Chelmer
Consultancy Services
'Groundbreaking Services'

Geo-Environmental Interpretative Report

Site	Union Park
	1-8 Packet Boat Lane
	Uxbridge UB8 2GH
Client	London Green Ltd
Date	August 2015
Our Ref	GENV/5338

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APPENDICES

EXECUTIVE SUMMARY

Item	Comments
Site	**Union Park, 1-8 Packet Boat Lane Uxbridge UB8 2GH**
Ground Conditions	The current work encountered MADE GROUND to a maximum depth of 1.9m below existing ground level (bgl). This was underlain by clay head deposits within boreholes BH1 & BH2 to a maximum depth of 3.1m bgl. The clay head in borehole BH1 and MADE GROUND in boreholes BH3-BH6 were found to be underlain by Lynch Hill Gravel Member to a maximum depth of 4.7m bgl. This was underlain by London Clay which was not penetrated at the maximum drilling depth of 15.0m bgl.
Groundwater	Groundwater 'strikes' were observed within boreholes BH1-BH4 & BH6 at depths of between 1.5m and 2.0m bgl. Standing groundwater was observed within boreholes BH1-BH6 at depths of between 1.2m and 2.0m bgl. Two monitoring visits were undertaken to boreholes BH1, BH4 and BH6 on 26th May and 5th June 2015. Groundwater depths of 5.92m and 5.9m bgl were recorded in borehole BH1, depths of 3.2m and 3.22m bgl were recorded in borehole BH4 and depths of 1.28m and 2.8m bgl were recorded in borehole BH6.
Roots	No roots were observed during the current investigation.
Foundations	If conventional shallow foundations are proposed, pad/strip foundations at this site should be set beneath any MADE GROUND and within the top of the superficial drift Clay or Lynch Hill Gravel Member. The superficial drift clay at a depth of 1.5m bgl should support a maximum (safe) design bearing pressure of approximately 60 kPa. The Lynch Hill Gravel at a depth of 2.0m bgl should support a maximum (safe) design bearing pressure of approximately 700 kPa. A basement car park is proposed under part of the site; the London Clay at a depth of 4.0m bgl should support a maximum (safe) design bearing pressure of approximately 75 KPa. If piled foundations are proposed at this site piles are anticipated to penetrate into London Clay and if used in retaining structures for the basement, support clay head deposits and Lynch Hill Gravel Member. Due to the presence of groundwater and the ground conditions encountered secant piles are likely to be an appropriate method of constructing the retaining structure for basement walls. Appropriate design parameters have been suggested, together with an indication of design capacity.
Buried Concrete	Taking the worst case data, the soils are classified as DS-4 in accordance with BRE guidance (Ref 6) with a corresponding ACEC class of AC-3s.
Swelling/ Shrinking	The clay head deposits have been confirmed to possess 'low' to 'medium' volume change potential in accordance with the National House Building Councils (NHBC) classification system given in Part 4 of their Standards (Ref. 4). The Lynch Hill Gravel Member would be classified as being 'non-shrinkable'. The deeper underlying London Clay has been confirmed to possess 'medium' to 'high' volume change potential.
Shallow Excavations	Shallow excavations within the site will most likely be within MADE GROUND/clay head deposits/Lynch Hill Gravel Member and short term support is likely to be required to maintain the excavations. All excavations will be subject to normal health and safety considerations.
Ground Gas	During the return groundwater/ground gas monitoring visits, the low concentrations of methane carbon dioxide were recorded. Although the Gas Screening Values (GSVs) of the two recent visits were low, the previous monitoring undertaken by Jomas Associates Ltd identified fairly high flow rates. This, along with the previously identified on-site BGS mineral site which has likely been infilled and the nearby historic landfill sites, we would consider that the current site be classified as **Characteristic Situation 2** under the modified Wilson & Card classification methodology as detailed in CIRIA C665 and BS8485 and therefore further action is recommended. Either the installation of continuous monitoring equipment for a two/three week period, to further assess the driving mechanisms and the potential ground gas risks or for ground gas protective measures should be incorporated within the new development.
Soil Disposal	The results of the WAC test indicated that the sample would probably be classified as "Inert" material. These are considered to be representative of MADE GROUND across the site.
Recommendations for Further Work	Prior to or as part of the final design stage it is recommended that a full Ground Movement Analysis for the project be undertaken in order to assess the impact of the proposed new development on the adjacent properties during both temporary and permanent works, together with recommending in detail on heave protection measures related to the anticipated stress changes. A Basement Impact Assessment should also be considered in order to fully understand the Hydrogeology beneath the site. Any excavated soils should be removed from site via a suitable waste disposal contractor. All waste transfer tickets should be retained, as evidence of suitable disposal, which may be required to be submitted to the Local Authority. It is It is also recommended a Demolition or Refurbishment Asbestos Survey (previously known as a Type 3 Asbestos Survey) be undertaken prior to development.

1.0 INTRODUCTION

1.1 This report has been prepared by Chelmer Site Investigation Laboratories Limited (CSI) to the instructions of the Consulting Structural Engineer, Symmetrys Ltd. The scope and objectives of the site investigation are set out within Symmetrys Specification for Geotechnical Site Investigation (Symmetrys ref 2015063).

1.2 The client for the project was London Green Ltd.

1.3 The site address is Union Park, 1-8 Packet Boat Lane, Uxbridge UB8 2GH and is located at approximate Ordnance Survey grid reference (OSNGR) 505341E, 181305N. At the time of the current survey the site comprised 2 No. three storey office buildings in the south of the site (Units 1-5) and the west (Unit 6) and 1 No. two storey office building in the east of the site (Units 7 & 8). Two substations were also identified, the first in the south east of the site and the second in the centre of the site.

1.4 It is understood that the proposed development will involve the refurbishment of the existing buildings by adding three extra floors and the construction of 4 No. new residential blocks of four, five and seven storeys, including a partial basement car park. *Proposed Development Plans* are appended to this report.

1.5 A Phase I Desk Top Study was prepared by CSI, ref DTS/5338 dated June 2015. From the historical information, the site appears to have been unoccupied agricultural land until 1914, when 'Allotment Gardens' were indicated on-site. In 1963-1965 a 'Mill' was identified within the centre of the site, with associated buildings. An 'Electrical Substation' was identified in the east of the site from 1963-1987 until the present day. A 'Timber Yard' was identified in the west of the site from 1977-1980 until 1990 when both the 'Timber Yard' and 'Mill' were no longer indicated. From 1992 the current on-site office buildings were indicated, as well as an additional 'Electrical Substation' in the centre of the site. A BGS recorded mineral site was also indicated on-site, now 'ceased', likely to have been in-filled.

