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CIVIL • STRUCTURAL
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**PROPOSED RESIDENTIAL DEVELOPMENT
PHASE 2, CARDWELLS FARM,
GARSTANG ROAD, BARTON, LANCASHIRE.
FOR
WAINHOMES (NW) LTD**

MAY 2018

**PHASE 1 GEO-ENVIRONMENTAL DESK
STUDY REPORT**

18079/GEDS

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PHASE 1 GEO-ENVIRONMENTAL DESK STUDY REPORT
PHASE 2, CARDWELLS FARM, GARSTANG ROAD, BARTON,
LANCASHIRE.

1.0 INTRODUCTION

1.1 Instructions

1.1.1 *We are instructed by Wainhomes NW Ltd., Kelburn Court, Daten Park, Birchwood, Warrington WA3 6UT to carry out a detailed Phase 1 desk study to examine the geotechnical and geo-environmental risks associated with the proposed Phase 2 residential development to an area of land east of Cardwells Farm, Garstang Road, Barton, Lancashire this is located east of the phase 1 development area and REFA have previously carried out a Phase 1 Desk Study (Report reference 16125/GEDS). This risk assessment has been prepared in support of a planning application to redevelop the site in a residential manner.*

1.2 Objectives

1.2.1 *This environmental assessment has been carried out in accordance with the principal recommendations of BS10175 : 2011 "Investigation of Potentially Contaminated Sites" with regard to the consideration of potential soil and groundwater contamination along with the generation and migration of toxic and explosive ground gasses. It is intended that the report will be submitted to the local planning authority as a preliminary risk assessment in support of a planning application. This report has been prepared to document the following:-*

- *Review of readily available published data which could provide information on the current status, ground conditions and site history;*
- *Findings of a walkover survey undertaken on the 17th May 2018;*
- *Findings of a preliminary contaminated land risk assessment;*
- *Findings of a preliminary geo-technical risk assessment;*

1.3 Sources Of Information

1.3.1 *This report has been prepared using information from the following sources:-*

- *Groundsure Enviro-Insight report dated 14th May 2018;*
- *Groundsure Geo-Insight report dated 4th May 2018;*
- *All available old Ordnance survey maps;*
- *Environment Agency information.*

1.4 Development Proposals

1.4.1 *At the time of preparation of this report a feasibility sketch for the residential development of this site had been prepared. A copy of the feasibility sketch is appended to this report for reference and to give general details of the extent and type of the development considered.*

1.4.2 *At present the development proposals include for the construction of one hundred and twenty one (121 No.) residential plots in detached and semi-detached configuration with associated road access and private garden areas. Areas of POS and sports fields are also proposed as part of the development.*

1.4.3 *It is acknowledged that the development proposals for this site are likely to be amended as a result of local planning requirements. It is however anticipated that the current proposals will be representative of the final development approval. However if the final development proposals are radically different from the current feasibility proposals, then recommendations made within this report may become inappropriate.*

1.5 Limitations Of Report

1.5.1 *This report is a desk study report which has been prepared using readily available information in accordance with the project stage requirements, budget and time scales. The opinions expressed in this report and the comments and recommendations given are based upon the information obtained from the desk assessment and an initial site reconnaissance. At this stage intrusive investigations have yet to be undertaken at site to establish actual ground and groundwater conditions and provide data for assessment of the environmental status of the site.*

1.5.2 *The information, views and conclusions drawn concerning the site are based in part on information supplied to Robert E Fry & Associates Ltd (REFA) by other parties. REFA has proceeded in good faith on the assumption that this information is accurate. REFA accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to REFA from others.*

