	<0.02	0.15	13.80
Acenaphthylene	(mg/kg)	UKAS	1.47	-	-	0.08	0.09	0.17
Anthracene	(mg/kg)	UKAS	89.8	-	-	0.24	0.32	11.60
Benzo (a) anthracene	(mg/kg)	MCERTS	85.2	-	-	0.57	0.95	8.53
Benzo (a) pyrene	(mg/kg)	MCERTS	64.4	-	-	0.77	1.13	6.75
Benzo (b) fluoranthene	(mg/kg)	MCERTS	82.4	-	-	0.95	1.34	7.53
Benzo (g, h, i) perylene	(mg/kg)	MCERTS	34.8	-	-	0.56	0.69	3.26
Benzo (k) fluoranthene	(mg/kg)	MCERTS	32.8	-	-	0.43	0.59	3.35
Chrysene	(mg/kg)	MCERTS	80.0	-	-	0.82	1.06	7.26
Dibenzo (a,h) anthracene	(mg/kg)	MCERTS	8.76	-	-	0.10	0.14	0.75
Fluoranthene	(mg/kg)	MCERTS	243	-	-	1.51	2.19	25.6
Fluorene	(mg/kg)	MCERTS	62.1	-	-	0.03	0.08	11.8
Indeno (1, 2, 3,-cd) pyrene	(mg/kg)	MCERTS	40.4	-	-	0.62	0.83	4.17
Naphthalene	(mg/kg)	MCERTS	93.7	-	-	0.05	0.27	6.99
Phenanthrene	(mg/kg)	MCERTS	291	-	-	0.54	0.77	34.50
Pyrene	(mg/kg)	MCERTS	196	-	-	1.25	1.84	20.8
Total PAH (Sum of USEPA 16)	(mg/kg)	UKAS	1500	-	-	8.55	12.4	167
Total TPH (>C ₈ to C ₄₀)	(mg/kg)	MCERTS	-	23	-	-	-	-
Asbestos	-	UKAS	No asbestos detected	-	Chrysotile	No asbestos detected	No asbestos detected	No asbestos detected



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Leicester
LE1 4DH

L16/0506/GRM/001

Project Reference - Kings Road, Spalding

Analytical Test Results - GRM Brownfield Suite

NCA Reference			16-6448	16-6449	16-6450
Client Sample Reference			TP01	TP01	TP05
Client Sample Location			TP01	TP01	TP05
Depth (m)			0.30	2.80	0.40
Date of Sampling			26.02.2016	26.02.2016	26.02.2016
Time of Sampling			Not provided	Not provided	Not provided
Sample Matrix			Loam	Sand	Slag
Determinant	Units	Accreditation			
Arsenic	(mg/kg)	MCERTS	11.1	< 10	< 10
Cadmium	(mg/kg)	MCERTS	0.5	0.4	0.3
Chromium (Total)	(mg/kg)	UKAS	7.2	5.0	28.2
Copper	(mg/kg)	MCERTS	30.1	28.4	65.4
Lead	(mg/kg)	MCERTS	113	191	29.6
Mercury	(mg/kg)	UKAS	< 2.5	< 2.5	< 2.5
Nickel	(mg/kg)	MCERTS	15.8	14.5	40.3
Selenium	(mg/kg)	u	< 8	< 8	< 8
Zinc	(mg/kg)	MCERTS	120	101	26.4
Total Phenols	(mg/kg)	MCERTS	< 1	< 1	< 1
Cyanide (Total)	(mg/kg)	MCERTS	< 1	< 1	< 1
Chromium (Hexavalent)	(mg/kg)	u	< 1	< 1	< 1
pH	pH Units	u	8.3	8.6	8.3
SOM	(%)	UKAS	3.2	3.9	40.5
Sulphate	(mg/l)	u	230	150	110
Acenaphthene	(mg/kg)	MCERTS	0.18	0.33	<0.02
Acenaphthylene	(mg/kg)	UKAS	0.56	0.13	0.04
Anthracene	(mg/kg)	UKAS	1.67	0.75	0.16
Benzo (a) anthracene	(mg/kg)	MCERTS	7.45	1.59	0.19
Benzo (a) pyrene	(mg/kg)	MCERTS	6.79	1.23	0.13
Benzo (b) fluoranthene	(mg/kg)	MCERTS	9.86	1.77	0.26
Benzo (g, h, i) perylene	(mg/kg)	MCERTS	4.48	0.77	0.14
Benzo (k) fluoranthene	(mg/kg)	MCERTS	3.69	0.67	0.07
Chrysene	(mg/kg)	MCERTS	7.42	1.71	0.25
Dibenzo (a,h) anthracene	(mg/kg)	MCERTS	1.16	0.16	0.03
Fluoranthene	(mg/kg)	MCERTS	12.7	5.03	0.36
Fluorene	(mg/kg)	MCERTS	0.17	0.35	0.03
Indeno (1, 2, 3-cd) pyrene	(mg/kg)	MCERTS	5.10	0.86	0.10
Naphthalene	(mg/kg)	MCERTS	0.26	0.29	3.36
Phenanthrene	(mg/kg)	MCERTS	4.75	1.67	0.94
Pyrene	(mg/kg)	MCERTS	11.2	3.91	0.35
Total PAH (Sum of USEPA 16)	(mg/kg)	UKAS	77.4	21.2	6.42
Total TPH (>C ₈ to C ₄₀)	(mg/kg)	MCERTS	-	-	-
Asbestos	-	UKAS	No asbestos detected	No asbestos detected	No asbestos detected