1.6 A 'Geo-environmental and Geotechnical Ground Investigation', ref P8775J437 dated June 2014 have previously been undertaken at the site, by Jomas Associates Ltd. A review of the above report identified the investigation comprised 10 No. window sampler boreholes drilled to a maximum depth of 4.0m below ground level (bgl), with the installation of 4 No. monitoring wells and a further 9 No. hand excavated trial pits. Associated soil sampling identified asbestos in the form of amosite and chrysotile. Some elevated metals were also identified within the groundwater samples tested – however these were considered a low risk to human health and the wider environment. 4 No. return monitoring visits were also undertaken to record ground gas concentrations. The report concluded that some remedial actions would be required in any proposed areas of soft landscaping, along with ground gas protection measures within the proposed development.

1.7 A 'Remediation Strategy Statement' was also undertaken by Jomas Associates Ltd ref P8775J432/ag/rs dated April 2015. It was recommended that within areas of retained soft landscaping, '*further screening of the soils for asbestos should be undertaken. Where positive results are recorded, these soils should be removed and replaced with appropriate clean topsoil of a minimum of 300mm thickness. Where asbestos is not identified, no further action will be deemed necessary. Alternatively, areas of soft landscaping should be completed with 300mm of certified clean imported topsoil. Should new areas of soft landscaping be proposed these will also require the importation of certified clean topsoil to the site. With regard to ground gas protection, the existing suspended floor is to be replaced with a new floor that shall incorporate the requirements of the gas protection measures. Appropriate measures for this would be a 2000gauge gas resistant membrane, designed and installed by a specialist contractor. The design also incorporates the creation of a vented, underfloor void*.'

1.8 The intrusive investigation and remediation strategy appears to have sufficiently targeted potential sources of contamination and that the scope of works, testing, monitoring and subsequent assessment undertaken adequately characterise the site. Therefore, as part of this investigation, no further contamination testing was deemed necessary.

1.9 This *Intrusive* site investigation has been commissioned to characterise the soil conditions of the site and provide information to assess the geo-environmental and geotechnical conditions and support foundation design for the proposed redevelopment of the site. Further ground gas monitoring to compliment the readings already undertaken by Jomas Associated Ltd were proposed, along with testing of the soils for waste disposal classification.

1.10 In addition to the site investigation, a limited groundwater/ground gas monitoring survey was also carried out using monitoring standpipes installed during the current investigation in boreholes BH1, BH4 and BH6.

1.11 This report presents the work carried out and discusses the findings.

2.0 SUMMARY OF FIELDWORK EXECUTED

2.1 All fieldwork and contamination sampling was executed in general accordance with applicable British Standards and accepted industry good practice (Ref.1 & 2).

2.2 The borehole locations were chosen by the Client and are indicated on the appended *Sketch Fieldwork Location Plan*.

2.3 Fieldwork was undertaken between 14th and 18th May 2015 and comprised the following elements:

C.f.a. Borehole

2.4 6 No. c.f.a. boreholes (BH1-BH6) were undertaken at the locations indicated on the *Sketch Fieldwork Location Plan.* All boreholes were advanced to a depth of 15.00m below existing ground level.

2.5 Discrete disturbed samples were taken from the boreholes at regular depth intervals as the boreholes were advanced, within each stratum and when a change of stratum was encountered.

2.6 In-situ Standard Penetration Tests (SPTs) and Cone Penetration Tests (CPTs) were also undertaken throughout the boreholes in order to provide additional information on the in-situ consistency of the material encountered. A *Penetration vs Depth Profile* has been appended to this report.

2.7 Upon completion of boreholes BH1, BH4 & BH6 combined groundwater/ground gas monitoring standpipes were installed to a depth of 10.00m below existing ground level. The gas monitoring installation comprised a 1.00m length of plain 50mm diameter HDPE pipe followed by a 7.00m long slotted geotextile wrapped length of pipe, capped at the base. A cement/bentonite seal was installed from 1.00m to ground level and the installation was finished with a gas valve and a flush fitting lockable cover.

2.8 Full details of the borehole findings are given on the appended borehole record sheets.

Groundwater & Ground Gas Monitoring

2.9 Following the initial site work, two monitoring visits have been undertaken to measure groundwater and ground gas within the site using the installations fitted within boreholes BH1, BH4 & BH6. Visits were carried out on 26th May and 5th June 2015.

2.10 The barometric pressure was recorded together with the concentration (%v/v) of Carbon Dioxide, Oxygen and Methane within the boreholes. In addition, gas flow (l/min) measurements were taken and the depth to groundwater recorded.

2.11 Full details of the readings are included on the appended Groundwater/Ground Gas Monitoring Record Sheet.

3.0 GEOLOGICAL SETTING

3.1 According to information published by the British Geological Survey (BGS) the underlying geology at this site is shown as the Langley Silt Member and the Lynch Hill Gravel Member overlying the London Clay Formation.

3.2 Langley Silt Member

Langley Silt is a river "brickearth" which generally comprises a silty sandy clay containing gravel in parts. These deposits are thought to represent the original overbank mud of the river, laid down during floods and usually lie over the river terrace gravels.

3.3 Lynch Hill Gravel Member

The Lynch Hill Gravel Member is a sand and gravel, with local lenses of silt, clay or peat from the parent material, the Maindenhead Formation. The Lynch Hill Gravel can be described as being coarse to fine subgranular gravel with coarse to fine brown sand. The Wolstonian age gravel rests unconformably on the bedrock geology and with an average thickness of 7m with a range typically 1-12m. It is geographically limited to the Thames Valley and associated tributaries. The Lynch Hill Gravel Member was previously known as the Lynch Hill Gravel Formation.

3.4 London Clay

It is inferred that the London Clay Formation was deposited during a period of sea inundation in the area up to 200m in depth. The London Clay can be up to 150m thick beneath south Essex thinning across London to about 90m near Reading. The formation consists of mainly dark blue-grey to brown-grey clay containing variable amounts of fine-grained sand and silt. London Clay generally weathers to an orange-brown colour with pockets of silty fine sand. The formation is particularly susceptible to swelling and shrinking when subjected to moisture content changes and is commonly intensely fissured. In addition, gypsum (selenite) crystals and pyrite nodules are commonly found throughout the formation.

When exposed to the weathering process the upper regions of the London Clay oxidise to brown in colour. It usually contains selenite crystals, often grouped in bands or layers, which are thought to have originated from the decomposition of shell fragments. London Clay contains clay minerals in the form of illite, kaolinite and smectite. The presence of smectite renders the London Clay particularly susceptible to changes in moisture content and is prone to shrinkage and swelling (settlement and heave) caused by alternate wetting and drying near the surface. In addition, weathering and possible slight transportation of semi-frozen material "en-masse" in glacial or peri-glacial regions is believed to have occurred. This action often completely destroys the structure of the material and can involve a serious loss of

strength. As the soil composition is derived mostly from materials local to the point of deposition, the lithology can be variable and reflects that of the parent strata.