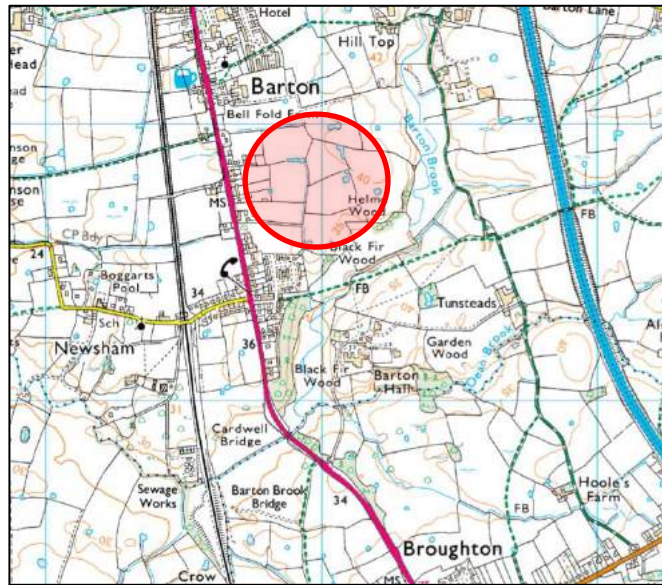
1.5.3 *The geo-environmental walkover survey consisted of a general externally inspection of the site aimed at identifying any obvious signs of geo-technical hazards affecting the site and potential sources of ground contamination. Any risks identified in this desk study are perceived risks based on the information reviewed and currently available. Actual risks can only be assessed following a physical investigation of the site.*

1.5.4 *The copyright of this report (including its electronic form) shall remain vested in (REFA) but the client shall have a license to copy and use the document for the purpose for which it was provided. REFA shall not be liable for the use by any persons of the document for any purpose other than that for which the same was provided by REFA. This document shall not be reproduced in whole or in part or relied upon by third parties for any use whatsoever without the express written authority of REFA.*

2.0 THE SITE

2.1 Location

2.1.1 *The site is irregular in shape and is located east of Garstang Road approximately 1.5km to the south of Barton village centre. It extends to an area of approximately 9.2 hectares and the centre of the site is situated at National Grid Reference SD 52112 36759 within a predominantly agricultural area but with residential development along the main highways to the north and the south. This location is shown in figure 1 overleaf.*

Figure 1 Site Location

2.2 Description, Geographic Setting & Topography

- 2.2.1 *The site comprises of multiple parcels of agricultural land which appear to have been utilised most recently for grazing and the production of hay.*
- 2.2.2 *The majority of the site is generally level although sloping topography has been noted within the southern area of the site where gradients have been identified between 1:8 – 1:10. Generally the gradients across the site are anticipated to have a minor impact upon the development proposals, but there may be a requirement for localised retaining structures within the southern area of the site.*
- 2.2.3 *The northern, eastern and southern boundaries are formed by further agricultural fields. The western boundary is formed by a further agricultural field designated for the Phase 1 development by Wainhomes.*
- 2.2.4 *The site does contain a number of hedgerows and trees but these appear to be limited only to the main boundaries. It is recommended that an arboriculturist report should be undertaken upon all trees and hedgerows within and adjacent to this site prior to any development taking place. The presence of trees and hedgerows may impact upon the foundation requirements for proposed properties within influencing distance.*

2.3 Site Walkover

- 2.3.1 *A site walkover was undertaken on the 17th May 2018 8th in an order to determine the condition and environmental setting of the site to inform the desk study. At the time of walkover survey the weather conditions were warm and settled.*
- 2.3.2 *The walkover survey has confirmed that the whole site comprises of agricultural land which appears to have most recently been utilised for animal grazing and the production of hay. During the walkover survey numerous ponds have been identified within the site and adjacent to site boundaries. The ground conditions of these greenfield areas are noted to be soft to firm underfoot.*

- 2.3.3 *Sloping gradients to the south were identified within the southern area of the site approximate gradients of 1:8 – 1:10. Within the southern area of the site an area of undulating ground was firm underfoot was identified but may indicate disturbed ground. The site contains numerous hedgerows around all boundaries along with semi-mature and mature trees. These features should be surveyed within an arboriculturist report prior to any further works taking place.*
- 2.3.4 *The primary details of the initial survey have been indicated upon the appended drawing number 18079/01 “Walkover Survey” for reference. The walkover survey plan gives general details of the topographical features along with features noted during the walkover survey. Photographs of the Walkover Survey are also appended to this report for reference and the locations of the photographs relate to the designated field areas shown upon the Walkover Survey Zoning Plan (18079/02).*

3.0 DESK STUDY

- 3.0.1 *As part of our environmental desk studies we have commissioned an Enviro-Insight report by Groundsure which gives details of all recorded environmental features relating to the site and its immediately surrounding area. We have also obtained copies of all available old Ordnance Survey maps for the area and these also give historical guidance regarding the former usage of the site area and its immediate vicinity. A Geo-Insight report has also been commissioned which assess the geological structures within the general area of the site.*