L16/0506/GRM/001

Project Reference - Kings Road, Spalding

Analytical Test Results - TPH CWG

NCA Reference			16-6441	16-6442	16-6445	16-6446	16-6447	16-6449
Client Sample Reference			WS04	WS03	TP07	WS05	WS06	TP01
Client Sample Location			WS04	WS03	TP07	WS05	WS06	TP01
Depth (m)			0.70	0.25	0.20	0.40	0.40	2.80
Date of Sampling			25.02.2016	25.02.2016	26.02.2016	25.02.2016	25.02.20016	26.02.2016
Time of Sampling			Not provided	Not provided	Not provided	Not provided	Not provided	Not provided
Sample Matrix			Clay	Sand	Clay	Clay	Loam	Clay
Determinant	Units	Accreditation						
Aliphatics								
>C ₅ to C ₆	(mg/kg)	u	0.05	<0.03	<0.04	<0.04	<0.04	0.08
>C ₆ to C ₈	(mg/kg)	u	<0.03	0.10	<0.04	<0.04	<0.04	0.83
>C ₈ to C ₁₀	(mg/kg)	u	<0.03	<0.03	<0.04	<0.04	<0.04	3.7
>C ₁₀ to C ₁₂	(mg/kg)	u	<13	<11	<12	<12	<12	177
>C ₁₂ to C ₁₆	(mg/kg)	u	<13	35	<12	<12	<12	573
>C ₁₆ to C ₂₁	(mg/kg)	u	<13	63	<12	<12	<12	27
>C ₂₁ to C ₃₅	(mg/kg)	u	<13	158	14	<12	19	107
Aromatics								
>C ₅ to C ₇	(mg/kg)	u	<0.03	<0.03	<0.04	<0.04	<0.04	<0.04
>C ₇ to C ₈	(mg/kg)	u	<0.03	<0.03	<0.04	<0.04	<0.04	<0.04
>C ₈ to C ₁₀	(mg/kg)	u	0.14	<0.03	<0.04	<0.04	<0.04	0.15
>C ₁₀ to C ₁₂	(mg/kg)	u	<13	84	<12	<12	<12	16
>C ₁₂ to C ₁₆	(mg/kg)	u	<13	313	<12	<12	71	100
>C ₁₆ to C ₂₁	(mg/kg)	u	<13	839	<12	<12	162	113
>C ₂₁ to C ₃₅	(mg/kg)	u	40	1378	35	22	243	179
Total								
>C ₅ to C ₃₅	(mg/kg)	u	66	2881	73	46	519	1297