4.0 SUMMARY OF GROUND CONDITIONS ENCOUNTERED

4.1 Full details of the ground conditions encountered are presented on the borehole records appended to this report and can be summarised as follows:

Depth From GL (m bgl)	Depth From GL (m bgl)	Stratum
0.00	0.40	TARMAC over CONCRETE
0.40	0.70/1.00	TYPE 1/Crushed CONCRETE
0.70/1.00	1.40/1.90	MADE GROUND
1.40	2.90/3.10	Drift Clay – *Firm to stiff, brown, sandy gravelly silty CLAY. (BH1, BH2)*
1.40/2.90	3.20/4.70	Lynch Hill Gravel Member - *Medium dense to dense, orange brown, clayey sandy medium to coarse GRAVEL. (BH1, BH3, BH4, BH5 & BH6)*
3.10/4.70	15.00+	London Clay – *stiff to very stiff, dark grey, silty CLAY*

4.2 It should be noted that the MADE GROUND depths recorded above are those encountered within the boreholes undertaken during the current work. Owing to the variable nature and unknown provenance of MADE GROUND it is possible that deeper or more extensive areas of MADE GROUND may exist at this site which have not been revealed by the current work.

4.3 From the in-situ SPT testing within the superficial drift Clay, N values of 14 and 18 were recorded indicating that this material is 'stiff' in consistency.

4.4 From the in-situ CPT testing within the Lynch Hill Gravel Member, N values between 21 and 42 were recorded indicating that this material is 'medium dense' to 'dense' in consistency.

4.5 From the in-situ SPT testing within the London Clay, N values between 20 and 43 were recorded indicating that this material is 'stiff' to 'very stiff' in consistency.

4.6 Groundwater was encountered during the current site investigation as summarised in the table below;

Location	Strike (m bgl)	Standing (m bgl)	Return Monitoring Visits (m bgl)
BH1	1.60	1.20	5.92/5.90
BH2	1.50	1.80	N/A
BH3	1.50	1.80	N/A
BH4	1.80	1.80	3.22/3.20
BH5	-	2.00	N/A
BH6	2.00	2.00	1.28/2.80

4.7 No roots were observed during the current investigation.

5.0 LABORATORY TESTING

5.1 The following geotechnical laboratory testing has been carried out on samples recovered from the boreholes undertaken at this site.

5.2 Unless otherwise stated, the geotechnical testing has generally been carried out in accordance with applicable British Standard (Ref. 3)

5.3 The chemical testing was carried out in accordance with standard industry methods in a UKAS approved laboratory which is also currently accredited in accordance with MCERTS for the majority of its testing. Further information regarding this accreditation is available on request together with a full list of test methods if required.

5.4 *Atterberg Limits and Moisture Content Tests*

The Atterberg Limits and moisture contents have been determined for a total of 16 samples from the site; three samples of superficial drift CLAY and 13 samples of London Clay.

Superficial drift CLAY

For the samples tested the liquid limit (LL) was found to range between 39% and 66%, the plastic limit (PL) between 18% and 24%, the plasticity index between 19% and 42% and modified plasticity index between 8% and 31%. The moisture content of these samples was found to range between 15% and 28%.

These results indicate that the samples tested would be classified as Clay of 'intermediate' to 'high' (CI-CH) plasticity in accordance with the Casagrande Geotechnical classification system.

London Clay

For the samples tested the liquid limit (LL) was found to range between 54% and 71%, the plastic limit (PL) between 20% and 25%, the plasticity index between 34% and 46% and modified plasticity index between 26% and 40%. The moisture content of these samples was found to range between 23% and 35%.

These results indicate that the samples tested would be classified as Clay of 'high' to 'very high' (CH-CV) plasticity in accordance with the Casagrande Geotechnical classification system.

5.5 *Particle Size Distributions*

The particle size distribution has been determined for five samples of the more granular soils encountered beneath the site.

The results are presented as grading curves appended to this report.

5.6 *pH and Sulphate Tests*

The pH and sulphate content has been determined for ten samples recovered from the site.

The pH value was found to range between 7.5 and 9.6, with the sulphate content, on a 2:1 water:soil extract found to range between 0.03 g/l and 0.40 g/l.

5.7 *Waste Classification Tests*

2 Nº. samples of the MADE GROUND were collected from borehole BH2 and BH6 and tested for Waste Acceptance Criteria (WAC) in accordance with BS EN 12457 Part 3 for the purpose of assisting the determination of appropriate offsite disposal.

Full details of the results are given on the appended results sheets.

5.8 *Soil Samples*

All soil samples will be kept for a period of 28 days after the date of the invoice for this project unless otherwise notified to Chelmer Site Investigation Laboratories Limited in writing. Should samples be required to be stored for longer than 28 days then a storage charge will be levied.

6.0 GEOTECHNICAL ASSESSMENT

SUMMARY OF PROPOSED DEVELOPMENT

6.1 The proposed development comprises the conversion of the existing office blocks for residential use which will include the construction of additional storeys. The development will also involve the construction of four new residential blocks of between four and seven storeys conjoining the existing buildings. Part of the development also includes the construction of a partial basement car park. *Proposed Development Plans* are appended to this report.

6.2 Full details of the proposed construction are not yet developed and it assumed that they will be subject to the findings of this investigation. As a consequence the foundation design discussed below is, by necessity, general in nature and is subject to confirmation following the results of this investigation and further design.

6.3 Should ground conditions during construction be found to differ significantly from those described in our report Chelmer Site Investigation Laboratories Limited should be contacted immediately and that the below noted allowable bearing pressures or recommended foundation type may need to be altered accordingly.

FOUNDATIONS

6.4 It is understood that as far as possible the proposed foundations will be conventional shallow pads/strip footings of similar construction and founding depth to existing foundations. There are some elements of the development which will require the foundations to extend to greater depths (e.g. lift pits within refurbished existing and new build elements of the development) and it understood that these too will utilise conventional shallow foundations.

6.5 It is further understood that the basement will be constructed in open excavation following demolition of existing buildings with the basement space being formed by some form of retaining wall construction around the perimeter prior to backfill and a ground bearing floor slab.

6.6 The site has a superficial veneer of Made Ground with a thickness of around 1.5m. Made Ground is by its nature homogeneous in composition and therefore its engineering properties are likely to be variable both laterally and vertically across the site. Therefore it is recommended that in all cases new foundations are taken below the Made Ground and set within the underlying natural soils.

6.7 The Made Ground is underlain by Lynch Hill Gravel which in the main comprises a medium dense to dense sandy GRAVEL and as such is expected to provide suitable founding conditions for the proposed shallow foundations subject to appropriate design. However, this soil does show some variability and in two of the boreholes this

stratum is overlain by a more cohesive soil which is inferred to comprise some form of drift deposit.