3.1 Historical Industrial Sites

- 3.1.1 *The Enviro-Insight report has identified seventy eight records of potentially contaminative past land uses within 500m of the search boundary. The first two records are located on-site and relate to an unspecified pit. These relate to the existing pond areas and therefore it is not anticipated that deep deposits of made ground are present in these areas associated with the infilling of former ponds. Further records of unspecified pits and sewage works are noted outside of the site boundary but are considered too remote as to pose a potential source of contamination within the development site.*
- 3.1.2 *The environmental report has identified five records of historical tanks however these are all located in excess of 220m from the site boundary.*
- 3.1.3 *The Enviro-Insight report has identified four records of historical energy features which all relate to electricity substations. These are all located in excess of 170m from the site boundary and are not considered to pose a potential source of PCB contamination within the site.*
- 3.1.4 *The Enviro-Insight report has identified ten records of potentially infilled features within the site however these all relate to existing ponds within the site area and therefore they are not anticipated to pose sources of deep made ground that may generate ground gases. All remaining records are located out of the site and relate to further unspecified pits and ponds and they are not considered to pose potential sources of explosive or toxic gases to this development.*

3.2 Environmental Permits, Incidents & Registers

3.2.1 *The Enviro-Insight report has identified two records of license discharge consent however these are located in excess of 259m from the site boundary and are not considered to pose a potential source of contamination.*

3.2.2 *The environmental report has identified three records of National incidence recording system list 2 however these are all located in excess of 249m from the site boundary. These are considered too remote as to pose potential source of contamination to this development site.*

3.3 Landfill Sites

3.3.1 *The Enviro-Insight report has not identified any landfill or waste sites within 1000m of the study site boundary and therefore the site is not considered to be at risk of migrating ground gases generated from landfills.*

3.4 Current Land Uses

3.4.1 *The environmental report has identified four records of potentially contaminative industrial estates however these are all located in excess of 95m from the site boundary and are not considered to pose a potential source of contamination.*

3.4.2 *The report has also not identified any petrol or fuel sites or underground high pressure oil or gas pipelines within 500m of the study site boundary.*

3.5 Hydrogeology & Hydrology

3.5.1 *The superficial deposits identified below the site area are designated as Secondary (Undifferentiated) which relates to deposits which have been previously designated and both minor and non-aquifer due to the variable characteristics of the soil type.*

3.5.2 *The site lies above a Principal Aquifer comprising of rocks with high intergranular permeability usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. The redevelopment of this site on a residential basis is not considered to represent a potential hazard to groundwater within the area, but clearly appropriate management techniques and precautions should be adopted at all times.*

3.5.3 *The environmental report has not identified any water abstraction points within 400m of the site boundary, although abstraction points do exist beyond this distance, the development of this site is not considered to pose a hazard to these abstraction points.*

3.5.4 *The Enviro-Insight report has identified that the site lies within a Type 3 Source Protection Zone, although due to the impermeable superficial deposits it is considered that these superficial deposits will provide a sufficient barrier to the underlying aquifer.*

3.5.5 *The Enviro-Insight report has identified EA information on groundwater vulnerability and soil leaching potential within 500m of the study site. This information is located on site and is classified as a major aquifer/high leaching potential with a soil vulnerability category L. This category indicates that soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal or they have the ability to attenuate diffuse pollutants.*

3.5.6 *The environmental report has identified the presence of a ditch located adjacent to the western boundary which trends in a general north to south direction. Smaller ditches have also been identified within the wooded area located adjacent to the eastern boundary. The development of this site is not anticipated to pose a potential hazard to these water courses however appropriate measures should be adopted to avoid any contamination of the existing water courses.*