L16/0506/GRM/001

Project Reference - Kings Road, Spalding

Analytical Test Results - TPH CWG

NCA Reference				16-6450
Client Sample Reference				TP05
Client Sample Location				TP05
Depth (m)				0.40
Date of Sampling				26.02.2016
Time of Sampling				Not provided
Sample Matrix				Sand
Determinant	Units	Accreditation		
Aliphatics				
>C ₅ to C ₆	(mg/kg)	u		0.38
>C ₆ to C ₈	(mg/kg)	u		0.57
>C ₈ to C ₁₀	(mg/kg)	u		<0.03
>C ₁₀ to C ₁₂	(mg/kg)	u		<11
>C ₁₂ to C ₁₆	(mg/kg)	u		12
>C ₁₆ to C ₂₁	(mg/kg)	u		<11
>C ₂₁ to C ₃₅	(mg/kg)	u		43
Aromatics				
>C ₅ to C ₇	(mg/kg)	u		<0.03
>C ₇ to C ₈	(mg/kg)	u		0.07
>C ₈ to C ₁₀	(mg/kg)	u		0.14
>C ₁₀ to C ₁₂	(mg/kg)	u		<11
>C ₁₂ to C ₁₆	(mg/kg)	u		<11
>C ₁₆ to C ₂₁	(mg/kg)	u		<11
>C ₂₁ to C ₃₅	(mg/kg)	u		41
Total				
>C ₅ to C ₃₅	(mg/kg)	u		119

L16/0506/GRM/001

Project Reference - Kings Road, Spalding

Analytical Test Results - SVOC

NCA Reference		16-6449	
Client Sample Reference		TP01	
Client Sample Location		TP01	
Depth (m)		2.80	
Date of Sampling		26.02.2016	
Time of Sampling		Not provided	
Sample Matrix		Sand	
Determinant	Units	Accreditation	
1,2,4-trichlorobenzene,	(mg/kg)	u	<0.6
1,3-dichlorobenzene,	(mg/kg)	u	<0.6
1,4-dichlorobenzene,	(mg/kg)	u	<0.6
1-chloronaphthalene,	(mg/kg)	u	<0.6
2,3,4,6-tetrachlorophenol	(mg/kg)	u	<0.6
2,4,5-trichlorophenol	(mg/kg)	u	<0.6
2,4,6-trichlorophenol	(mg/kg)	u	<0.6
2,4-Dichlorophenol	(mg/kg)	u	<0.6
2,4-dimethylphenol	(mg/kg)	u	<0.6
2,4-Dinitrophenol,	(mg/kg)	u	<0.6
2,6-Dichlorophenol	(mg/kg)	u	<0.6
2,6-Dinitrotoluene	(mg/kg)	u	<0.6
2-chlorophenol,	(mg/kg)	u	<0.6
2-Methylnaphthalene	(mg/kg)	u	<0.6
2-methylphenol,	(mg/kg)	u	<0.6
2-Nitroaniline	(mg/kg)	u	<0.6
2-Nitrophenol	(mg/kg)	u	<0.6
3,3-Dichlorobenzidine	(mg/kg)	u	<0.6