6.8 The Lynch Hill Gravel Member is anticipated to provide good founding conditions and it recommended that all foundations are taken down below the Made Ground and the superficial clay drift deposists and are set at an appropriate depth in the gravel. As with most granular soils bearing capacity is rarely a problem and foundation performance is determined settlement characteristics under load.

6.9 Shallow foundations which are set below the Made Ground and within the upper levels of the Lynch Hill Gravel should be designed for a safe allowable bearing pressure of around 130kPa. However, with increasing depth the bearing capacity of the medium dense to dense gravels increases markedly and at a depth of 2.0m and below the bearing capacity is likely to be in excess of 500kPa. It is acknowledged that these values are ostensibly high however they have been calculated on the basis of conventional bearing capacity theory and are consistent with published estimates (e.g. Tomlinson, 2001, and former BS8004:1986).

6.10 This notwithstanding it should be noted that groundwater is relatively high and allowance has been made in estimating the bearing capacity for groundwater to be at or just below the foundation level. If however the water table were to rise above the foundation level the bearing capacity may be reduced and based on a conservative approach the value may decrease by half. Therefore it is recommended that due consideration is given to this within the foundation design.

6.11 Settlement within the Lynch Hill Gravel is unlikely to be a constraint and bearing pressures not exceeding 700 kPa any settlement is expected to be immediate and within normal acceptable tolerances of 25mm or less.

6.12 At this stage it is not confirmed if piled foundations will be required. However, in the event that shallow foundations are not suitable for the proposed development piles extending in to the London Clay will offer a suitable alternative. It is understood that piles are not intended for construction of the basements.

6.13 Given the nature of the ground conditions encountered and the proximity to adjacent buildings, a non-displacement pile type (e.g. bored cast-in-place, hollow stem auger CFA, or similar) is considered most appropriate. This type of pile construction will generate pile arisings and therefore the piling technique should be selected to minimise spoil and otherwise the arisings will need to appropriately managed.

6.14 It is beyond the scope of this investigation to provide a full and detailed pile design and the advice of a specialist piling contractor should be sought in this respect. However, the following soil engineering parameters listed below are given for guidance purposes only. These soil parameters/assumptions relate to “static design” for vertically loaded single piles:

Made Ground	
Bulk unit weight, γ_b	18 kN/m^3
Effective angle of internal friction, φ'	0
Undrained shear strength, Su	0
Clay Head Deposits	
Bulk unit weight, γ_b	18 kN/m^3
Effective angle of internal friction, φ'	25^0
Undrained shear strength, Su	70-90 kN/m^2 (based on SPTs)
Pile Shaft adhesion factor, α	0.45 (subject to pile type and design methodology)
Lynch Hill Gravel Member	
Bulk unit weight, γ_b	19 kN/m^3
Effective angle of internal friction, φ'	34^0 (based on CPT results and research by Peck, Hanson & Thorburn)
Undrained shear strength, Su	0
Effective angle of wall friction, δ'	Piling contractor's advice, but typically 0.70 to 0.80
London Clay	
Bulk unit weight, γ_b	20 kN/m^3
Effective angle of internal friction, φ'	18-22^0
Undrained shear strength, Su	85-180 kN/m^2 (based on SPTs)
Pile Shaft adhesion factor, α	0.45 (subject to pile type and design methodology)

6.15 The following are estimated safe working loads (axial capacity) for a range of typical diameters for single bored piles extending to 8.00m and 12.00m below existing ground level.

Pile Type	*Depth (m bgl)*	*Diameter (m)*	*Estimated safe pile capacity (kN)*
Bored	8.00	0.30	100-150
Bored	8.00	0.45	200-250
Bored	8.00	0.60	300-350
Bored	12.00	0.30	200-250
Bored	12.00	0.45	350-400
Bored	12.00	0.60	500-550

6.16 It is recommended that the advice of competent piling contractors be sought as to the most suitable pile type at this site and for confirmation of the order of working load achievable given the ground conditions encountered and the proprietary pile type selected.

6.17 London Clay is generally overconsolidated and may be subject to heave when excavated during basement construction (see 6.24 below). Therefore in order to mitigate the effect of heave on pile shaft and concomitant reduction in pile capacity, it is recommended that the top 2 to 3m of each pile is 'sleeved', subject to confirmation of type of pile constructed.

6.18 Made Ground has been identified within this site which should always be viewed as being a potential source of contamination. With regard to the possible downward migration of contaminants the recommendations given in the Environment Agency in respect of piling in contaminated land should be followed.

RETAINING WALL & BASEMENT CONSTRUCTION

6.19 It is understood that the proposed basement will cover the entire footprint of blocks F & G as well as part of the footprint of block E and the area in front of block G, according to architectural drawings. It is not known at what depth the proposed basement will be set, however, it is assumed that the basement will be set at a depth of 4.00m below existing ground level, within the top of the 'stiff' London Clay.

6.20 From in-situ SPT (standard penetration tests) a blow count of approximately 22 at a depth of 4.00m can be adopted for design purposes. Whilst SPT does not directly measure shear strength, using accepted empirical correlations (Stroud, 1975) with a measured PI (plasticity index) for the clay of around 43%, the clay at this depth is estimated to have an undrained shear strength (C_u) of around 90 kPa.

6.21 Based on the estimated shear strength, the safe allowable bearing capacity of the London Clay at a depth of 4.00m below existing ground level is estimated to be applying a global factor of safety of 3 on failure and making an allowance for the high water table. Limiting bearing pressure to this value, settlements are expected to be within normal acceptable tolerances.

6.22 Excavation of the basement within London Clay will result in stress release and the soil will naturally have a tendency to swell and undergo heave within the excavation. The degree of movement (heave) will be a function of depth of excavation, the characteristics of the soils and the response of the soil to the combination of imposed loads from the foundations and structure. This movement should be quantitatively assessed and the ground bearing floor slab may need to be designed to resist uplift forces imposed from heave within the exposed clay. (see also 6.24 below).

6.23 The full design of temporary and permanent retaining structures is beyond the scope of this investigation. Retaining structures should be designed in accordance with accepted good practice. The calculation of permanent lateral pressures against the sides should relate to long-term (effective) stress analysis.