3.6 Flooding

3.6.1 *The Enviro-Insight report has identified that the site does not lie within an Environment Agency flooding zone 2 or 3, though it does highlight that the site is located within 50m of a British Geological Survey groundwater flooding susceptibility area and this relates to clear water flooding with potential below surface. Where potential for groundwater flooding of properties situated below ground level is indicated this means that given the geological conditions there may be a groundwater flooding hazard to basements and other below surface infrastructure. Unless other relevant information e.g., records of previous flooding suggests that groundwater flooding has occurred before in this area, then there is no need to take further action in relation to groundwater flooding hazard. If there are any records of previous incidences of groundwater flooding then it is recommended that other information e.g. rainfall history, property type and land drainage information in addition to previous records of flooding be investigated in order to establish relative but not absolute risk of groundwater flooding. A low confidence rating is given to this result.*

3.5.2 *During the site walkover soft areas were identified underfoot following periods of extensive warm weather and it is anticipated that the underlying strata comprises of impermeable clay deposits and it is likely that during periods of inclement weather standing water may develop within excavations and exposed areas of clay deposits.*

3.7 Environmentally Sensitive Sites

3.7.1 *The desk study report has identified no environmentally sensitive sites lying within a buffer zone of 2000m of the study site area.*

3.8 Geology

3.8.1 *The superficial deposits located within this area are likely to comprise of glacial till comprising of clays with occasional granular lenses. Glacial till would have a varied permeability from low to high with a mixed flow type.*

3.8.2 *The solid geology within the area comprises of the Sherwood Sandstone Group which is Ladinian in age and will consist primarily of sandstone with minor mudstone and siltstone units. Typically the formation is anticipated to have a thickness in the order of some 1500m.*

3.8.3 *The geological report confirms the presence of a fault trending in a north to south direction running through the eastern half of the site. There will be a requirement to incorporate nominal reinforcement within the foundations in this area of the site in case of ground movements associated with the existing geological fault.*

3.8.4 *The geological report identifies that the study area is not within a radon affected area as less than 1% of properties are above the action level. No radon protective measures are required.*

3.9 Ground Workings

3.9.1 *The geological report has identified twelve records on site which relate to ground workings associated with unspecified pits and pond areas. The unspecified pit features relate to existing ponds and therefore it is not anticipated that deep deposits of made ground exist within the site within these areas. Therefore there is no requirement for a programme of ground gas monitoring. Further historic ground working features are identified outside of the site boundary but again relate to existing pond areas and a sewage works.*

3.9.1 *The geological report has not identified any historical underground working features within 1000m of the study site boundary and all BGS current ground workings are located in excess of 375m from the site boundary. These all relate to clay and shale or sand and gravel pits all have noted to have ceased operations.*

3.10 Mining

3.10.1 *The geological report has not identified any areas of mining, extraction and natural cavities within 975m of the study site boundary.*

3.11 Soil Chemistry

3.11.1 *The Geo-Insight report includes an estimation of the natural soil chemistry within 250m of the study site boundary. At this site the estimated geometric mean soil concentrations of arsenic, cadmium, chromium, nickel and lead are all anticipated to lie below current soil guideline values or general assessment criteria applicable at the time of preparing this report.*

3.12 Railways & Tunnels

3.12.1 *The geological report has identified historical railway located 245m to the west. This is not anticipated to pose a potential source of contamination to this development site.*

3.13 Site History

3.13.1 Table 1: Review Of Historical Maps

Date	Site	Adjoining Land
1847	<i>The site is indicated to be solely agricultural land with a pond located within the north eastern corner of the site. The southern corner of the site is noted to be wooded area noted as Black Fir wood.</i>	<i>Cardwells farm is located approximately 100m to the west adjacent to Garstang Road which trends in a north to south direction. Barton brook is located approximately 80m to the east and south east and trends in a general north east to south west direction. The majority of the surrounding land comprises of further agricultural field which sporadic ponds.</i>
1892	<i>Two additional ponds are now located within the central and southern areas of the site.</i>	<i>No significant changes.</i>
1932	<i>A drainage brook is indicated to run centrally through the middle of the site flowing in a southerly direction.</i>	<i>No significant changes.</i>
1960	<i>Black Fir wood within the southern area of the site has been dramatically reduced though a thin strip is still present adjacent to the south eastern boundary.</i>	<i>Significant residential development has taken place along Garstang Road.</i>

1981 - 1987	No significant changes.	No significant changes.
2002	No significant changes.	No significant changes.
2010 - 2014	No significant changes.	No significant changes.