3/4-methylphenol,	(mg/kg)	u	<0.6
3-Nitroaniline	(mg/kg)	u	<0.6
4-Chlorophenyl phenyl ether	(mg/kg)	u	<0.6
4,6-Dinitro-2-methylphenol	(mg/kg)	u	<0.6
4-bromophenyl phenyl ether	(mg/kg)	u	<0.6
4-chloro-3-methylphenol,	(mg/kg)	u	<0.6
4-Chloroaniline	(mg/kg)	u	<0.6
4-Nitroaniline	(mg/kg)	u	<0.6
4-nitrophenol,	(mg/kg)	u	<0.6
Acenaphthene	(mg/kg)	u	<0.6
Acenaphthylene	(mg/kg)	u	<0.6
Aniline	(mg/kg)	u	<0.6
Anthracene	(mg/kg)	u	0.7
Azobenzene	(mg/kg)	u	<0.6
Benz[a]anthracene	(mg/kg)	u	1.6
Benzene, 1,2-dichloro-	(mg/kg)	u	<0.6
Benzidine	(mg/kg)	u	<0.6
Benzo[ghi]perylene	(mg/kg)	u	0.8
Benzo[a]pyrene	(mg/kg)	u	1.4
Benzo[b]fluoranthene	(mg/kg)	u	1.9
Benzo[k]fluoranthene	(mg/kg)	u	<0.6
Benzoic Acid	(mg/kg)	u	<0.6
Benzyl Alcohol	(mg/kg)	u	<0.6
Benzyl butyl phthalate	(mg/kg)	u	<0.6
Bis(2-chloroethoxy)methane	(mg/kg)	u	<0.6
Bis(2-chloroethyl)ether	(mg/kg)	u	<0.6
Bis(2-chloroisopropyl)ether	(mg/kg)	u	<0.6
Bis(2-ethylhexyl) phthalate	(mg/kg)	u	1.1
Chrysene	(mg/kg)	u	1.6
Dibenzo[a,h]anthracene	(mg/kg)	u	<0.6
Dibenzofuran	(mg/kg)	u	<0.6
Dibutyl phthalate	(mg/kg)	u	<0.6
Diethyl Phthalate	(mg/kg)	u	<0.6
Dimethyl phthalate	(mg/kg)	u	<0.6
Di-n-octyl phthalate	(mg/kg)	u	<0.6
Diphenylamine	(mg/kg)	u	<0.6
Fluoranthene	(mg/kg)	u	4.0
Fluorene	(mg/kg)	u	<0.6
Hexachlorobenzene	(mg/kg)	u	<0.6
Hexachlorobutadiene	(mg/kg)	u	<0.6
Hexachlorocyclopentadiene	(mg/kg)	u	<0.6
Hexachloroethane,	(mg/kg)	u	<0.6
Indeno[1,2,3-cd]pyrene	(mg/kg)	u	0.8
Isophorone	(mg/kg)	u	<0.6
Methyl Methanesulfonate	(mg/kg)	u	<0.6
Naphthalene	(mg/kg)	u	<0.6
NitroBenzene	(mg/kg)	u	<0.6
N-Nitrosodimethylamine	(mg/kg)	u	<0.6
Pentachlorophenol	(mg/kg)	u	<0.6
Phenanthrene	(mg/kg)	u	2.0
Phenol	(mg/kg)	u	<0.6
Pyrene	(mg/kg)	u	3.1