6.24 Based on the findings of the site investigation undertaken the following soil parameters are recommended for use in the retaining wall design:

Made Ground	
Bulk unit weight, γ_b	18 kN/m^3
Earth pressure coefficient at rest, K_0	0.3-0.4
Undrained shear strength, Su	0
Effective shear strength, c'	0
Effective angle of internal friction, φ'	20^0
Clay Head Deposits	
Bulk unit weight, γ_b	18 kN/m^3
Earth pressure coefficient at rest, K_0	0.58
Undrained shear strength, Su	70-90 kN/m^2 (based on SPTs)
Effective angle of internal friction, φ'	25^0
Lynch Hill Gravel Member	
Bulk unit weight, γ_b	19 kN/m^3
Earth pressure coefficient at rest, K_0	0.44
Effective shear strength, c'	0
Effective angle of internal friction, φ'	34^0
Friction at wall/soil interface, δ'	1/2 - 2/3 φ' depending on anticipated settlement.
London Clay	
Bulk unit weight, γ_b	20 kN/m^3
Earth pressure coefficient at rest, K_0	2-2.5
Undrained shear strength, Su	85-180 kN/m^2 (based on SPTs)
Effective shear strength, c'	15 kN/m^2
Effective angle of internal friction, φ'	18-22^0

6.25 Groundwater was encountered at depths between 1.2m and 2.0m below existing ground level during the site investigation. During the monitoring visits groundwater was recorded at depths between 1.28m and 5.92m below existing ground level. Groundwater may be subject to seasonal variation and may be present at shallower depths within the site at other times of the year or under different circumstances to those prevailing at the time of investigation.

6.26 Design of the retaining walls should include allowance for groundwater in accordance with accepted good design practice and allowance for hydrostatic forces to both the ground bearing floor slab and retaining walls should be based on site specific

hydrological and hydrogeological assessment. In addition the basement design should include appropriate waterproofing systems compliant with current standards and good practice (BS8102:2009 and applicable NHBC guidance) compatible with the retaining wall and foundation design.

6.27 Allowance should be made for appropriate groundwater control during construction cognisant of the site conditions.

6.28 Groundwater/surface water should be prevented from accumulating at the base of foundation excavations. It is important that the base of foundation excavations is kept dry and the exposed formation is protected to prevent softening by exposure to surface water. In the event that the formation is exposed, the material should be inspected immediately prior to floor slab construction and any soft spots are excavated and materials replaced and compacted prior to pouring foundation concrete. Alternatively 'blinding' concrete may be used to preserve the formation prior to foundation being constructed.

ANTICIPATED GROUND MOVEMENT

6.29 London Clay can be a particularly challenging soil. It is an overconsolidated material, making it stiff and typically almost impermeable. The clay is generally competent and resists further compression under compressional loading. Below a depth of about 50m this clay gives way to substantial amounts of water-bearing silt and sand. When the clay is unloaded by excavations in-situ stress is relieved and it has a potential to expand. Any immediate rebound is generally small in magnitude and is 'lost' in the excavation process. However following excavation the material has a potential to continue to swell. This can produce significant uplift at excavated formation level. The uplift forces need to be properly assessed and accounted for within the structural design of the basement.

6.30 Similarly, lateral stress release in the ground surrounding the excavation by both foundation construction and excavation in front of the retaining structure will manifest itself in lateral and associated vertical ground movement at the edge of excavation and line of foundations/retaining structure and extending back from the edge of the excavation/line of basement wall. The magnitude of lateral and vertical movement and the limit of its extent beyond the excavation will depend on the nature of the soils, the foundation system, and the construction methodology. There is published empirical data available to predict the degree of movement that can be expected (CIRIA C580) (Ref 4).

6.31 Notwithstanding predicting ground movements using published empirical data, consideration may be given to undertaking an appropriate ground movement analysis (GMA) specific to the site conditions, the proposed basement construction and basement geometry if ground movements are considered likely to adversely effect the existing buildings on the site or neighboring properties.

6.32 It is important to ensure that the construction sequence and construction method statement (CMS) is developed with full recognition of anticipated ground movements as assessed from the GMA. It is implicit within this that good standards of workmanship will be maintained throughout so as to minimise and otherwise ameliorate the effects of ground movement associated with basement construction. This may include, inter alia, control on pile installation, sequencing of installation to minimise ground movement, use of necessary temporary support, and adequate control of groundwater.

6.33 The London Clay encountered beneath the site has been confirmed to possess 'high' volume change potential in response to changes in moisture content. In this regard additional lateral loading conditions may need to be considered in the design of the retaining structures and in this regard guidance provided by NHBC should be followed (Ref 5).

SHALLOW SERVICE EXCAVATIONS

6.34 Shallow excavations within the site will most likely be within MADE GROUND/clay head deposits/Lynch Hill Gravel Member and short term support is likely to be required to maintain the excavations. All excavations will be subject to normal health and safety considerations.

SWELLING AND SHRINKAGE

6.35 The clay drift deposits have been confirmed to possess 'low' to 'medium' volume change potential in accordance with the National House Building Councils (NHBC) classification system given in Part 4 of their Standards (Ref. 4). The Lynch Hill Gravel Member would be classified as being 'non-shrinkable'. The deeper underlying London Clay has been confirmed to possess 'medium' to 'high' volume change potential.

BURIED CONCRETE

6.36 Chemical testing has been carried out to determine the nature of the soils in the context of the durability of buried concrete. Based on the available test data the soluble sulphate content of the soils is noted to be variable and ranges between 30 and 400 mg/l (measured as soluble SO_4) with a pH of 7.5 to 9.6. Taking the worst case data, the soils are classified as DS-4 in accordance with BRE guidance (Ref 6) with a corresponding ACEC class of AC-3s.

7.0 PRELIMINARY CONTAMINATION ASSESSMENT

BACKGROUND AND TERMS OF REFERENCE

7.1 In the UK, contaminated land is assessed and managed through a number of integrated policies and guidance. Contaminated land is defined in legislation enacted under Part IIA of the Environmental Protection Act 1990 and guidance issued by DEFRA under CLR11 and sister documentation published in 2012 advises on how the legislative framework dealing with contaminated land should be implemented.

7.2 Distinct from the strict and onerous legal definition and classification of land as being contaminated but a corollary to the legislation and associated statutory guidance, the National Planning Policy Framework (NPPF) makes provision or assessing and managing contaminated land in the context of redevelopment which is subject to planning control. Earlier published guidance (PPS23) identified contamination as being a material consideration within any planning application and current policy under NPPF states that land which "*is affected by contamination or land stability issues*" must be correctly assessed such that planning decisions should ensure that "*the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation*".

7.3 The assessment process requires that "*adequate site investigation information, prepared by a competent person, is presented*." The guidance provided in NPPF also states that "*all investigations of land potentially affected by contamination should be carried out in accordance with established procedures, such as BS10175 (2001)*."

7.4 The NPPF and statutory provisions for dealing with contaminated land are clear in ensuring that where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the "*developer and/or landowner*."