3.13.2 Careful appraisal of all available historical information has confirmed that the site has been remained in agricultural usage throughout the whole of its recorded usage. A pond and a drainage ditch have been added to the site post 1900's and Blackfair wood has reduced significantly in size within the southern area of the site post 1930's. No significant source of contamination or ground gases have been identified within or in close proximity to the site.

4.0 REVIEW OF GEO-ENVIRONMENTAL RISK

4.1 Introduction

4.1.1 This element of the report is aimed at identifying possible risks, if any, arising from substances used or deposited on site or from other sources of land contamination. Both past and current potentially contaminative land uses have been considered.

4.1.2 The risk assessment utilises a source-pathway-receptor methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This requires that there be a pollutant linkage from source to receptor for harm to be caused. The source-pathway-receptor methodology relationship allows an assessment of the environmental risk to be determined based upon the nature of the source, the degree of exposure of the receptor of the source and the sensitivity of the receptor.

Table 2 : Statutory Receptors & Pathways

Target (Receptor)	Potential Source – Pathway Linkage
Site Users / Residents	Inhalation of soil gas, odours or dust. Ingestion of, and skin contact with, contaminated soil. Ingestion of contaminants in vegetables etc. or in soils adhering to vegetable etc.
Construction / Maintenance Workers	Inhalation of soil gas, odours or dust. Ingestion of, and skin contact with, contaminated soil.
Plants	Adverse effects on growth caused by presence of contaminants in soil.
Buildings & Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion & fire hazards. Sulphate attack of foundations. Hydrocarbons penetration plastic water supply pipes.
Groundwater	Migration of soluble contaminants into groundwater on/off site. Migration of oils into groundwater on/off site.
Surface water	Migration of soluble contaminants and/or direct run off of contaminants. Migration of oils into groundwater on/off site.

4.1.3 A conceptual model of plausible pollutant linkages has been formulated for the site in accordance with the risk assessment approach applied to contaminated land assessment.

4.2 Potential Sources Of Contamination

4.2.1 *The historical Ordnance Survey maps indicate that the site has remained in agricultural usage throughout the whole of its recorded history and assessment has not identified any significant sources of contamination or ground gases within the site or in close proximity to the site. It is anticipated that the majority of the site will comprise of topsoil overlying glacial till clay deposits.*

4.2.2 *The likelihood of widespread soil contamination is expected to be very low due to the continuous agricultural land use with no other evidence of development.*

4.2.3 *Potential sources of contamination could be limited to the following:-*

- *Naturally occurring elevated concentrations of contaminants within the topsoil.*

4.3 Pathway For Migration

4.3.1 *It is recognised that the migration pathways could change during the development of the site. These pathways are summarised below:-*

- *Migration of contamination (if present) via the un/saturated zones;*
- *Migration of contamination (if present) via buried services and foundations;*
- *Run-off from adjacent site areas;*
- *Migration of ground gas via soil pores;*
- *Direct contact with contaminated materials.*

4.3.2 *This list recognises that it is plausible that there are pathways associated with the presence of both on site and off site contamination. The above list recognises that the new development may not affect certain migration pathways such as migration in the saturated zone from an offsite source but could create new pathways such as the presence of services and foundations.*

4.3.3 *It is anticipated that, if a potential risk is identified, it can be reduced to an acceptable level by using a combination of mitigation measures during construction and in the building design. Site workers may be exposed to bare ground and existing building fabrics when clearing and redeveloping this site. Precautions should be taken to reduce the risks associated with these pathways including the adoption of personnel protective equipment (PPE), being rigorous in matters of personnel hygiene and adopting safe practices for workers entering enclosed underground cavities. Environmental management practices should be implemented to prevent potential impact associated with dust generation and dispersion and surface water run-off for example.*

4.4 Potential Receptors

4.4.1 *The principal receptors are considered to be as follows:-*

- *Humans – future site users;*
- *Humans – construction and maintenance workers;*
- *Controlled waters;*
- *Building structures and services.*