Nicholls Colton Analytical
7 - 11 Harding Street
Leicester
LE1 4DH

L16/0506/GRM/001

Project Reference - Kings Road, Spalding

Sample Descriptions

NCA Reference	Client Sample Reference	Sample Depth (m)	Description	Moisture Content (%)	Stone Content (%)
16-6441	WS04	0.70	Dark brown sandy clay.	25	0
16-6442	WS03	0.25	Light brown gravelly sand with sandstone.	5.8	27
16-6443	WS03	0.60	Dark brown sandy clay.	26	0
16-6445	TP07	0.20	Dark brown silty sandy clay with organic matter.	25	7.8
16-6446	WS05	0.40	Dark brown slightly silty slightly sandy clay.	20	0
16-6447	WS06	0.40	Brown slightly silty slightly sandy clay.	22	0
16-6448	TP01	0.30	Brown sandy silt with root fragments.	9.2	5.7
16-6449	TP01	2.80	Dark brown silty sandy gravelly clay with crushed rock.	14	0
16-6450	TP05	0.40	Black/brown burnt slag.	14	0



Nicholls Colton Analytical
7 - 11 Harding Street
Leicester
LE1 4DH

L16/0506/GRM/001

Project Reference - Kings Road, Spalding

Analysis Methodologies

Matrix	Determinant	Sample condition for analysis	Test Method used
Soil	Metals	Air Dried	In house method statement - MS - CL - ICP metals
Soil	PAH	As Received	In house method statement - MS - CL - PAH (As received)
Soil	Phenols	As Received	In house method statement - MS - CL - Phenols (Skalar)
Soil	Chromium (hexavalent)	As Received	In house method statement - MS - CL - Chromium (Hexavalent)
Soil	Cyanide	As Received	In house method statement - MS - CL - Cyanide by Skalar
Soil	pH	As Received	In house method statement - MS - CL - pH (Soil) using a 1:3 soil to water extraction
Soil	SOM	Air Dried	In house method statement - MS - CL - TOC
Soil	Sulphate	Air Dried	In house method statement - MS - CL - Anions (Aquakem)
Soil	Total TPH	As Received	In house method statement - MS - CL - TPH - Sample was not subject to a 'scrubbing' cleanup step prior to analysis
Soil	CWG	As Received	In house method statement - MS - CL - EPH and VPH
Soil	Asbestos	As Received	Fibre identification is in accordance with in house documented methods which are based on the procedure documented in the HSE Document HSG 248 "Asbestos: The analysts guide for sampling, analysis and clearance procedures"
Soil	SVOC	As Received	In house method statement - MS - CL - SVOC



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	GRM TIER 1 ASSESSMENT CRITERIA		
LAND USE	Residential with Plant Uptake		
CONTAMINANT	1%	2.50%	6%
^e Arsenic	37	37	37
^e Cadmium	26	26	26
^b Chromium III	2590	2590	2590
^e Chromium VI	21	21	21
^e Lead	200	200	200
^c Mercury	170	170	170
^a Selenium	350	350	350
^a Nickel	130	130	130
^b Phenols	240	471	951
^b Copper	2300	2300	2300
^b Zinc	4590	4590	4590
^d Cyanide	34	34	34
^e Benzene	0.20	0.36	0.87
^b Toluene	118	267	609
^b Ethylbenzene	64	151	349
^b <i>o</i> - xylene	43	101	235
^b <i>m</i> - xylene	41	98	228
^b <i>p</i> - xylene	40	93	217
Non Genotoxic PAHs			
^b Acenaphthene	333	746	1450
^b Acenaphthylene	170	407	906
^b Anthracene	3770	7890	13700
^b Fluoranthene	391	690	981
^b Fluorene	166	939	849
^b Naphthalene	1.5	3.5	8.2
^b Phenanthrene	149	316	558
^b Pyrene	867	1560	2270
Genotoxic PAHs			
^{e/f} Benzo(a)pyrene	5	5	5
ALIPHATIC HYDROCARBONS			
^b C5-C6	28	51	105
^b C6-C8	68	152	347
^b C8-C10	18	43	102
^b C10-C12	87	215	509
^b C12-C16	709	1680	3400
^b C16-35	128000	128000	128000
AROMATIC HYDROCARBONS			
^b C5-7 (benzene)	64	128	271
^b C7-8 (toluene)	118	267	609
^b C8-C10	26	63	146
^b C10-C12	69	165	364
^b C12-C16	141	325	662
^b C16-C21	264	547	938
^b C21-C35	1120	1490	1720

Notes

- a SGV (2009)
 - b LQM/CIEH values or derived using CLEAv1.06 with LQM/CIEH Data.
 - c SGV for inorganic Hg used (ref.2009 SGV, Pg5, Para.4)
 - d Atkins ATRISKsoil Value
 - e C4SL - SP1010 (2014)
 - f Benzo(a)pyrene is a surrogate marker for the 8 genotoxic PAHs (Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(ah)anthracene, Ideno(1,2,3-cd)pyrene)
- NB Where C4SLs/SGVs have not been produced, all TACs have been revised in line with report SP1010 (2014), however, the default consumption rates in the CLEAv1.06 model have been retained.