7.5 Fundamental to the assessment of contaminated land is the development of a Conceptual Site Model (CSM). This is an evaluation of the site conditions and its particular characteristics with respect to so called Source-Pathway-Receptor relationships, or plausible pollutant linkages. The CSM can then be used to assess and define risk and in turn it provides a basis for determining the condition of the land in the context of the proposed development and what, if any, action needs to be taken to allow the proposed development to proceed safely and without detrimental impact to the site itself or the wider environment.

7.6 A plausible pollutant linkage is defined by three elements;

Source A hazard which exists within the site or its environs which has the potential to cause harm (e.g. contaminated soil, ground gas, unstable ground, etc.)

Receptor Something associated with the site (e.g. end-user, building, off-site feature, etc.) which can be harmed.

Pathway A plausible linkage between the Source and Receptor such that harm can be realised (e.g. end-user coming into direct contact with contaminated soil, mobile contamination adversely impacting groundwater, etc.).

7.7 By definition a pollutant linkage can only exist where the three elements, source-pathway-receptor, are present and co-exist. If one of the elements that make up the pollutant linkage are not present then it follows that there can be no related risk. The breaking of pollutant linkages is a fundamental principal in the management of contaminated land risk and where the risk is identified and deemed to be unacceptable the appropriate action taken be "breaking" the pollutant linkage in some way.

7.8 Risk in the context of contaminated land is considered in terms of its significance and this is qualitatively assessed on the basis of magnitude of harm that may occur and likelihood of that harm occurring. The risk assessment follows the general principles as set out within BS10175:2001 and CIRIA Report C552.

7.9 The CSM is used to provide both a context and framework for undertaking any intrusive site investigation which may be deemed necessary to characterise the site with respect to contamination. Where a pollutant linkage is identified further investigation may be needed to confirm or quantify specific conditions, validate the existence of the pollutant linkage and thereby confirm and quantify the degree of risk. This is an important element of the assessment process and under the principles of risk assessment constitutes "*hazard identification*" and "*hazard assessment*".

CONCEPTUAL SITE MODEL & PLAUSIBLE POLLUTANT LINKAGES

Hazards

7.10 Potential on-site sources of contamination identified during the Phase I Desk Top Study included 'Allotment Gardens' from 1914 to the early 1960s, when a 'Mill' was identified within the centre of the site, with associated buildings. Two 'Electrical Substation' was on-site, with a 'Timber Yard' identified in the west of the site from 1977-1980 until 1990 when both the 'Timber Yard' and 'Mill' were no longer indicated.

From 1992 the current on-site office buildings were indicated. A BGS recorded mineral site was also indicated on site, now 'ceased' likely to have been infilled.

7.11 Potential off-site sources of contamination identified during the Phase I Desk Top Study included a cement works 30m south of the site from the late 1800s to the early 1910s, several works identified to the south of the side from the early 1960 to the 1980s and 2 No. historic landfill sites, indicated 17m south west of the site at 'Cowley Lane' and 84m south of the site at 'British Waterways Site', both dealing with 'Inert Industrial, Commercial, and Household Waste'.

7.12 Due to historic development on-site and in close proximity of the site, MADE GROUND would be expected across the site, which may pose a risk to future users of the site. Contaminants such as heavy metals, TPHs, PAHs, PCBs and asbestos could be present in the MADE GROUND, as well as potential gas risks.

7.13 Ground gas (carbon dioxide, methane, and possibly other related gases and vapours) are ubiquitous within the subsoil environment. Low concentration of either, or both, carbon dioxide and methane may not be problematic. However, elevated concentrations of ground gas and/or conditions where ground gas is being actively generated (e.g. filled ground, landfill, organic rich natural soils, etc.) may present a significant hazard to the site development or the wider environment. Ground gas may be present from sources either within the site itself or maybe being generated from an off-site source and migrating on to the site.

7.14 Groundwater present within a site may itself be contaminated or may liberate and be a source of (and pathway for) mobile contamination. Contaminated groundwater can impact on various receptors but most notably controlled waters either on the site or offsite.

Pathways

7.15 Contamination within the soil could reach receptors by direct contact with the soils where there is a potential for contamination to be ingested by some means (direct ingestion, inhalation, dermal contact). This is most acute during site development although contact, albeit limited, is also possible for current site users and future site users. The proposed end-use is residential and as such represents a sensitive type of end-use.

7.16 Mobile contamination, present either within the groundwater or otherwise liberated by contact with groundwater (leachable contaminants), may exist, especially given the identified permeable underlying geology.

7.17 Ground gas may migrate through or on/offsite through preferential pathways most likely in the superficial Made Ground.

7.18 Elements of the building fabric for the proposed development may be in direct contact with contamination which may have adverse impacts. Plastic potable water supply pipelines may be susceptible to certain organic contamination if present.

Receptors

7.19 From the results of the desk study and the intended end site use, the following potential receptors have been identified:

- *Construction workers on the site likely to come into contact with the soils.*
- *Structures/Services*
- *Neighbours*
- *Controlled Waters*
- *Future residents/users of the proposed development, including young children.*

ASSESSMENT OF RESULTS

Soils

7.20 No contamination testing was undertaken as part of this investigation, as previous testing undertaken during the Jomas Associates Ltd was deemed sufficient.

Controlled Waters

7.21 No groundwater testing was within the scope of these works. However, some slightly elevated lead concentrations were identified within tested groundwater samples during the Jomas Associates Ltd investigation, when compared against UK drinking water standards. However, with no potable water abstractions on-site or within 250m of the site, the risk to human health is considered to be '**low**'. Although the Grand Union Canal is 5m to the south of the site, given the lack of a mobile contamination source, the risk to controlled waters is also considered to be '**low**'.

Ground Gas

7.22 During the return groundwater/ground gas monitoring visits, the maximum concentration of methane was recorded at 0.1%v/v and the maximum carbon dioxide concentration was recorded at 0.5%v/v. The maximum carbon monoxide concentration was recorded at 14ppm. A maximum flow rate of 0.2 l/hr was recorded.

7.23 The full ground gas assessment details are appended.

7.24 Carbon monoxide was recorded at a maximum concentration of 14ppm in BH6. The lower assessment threshold for carbon monoxide from the UK Air Quality Objective is 5ppm. BS8576:2013 states that the acute effects produced by carbon monoxide start from 35ppm. The carbon monoxide concentrations recorded are therefore not considered to pose a risk of significant harm to future residents.

7.25 Although the Gas Screening Values (GSVs) of the recent two visits are low, the previous monitoring undertaken by Jomas Associates Ltd identified fairly high flow rates. This, along with the previously identified on-site BGS mineral site which has likely been infilled and the nearby historic landfill sites, we would consider that the current site be classified as **Characteristic Situation 2** in line with CIRIA C665 and BS8485:2015 (Modified Wilson and Card), and therefore further action is recommended.