4.5 Assessment Of Plausible Pollutant Linkages

- 4.5.1 The overall risk associated with future site users is considered to be very low.
- 4.5.2 Contamination is not expected at this site, though nevertheless site workers should adopt a precautionary approach in respect of potential land contamination. On the basis of the current assessment and recommendations the overall risk to site workers is considered to be low.
- 4.5.3 The overall risk associated with the water environment is considered to be low. The presence of impermeable glacial till deposits overlying principal aquifer rocks suggests a low potential risk to groundwater.
- 4.5.4 Substances that may be involved in chemical attack upon building materials, structures and services may be present in the ground and there is the potential for ground gas to migrate through permeable deposits and accumulate in enclosed spaces. Currently the overall risk associated with this category of hazard is considered to be low. The building's design and the materials used in its construction should be compliant with the prevailing ground conditions in order to mitigate potential harm from chemical attack where identified.
- 4.5.5 Careful assessment of all currently available information has enabled a preliminary conceptual model to be prepared and this is detailed in table 3 below:

Table 3 : Preliminary Conceptual Model

Potential Source	Potential Receptor	Possible Pathway	Probability	Consequence	Risk	Mitigation / Investigation
Contaminated Soils	Site personnel during construction	Direct contact of soils Inhalation or ingestion of soil / dust	Li	Mi	Moderate/Low	Soil sampling during intrusive investigations. Laboratory analysis of samples
	Future site users	Direct contact of soils Inhalation or ingestion of soil / dust	Lw	Md	Moderate/low	
	Surface water in the vicinity of the site	Leaching of contaminants through drainage system	Lw	Md	Moderate/Low	
	Ground water in aquifer	Leaching of contaminants to ground water	Ul	Md	Low	
	Future site users	Vapour migration from soils	Lw	Mr	Very Low	
Proposed buildings and services	Proposed buildings and services	Direct contact with contaminated soils	Lw	Mi	Low	
	Plants in gardens and soft landscaping	Direct contact	Lw	Mi	Low	

Contaminated ground water	Site personnel during construction	Water entering excavations	Lw	Mi	Low	Sampling of ground water (where encountered)
	Future site Users	Retained surface water	Lw	Mi	Low	
Toxic and explosive gasses	Proposed buildings and occupiers	Ground gas migration into buildings	Lw	Md	Moderate / Low	Program of ground gas monitoring (where required)
Radon Gases	Proposed buildings and occupiers	Ground gas migration into buildings	Ul	Md	Low	Site is located in an area where less than 1% of properties are affected by radon gas.
Key: Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor Hi = High, Li = Likely, Lw = Low Likelihood, Ul = Unlikely						

4.5.6 In this qualitative risk assessment a low risk implies that remedial action is unlikely to be necessary at the site, although until a full intrusive investigation is carried out, this cannot be positively confirmed. Specific attention is required to the areas of the existing residential property and outbuildings. Specific attention will also be required in areas close to the western boundary for the potential of localised made ground associated with the railway cutting.

5.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

5.1 Details Of The Site

5.1.1 The site is currently a series of agricultural fields with pond areas and has remained in similar condition throughout the majority of its history. It is anticipated that over the majority of the site natural strata will immediately underlie the surface topsoil layer.

5.1.2 It is likely that the development of the site will require the following stages:-

- Provision of foundations typically extending to depths of some 0.9m below ground level;
- Construction of drainage and highways;
- Construction of residential properties;
- Preparation of soft landscaped areas and hard standings.

5.2 Geotechnical Hazards & Foundation Considerations

5.2.1 Based upon the information available to this desk study the anticipated ground conditions present within this site are outlined in table 4 below:-

Table 4: Anticipated Ground Conditions

Ground Material	Anticipated Condition
Topsoil	Anticipated to be present throughout the whole of the site area.
Glacial Till deposits	Deposits comprising of clays.
Bedrock	Sherwood Sandstone Group comprising of sandstones, minor mudstones and siltstone units.
Groundwater	Natural groundwater is expected to lie at depth within the bedrock. Excavations and low lying areas are likely to be subject to surface water retention due to the possible low permeability of soils.

Of course it will be essential for intrusive ground investigation works to be undertaken to confirm that the anticipated ground conditions are an accurate appraisal of the true ground conditions.