GRM.TAC.08.14

	GRM TIER 1 ASSESSMENT CRITERIA		
LAND USE	Public Open Space 1 (residential)		
CONTAMINANT	1%	2.50%	6%
^e Arsenic	79	79	79
^e Cadmium	220	220	220
^b Chromium III	10500	10500	10500
^e Chromium VI	23	23	23
^e Lead	630	630	630
^g Mercury	502	502	502
^g Selenium	1380	1380	1380
^g Nickel	622	622	622
^b Phenols	8760	8810	8840
^b Copper	16400	16400	16400
^b Zinc	80700	80700	80700
^d Cyanide	34	34	34
^e Benzene	140	140	140
^b Toluene	55,000	55100	55200
^b Ethylbenzene	24,400	24600	24700
^b o - xylene	40,600	42000	42800
^b m - xylene	40,500	41900	42800
^b p - xylene	40,400	41800	42700
Non Genotoxic PAHs			
^b Acenaphthene	14600	14600	14600
^b Acenaphthylene	14600	14600	14600
^b Anthracene	72900	72900	72900
^b Fluoranthene	3030	3035	3040
^b Fluorene	9710	9710	9710
^b Naphthalene	3990	4360	4360
^b Phenanthrene	3020	3020	3020
^b Pyrene	7290	7290	7290
Genotoxic PAHs			
^{e/f} Benzo(a)pyrene	10	10	10
ALIPHATIC HYDROCARBONS			
^b C5-C6	567000	583000	596000
^b C6-C8	550000	565000	581000
^b C8-C10	12300	12400	12400
^b C10-C12	12400	12400	12400
^b C12-C16	12400	12400	12400
^b C16-35	249000	249000	249000
AROMATIC HYDROCARBONS			
^b C5-7 (benzene)	54800	55000	55100
^b C7-8 (toluene)	55000	55100	55200
^b C8-C10	4950	4960	4970
^b C10-C12	4970	4970	4970
^b C12-C16	4980	4980	4970
^b C16-C21	3730	3730	3730
^b C21-C35			

Notes

- a SGV (2009)
- b LQM/CIEH values or derived using CLEAv1.06 with LQM/CIEH Data.
- c SGV for inorganic Hg used (ref.2009 SGV, Pg5, Para.4)
- d Atkins ATRISKsoil Value
- e C4SL - SP1010 (2014)
- f Benzo(a)pyrene is a surrogate marker for the 8 genotoxic PAHs (Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(ah)anthracene, Ideno(1,2,3-cd)pyrene)
- g Based on SGV TOX data with revised exposure parameters
- NB Where C4SLs/SGVs have not been produced, all TACs have been revised in line with report SP1010 (2014), however, the default consumption rates in the CLEAv1.06 model have been retained.

GRM.TAC.08.14

Table 1a

UKDWS			EQS (µg/l)*
Parameter	Concentration	Units	
Acrylamide	0.1	µg/l	-
Aluminium	200	µgAl/l	-
Ammonium	0.5	mgNH4/l	0.2
Antimony	5	µgSb/l	-
Arsenic	10	µgAs/l	50 (dissolved)
Benzene	1	µg/l	10
Boron	1	mgB/l	2000
Bromate	10	µgBrO3/l	-
Cadmium	5	µgCd/l	See Table 2b
Chromium	50	µgCr/l	-
Chromium (III)		µg/l	4.7
Chromium (VI)		µg/l	3.4
Chloride (i)	250	mgCl/l	250
Conductivity (i)	2500	µS/cm at 20°C	-
Copper(ii)	2	mg/l	See Table 2a
Cyanide	50	µgCN/l	1
1, 2 dichloroethane	3	µg/l	10
Dichloromethane		µg/l	20
Epichlorohydrin	0.1	µg/l	-
Fluoride	1.5	mgF/l	1 (Hardness <50mg/l CaCO ₃) 2 (Hardness <50mg/l CaCO ₃)
Hydrogen ion	10	pH value	-
Iron	200	µgFe/l	1000 (dissolved)
Lead (ii)	25	µgPb/l	1.2 (dissolved & bioavailable)
Manganese	50	µgMn/l	30
Mercury	1	µgHg/l	0.07 (dissolved)
Mineral Oil (TPH)	10	µg/l	5000 (total) ****
Nickel (ii)	20	µgNi/l	4 (dissolved & bioavailable)
Nitrate (iii)	50	mgNO3/l	-
Nitrite (iii)	0.5	mgNO2/l	-
Phenol	0.5	µg/l	7.7
Polycyclic Aromatic Hydrocarbons (vii) *	0.1	µg/l	-
Fluoranthene		µg/l	0.0063
Naphthalene		µg/l	2
Benzo(a)pyrene	0.01	µg/l	0.00017
Benzo(b)fluoranthene		µg/l	-
Benzo(k)fluoranthene		µg/l	-
Benzo(g,h,i)perylene		µg/l	-
Indeno(1,2,3-cd)pyrene		µg/l	-
Anthracene		µg/l	0.1
Selenium	10	µgSe/l	-
Sodium	200	mgNa/l	-
Sulphate (i)	250	mgSO4/l	-
Tetrachloroethene and Trichloroethene (viii)	10	µg/l	10
Tetrachloromethane	3	µg/l	12
Toluene	700***	µg/l	50
Xylene	500***	µg/l	30
Ethylbenzene	300***	µg/l	20**
1,1,1-Trichloroethane		µg/l	400
Trichlorobenzenes		µg/l	0.4
Trichloromethane		µg/l	2.5
Vinyl chloride	0.5	µg/l	N/A
Carbon Tetrachloride		µg/l	12
Zinc	5000	µg/l	See Table 2a