7.26 **Characteristic Situation 2** is a Low risk classification as per modified Wilson and Card classification system, which requires gas protection measures to be incorporated within the proposed development.

WASTE ACCEPTANCE CRITERIA

7.27 Two EN 14473/02 Waste Acceptance Criteria (WAC) tests were undertaken to classify for waste disposal purposes. Sample were collected and tested from borehole BH2 and BH6 at depths of 1.00m bgl.

7.28 The results of the WAC test indicated that the sample would probably be classified as "Inert" material. These are considered to be representative of MADE GROUND across the site. Full details of the results are given on the appended results sheets.

7.29 However, it should be noted that Chelmer Site Investigation Laboratories Ltd are not a licensed landfill operator and we therefore strongly recommend that the WAC data should be presented to potential Waste Management Companies in order for them to confirm the waste classification of surplus soils to be removed from this site and to determine its acceptability at appropriate landfill sites for disposal/treatment.

UPDATED CONCEPTUAL MODEL

7.30 The following diagram summaries the potential pollution linkages identified for this site in the form of an updated diagrammatic Conceptual Model.

CIRIA Contaminated Land Risk Assessment Table

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

*Extracted from CIRIA Publication C552 Contaminated Land Risk Assessment

Source	Pathway	Receptor	Assessment of Risk	Comments
Contaminated soil	Dermal contact with contaminated soils and inhalation/ingestion of soil vapours, soil derived dust and other airborne particulates	Site-end users	Moderate	Associated soil sampling identified asbestos in the form of amosite and chrysotile. However, following development much of the site will be covered by the footprint of buildings or areas of hardstanding, removing the risk of harm to site end users via human health exposure pathways. The risk will remain in gardens/ areas of open space if the Made Ground remains on site and is not covered by building footprint. In these areas consideration should be given to providing a suitable clean cover layer of topsoil/subsoil. In view of the contamination Made Ground should not be reused within the site as part of the development.
		Construction /maintenance workers	Low	Associated soil sampling identified asbestos in the form of amosite and chrysotile. As a preventative measure that appropriate Personal Protective Equipment (PPE) and other measures (e.g. good standards of hygiene, washing facilities) are utilised to mitigate the risk.
	Leaching	Surface water and groundwater	Very Low	The risks are considered very low if not negligible.
	Plant uptake	Vegetation (not for consumption)	Low	The soil at this site to not present a phytotoxic risk to new vegetation (not for consumption).
	Direct contact	Construction materials	Low/Moderate	In accordance with BRE Special Digest 1 2005 (Concrete in Aggressive Ground) the site is given an overall Design Sulphate Classification of DS-4 and an ACEC Classification of AC-3s.
Contaminated surface water or groundwater	Direct contact	Site end users / Construction /maintenance workers	Very Low	The risks are considered very low if not negligible.
	Direct contact	Construction materials	Very Low	
	Vertical /lateral migration	Controlled waters / Adjacent properties	Very Low	
	Surface water run-off	Controlled waters / Adjacent Properties	Very Low	
Ground Gas and Vapour	Migration	Proposed development and adjacent sites	Low/Moderate	The gas monitoring data indicates Characteristic Situation 2 and special precautions are deemed necessary to safeguard the development.
	Inhalation of vapours	Site end users/ Construction and future maintenance workers	Low/Moderate	The gas monitoring data indicates Characteristic Situation 2 and special precautions are deemed necessary to safeguard the development.

8.0 DISCUSSION OF CONTAMINATION

8.1 Soil sampling and testing undertaken during the Jomas Associates Ltd investigation identified asbestos in the form of amosite and chrysotile within the near surface MADE GROUND. This has the potential to pose a significant risk of harm to future residents/site users.

8.2 Although the proposed development has changed since the previous application which the previous Jomas Associates Ltd investigation was submitted for, it is very similar and if anything further reduces the risk by covering the site with more buildings/hard standing. Therefore, as recommended by Jomas Associates Ltd, a clean cover system should be undertaken within all areas of soft landscaping across the site. This will involve excavating the existing site soils to an agreed depth and replacing with clean imported soils, together with a marker layer or geotextile membrane to separate the imported soils from the underlying existing site soils. This will effectively break the pollution pathway between source and receptor on-site and thus reduce the risk to future users.

8.3 Due to the high flows identified during the return monitoring visits undertaken by Jomas Associates Ltd and given the on-site BGS in-filled mineral site and nearby historic landfill sites, further works are recommended to address the potential ground gas risk.

8.4 We would therefore recommend either;

- Installation of continuous monitoring equipment for a two/three week period, to further assess the driving mechanisms and the potential ground gas risks or;
- Gas protective measures to be incorporated within the new development.

8.5 As discussed above, the site has been classified as **Characteristic Situation 2,** which requires gas protection measures to be incorporated within the proposed development. The required gas protection measures are taken from table 4 in BS 8485:2015 and should incorporate a selection of appropriate gas protection measures as listed within tables 5, 6 and 7 in BS 8485:2015.

8.6 A scoring system is referred to within BS 8485:2015, whereby each protection measure has an individual score and the combined score must equal or exceed a gas protection score of 3.5 for **Characteristic Situation 2.**

The following solutions are provided to meet requirements for **Characteristic Situation 2** and are dependent on achieving the necessary points score as detailed above;

Floor and substructure design (Score 0):
- Precast suspended segmental subfloor (i.e. beam and block);
- Breaches in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances.

Protection element / system (Score 1.5):
- Passive subfloor dispersal layer
(media used to provide dispersal layer are: clear void, polystyrene void former blanket, geocomposite void former blanket, no fines gravel layer with gas drains, no fines gravel layer);

Proprietary gas resistant membrane (Score 2):
- Gas resistant membrane
It is important that the membrane is durable so that damage is prevented during construction on-site and is installed correctly by a competent contractor. All joints and penetrations (e.g. services) should be appropriately sealed and bonded to the membrane. The use of pre-fabricated or site fabricated top hats should be used to minimise leaks;

The above options are considered to best compliment the anticipated foundation design, however, other options can be developed using BS8485 if required.

8.7 It is beneficial to design simple foundations to aid the easy incorporation of gas protection systems. For example, the reduction of service penetrations through a slab by relocation through the outer wall above ground level will reduce the detailing required if laying a membrane and therefore reduce the risk of failure.

8.8 Service runs should be sealed at the edge of the building by filling the annulus around pipes with an impermeable barrier to prevent ground-gas migration. Where piped cable runs are present, the internal pipes should be sealed with a closed cell foam (or similar) at the edge of buildings. These measures are in addition to the specialist seals around the service entry points to the buildings envelopes discussed above.

8.9 This method of remediation should be agreed with the Local Authority prior to implementation and may require a verification report providing evidence of it's suitable installation.