5.2.2 A summary of potential geo-technical hazards is detailed within table 5 overleaf:-

Table 5 : Summary Of Potential Geotechnical Hazards

Hazard Category (excluding contamination issues)	Hazard Status	Engineering Considerations
<i>Highly compressible / low bearing capacity soils (including peat / soft clays)</i>	<i>Possible</i>	<ul style="list-style-type: none"> • <i>Localised made ground</i> • <i>Cohesive deposits</i>
<i>Ground subject to or at risk of landslides</i>	<i>Possible</i>	<ul style="list-style-type: none"> • <i>The majority of the site has no significant slopes.</i> • <i>Sloping topography within the southern area of the site.</i>
<i>High ground water table</i>	<i>Unlikely</i>	<ul style="list-style-type: none"> • <i>Unproductive superficial deposits</i> • <i>Principle aquifer bedrock</i>
<i>Surface water retention</i>	<i>Likely</i>	<ul style="list-style-type: none"> • <i>Impermeable superficial deposits</i>
<i>Surface water run off</i>	<i>Unlikely</i>	<ul style="list-style-type: none"> • <i>Impermeable surface</i> • <i>Majority of the site has no significant slopes.</i>
<i>Mining</i>	<i>Unlikely</i>	<ul style="list-style-type: none"> • <i>No recorded history of mining.</i>
<i>Volume change potential of soils</i>	<i>Likely</i>	<ul style="list-style-type: none"> • <i>Cohesive superficial deposits</i>
<i>Adverse ground chemistry</i>	<i>Unlikely</i>	<ul style="list-style-type: none"> • <i>Potential elevated concentrations of contaminants within the topsoil strata.</i>
<i>Live services</i>	<i>Unlikely</i>	<ul style="list-style-type: none"> • <i>No previous site occupation/ development</i>

5.2.3 *It is anticipated that the ground conditions present within this site may be conducive to the adoption of a shallow spread type foundation to residential structures constructed within this site area. It is possible that increased foundation depths and specialist precautions may be required in those areas where existing trees are present or where neighbouring trees lie in close proximity to the proposed structures. The engineering properties of the strata within the site should be assessed during the intrusive phase of investigations.*

5.2.4 *Whilst the presence of significant thicknesses of made ground is not anticipated to be present within this site, it is nevertheless likely that all properties within this site should be provided with a suspended ground floor construction. This may be of a pre-cast concrete beam and block type arrangement or of a cast insitu construction, though properties which are affected by the presence of tree roots may specifically require the provision of a sub floor void.*

5.3 Drainage

5.3.1 *The geological information relating to this site suggests that the superficial strata is likely to consist of glacial till deposits which comprise of clays with minor sand lenses and are considered to be effectively impermeable. Based upon the currently available information it is considered that the ground conditions present within this site are not conducive to the adoption of a ground infiltration method of surface water disposal.*

6.0 PROPOSED GROUND INVESTIGATIONS**6.1 *Ground Investigation***

6.1.1 *By undertaking an intrusive ground investigation an assessment of the ground and groundwater profiles may be carried out and the geo-technical and geo-environmental risks associated with this site identified. The investigation will allow a quantitative assessment as to whether any of the potential risks identified in this study are present and are of material concern to the proposed development. The works should be undertaken in accordance with the recommendations laid down in BS 10175 : 2011 "Investigation of Potentially Contaminated Sites".*

6.2 *Proposed Scope Of Ground Investigations*

6.2.1 *On the basis of the currently available information regarding the geo-environmental setting of the site and to confirm the assumptions made, an intrusive ground investigation should be carried out. This should be utilised to confirm the geological succession and engineering properties of the sub surface materials. Intrusive investigations are required and may require the provision of appropriate gas monitoring points to assess the presence of any potential landfill gas generation from unrecorded buried materials. The scope of works for the ground investigation should comprise of the following:-*

- *Program of ground investigations to identify the strata sequence and assess engineering properties;*
- *Sampling of the existing strata for chemical and civil engineering laboratory test purposes;*
- *Program of chemical analyses upon representative samples of the strata to determine their suitability for reuse within a residential environment;*
- *Reinstatement;*
- *Commission an arboriculturists report on all trees within and adjacent to the site;*
- *Preparation of factual and interpretative report.*

6.2.2 *These ground investigation proposals are intended to represent a preliminary assessment only and it is important that where unusual or suspicious ground conditions are identified, the design of the intrusive investigations should be amended to assess these areas.*

Yours sincerely



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