Table 1b

Pesticides			EQS (µg/l)*
Aldrin	0.03	µg/l	
Dieldrin	0.03	µg/l	
Heptachlor	0.03	µg/l	
Heptachlor epoxide	0.03	µg/l	
other pesticides	0.1	µg/l	
Cyclodiene pesticides		µg/l	0.01 (sum)
Pesticides: Total (vi)	0.5	µg/l	

Table 2a

EQS for Hardness Related Substances*							
Substance	EQS type	EQS (ug/l) for Hardness bands (mg/l CaCO ₃)					
		0-50	>50-100	>100-150	>150-200	>200-250	>250
Freshwaters, suitable for all fishlife							
Copper (dissolved)	Annual average	1	6	10	10	10	28
Zinc (total)	Annual average	8	50	75	75	75	125

Table 2b

Substance	EQS Type	EQS (µg/l) for hardness bands (mg/l CaCO ₃)				
		<40	40-50	50-100	100-200	>200
Cadmium (dissolved)	Annual average	<0.08	0.08	0.09	0.15	0.25

Reference

* The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010

** Provisional EQS Value

*** WHO Drinking Water Standard

**** EA PPG3

Contaminant Thresholds for Subsurface Water Pipes

Contaminant	Thresholds (mg/kg)
Corrosion	
Wrapped Steel	pH<7 Cond >400µS/cm
Wrapped Ductile Iron	pH<5 Cond >400µS/cm, he not neutral
Copper	pH<5 >8 and Eh +ve
Toxic Substances	
Chromium (total) (Cr)	Applies to above pipe materials
Organic Contaminants	
VOC's	0.5 PE/0.125 PVC
BTEX & MTBE	0.1 PE/0.03 PVC
SVOC	2 PE/1.4 PVC
Phenols	2 PE/0.4 PVC
Cresols & Chlorinated Phenols	2 PE/0.04 PVC
Mineral Oil C11-C20	10 PE
Mineral Oil C21 - C40	500
Ether/Ketone/Amines, Nitrobenzene/Aldehydes	0.5 PE/0.02-1 PVC

Notes.

It is not recommended that water pipes should be laid in sites where these substances are identified or suspected

Local Utility Companies should be consulted prior to pipe specifications being finalised.

Ref: Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites. UKWIR Ref. No. 10/WM/03/21. 2010.



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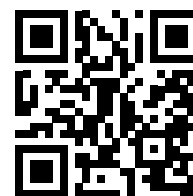
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Waste Classification Report



ENSQ3-2HJMF-5QMJ5

Job name

P7343 - Kings Road, Spalding

Waste Stream

GRM Standard Suite - incl TPH

Comments

RH

Project

P7343

Site

King's Road, Spalding

Classified by

Name:
Coffey, Simon
Date:
29/03/2016 09:44 UTC
Telephone:
01283 551 249

Company:
GRM Development Solutions Ltd
Laurus House
Centrum 100, First Avenue
Burton Upon Trent
DE14 2WH

Report

Created by: Coffey, Simon
Created date: 29/03/2016 09:44 UTC

Job summary

#	Sample Name	Depth [m]	Classification Result	Hazardous properties	Page
1	TP07	0.20	Non Hazardous		2
2	WS05	0.40	Non Hazardous		5
3	WS06	0.40	Non Hazardous		8
4	TP01	0.30	Non Hazardous		11
5	TP01[1]	2.80	Hazardous	HP 3(i), HP 7, HP 11	14
6	TP05	0.40	Non Hazardous		17
7	WS03	0.6	Non Hazardous		20
8	WS04	0.70	Non Hazardous		21
9	WS03[1]	0.25	Hazardous	HP 3(i), HP 7, HP 11	22

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A P P E N D I X K

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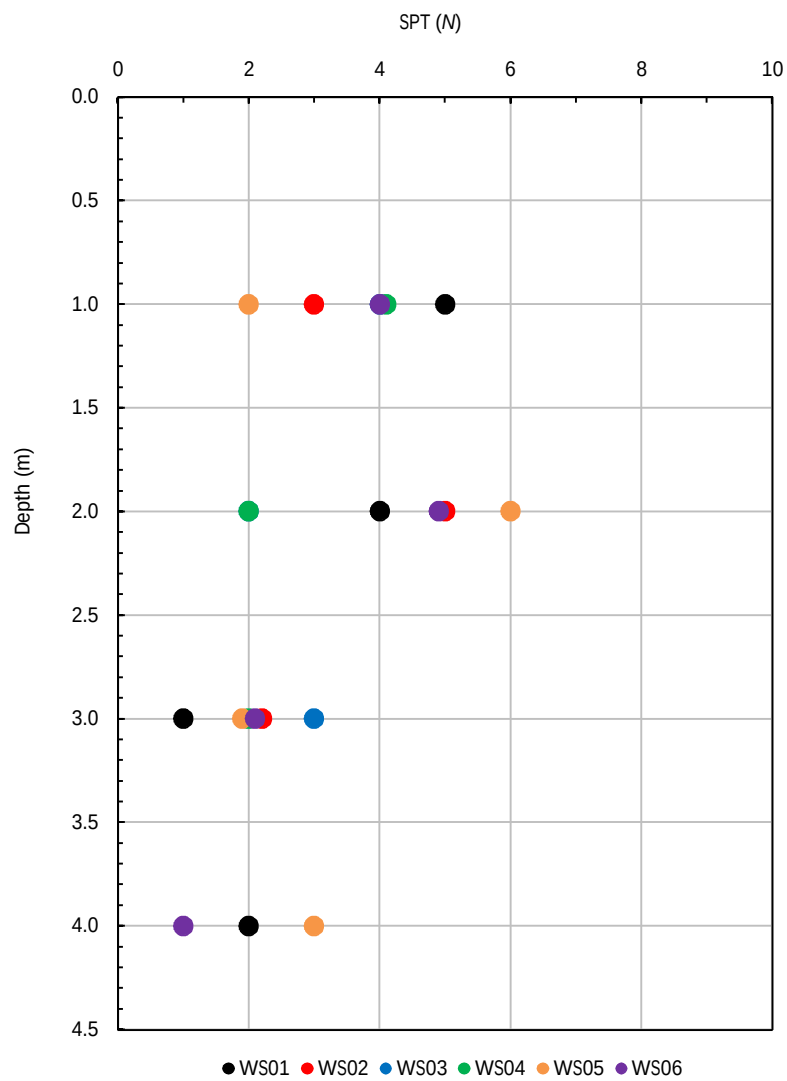


Figure x.1 - Summary of SPT *N* values vs depth (m) - cohesive strata

Foundation type:	Eurocode		British Standards (FoS = 3)	
	<i>p</i> (kN/m ²)	<i>s</i> (mm)	<i>p</i> (kN/m ²)	<i>s</i> (mm)
Strip (1m)	85	15-20	40	15-20
Raft	70	30	35	30

Table x.1 - Bearing capacity and settlement data using the Eurocode and British standards