9.0 RECOMMENDATIONS

9.1 Prior to or as part of the final design stage it is recommended that a full Ground Movement Analysis for the project be undertaken in order to assess the impact of the proposed new development on the adjacent properties during both temporary and permanent works, together with recommending in detail on heave protection measures related to the anticipated stress changes. A Basement Impact Assessment should also be considered in order to fully understand the Hydrogeology beneath the site.

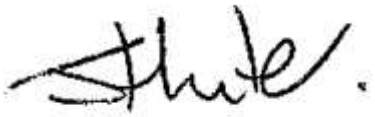
9.2 We would recommend that Health and Safety precautions be taken with regard to ground workers at this site, to help reduce the potential risk. These should include PPE equipment such as gloves, overalls etc. to prevent dermal contact with the soils. Washing facilities should be made available on-site to reduce extended contact with site soils. During the construction phase, dust suppression measures may be required to minimise potential inhalation of dust by neighbours or ground workers.

9.3 With regard to the installation of any future water supply pipe work, reference should be made to the UK Water Industry Research (UKWIR) published "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21; the 'UKWIR Guidance'). This publication supersedes the Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-03 "Laying Pipes in Contaminated Land", which has been withdrawn. It is recommended that the results of the soil chemical analyses undertaken on the site should be provided to the potable water supply company in order to ensure that any pipe provided complies with their requirements.

9.4 Any excavated soils should be removed from site via a suitable waste disposal contractor. All waste transfer tickets should be retained, as evidence of suitable disposal, which may be required to be submitted to the Local Authority.

9.5 It is also recommended a Demolition or Refurbishment Asbestos Survey (previously known as a Type 3 Asbestos Survey) be undertaken prior to development.

9.6 As always, the above recommendations regarding contamination are based on a selected number of representative samples and further testing may be required if any other contamination is suspected or encountered during future ground works.



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1. BS 5930:1999+A2:2010 (2010) Code of practice for site investigations.
2. BS 10175:2011 (2011) Code of Practice for the Investigation of Potentially Contaminated Sites.
3. BS 1377:1990 (1990) Methods of Test for Soils for Civil Engineering Purposes.
4. NHBC (2013) NHBC Standards, Chapter 4.2, Building Near Trees.
5. BRE (2005) Concrete in Aggressive Ground, Special Digest 1.
6. CIRIA (2007) C665. Assessing Risks posed by Hazardous Ground Gases to Buildings.

End of report

a) This report has been prepared for the purpose of providing advice to the client pursuant to its appointment of Chelmer Site Investigation Laboratories Limited (CSI) to act as a consultant.
b) Save for the client no duty is undertaken or warranty or representation made to any party in respect of the opinions, advice, recommendations or conclusions herein set out.
c) All work carried out in preparing this report has used, and is based upon, our professional knowledge and understanding of the current relevant English and European Community standards, approved codes of practice, technology and legislation.
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Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 1 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 1	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type Result	Root Information	Depth to Water	Depth Mtrs
G.L.	TARMAC over CONCRETE	0.4				No roots observed.		
0.4	TYPE 1/CRUSHED CONCRETE	0.3		D				0.5
0.7	MADE GROUND: soft, moist, orange/brown, slightly sandy slightly gravelly silty clay with occasional brick and concrete fragments.	0.7		D			*1.2*	1.0
1.4	Firm, brown slightly sandy very gravelly CLAY.	1.5		D	SPT N = 14		*1.6*	1.5
				D				2.0
				D				2.5
2.9	Medium dense, brown medium to coarse GRAVEL.	1.8		D	CPT N = 34			3.0
				D				3.5
				D				4.0
4.7				D	CPT N = 34			4.5
				D				5.0
				D				5.5
	Stiff, dark grey silty CLAY.	10.3		D	SPT N = 25			6.0
				D				7.0
	Becoming very stiff from 7.5m.				SPT N = 39			7.5
				D				8.0

Drawn by: JF **Approved by:** JH

Remarks:

CONTINUED ON SHEET 2 OF 2

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 2 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 1	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
				D	SPT	N = 38			9.0
				D					10.0
					SPT	N = 39			10.5
				D					11.0
				D	SPT	N = 43			12.0
				D					13.0
					SPT	N = 41			13.5
				D					14.0
15.0	Borehole ends at 15.0 m			D	SPT	N = 38			15.0

Drawn by: JF **Approved by:** JH

Remarks: *Groundwater strike at 1.6m.*
Groundwater standing at 1.2m.
Borehole collapsed to 9.0m on completion.
Standpipe installed to 10.0m.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 1 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 2	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type Result	Root Information	Depth to Water	Depth Mtrs
G.L.	TARMAC over CONCRETE	0.4				No roots observed.		
0.4	TYPE 1/CRUSHED CONCRETE	0.6		D				0.5
1.0	MADE GROUND: Stiff, moist, brown, silty clay with brick fragments.	0.4		D				1.0
1.4	Stiff, moist, brown, slightly gravelly silty CLAY.	1.7		D	SPT N = 18		*1.5*	1.5
				D				2.0
				D				2.5
3.1	Stiff, dark grey, silty CLAY.	2.5		D	CPT N = 25			3.0
				D				3.5
				D				4.0
				D	CPT N = 27			4.5
				D				5.0
5.6				D				5.5
	Very stiff, dark grey silty CLAY.	10.3		D	SPT N = 33			6.0
				D				7.0
	Becoming very stiff from 7.5m.				SPT N = 32			7.5
				D				8.0

Drawn by: JF **Approved by:** JH

Remarks:

CONTINUED ON SHEET 2 OF 2

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 2 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 2	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
				D	SPT	N = 31			9.0
				D					10.0
					SPT	N = 35			10.5
				D					11.0
				D	SPT	N = 38			12.0
				D					13.0
					SPT	N = 39			13.5
				D					14.0
15.0	Borehole ends at 15.0 m			D	SPT	N = 39			15.0

Drawn by: JF **Approved by:** JH

Remarks: *Groundwater strike at 1.5m.*
Groundwater standing at 1.8m.
Borehole collapsed to 8.0m on completion.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 1 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 3	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.	TARMAC over CONCRETE	0.4					No roots observed.		
0.4	TYPE 1/CRUSHED CONCRETE	0.5		D					0.5
0.9	MADE GROUND: Soft, moist, dark brown, slightly sandy silty clay with occasional glass, brick and concrete fragments.	0.5		D					1.0
1.4	Dense, moist, orangey brown, clayey medium to coarse GRAVEL.	0.5		D	CPT	N = 32		*1.5*	1.5
1.9	Dense, wet, orange brown, slightly sandy medium to coarse GRAVEL.	3.7		D					2.0
				D					2.5
				D	CPT	N = 42			3.0
				D					3.5
				D					4.0
				D	CPT	N = 42			4.5
				D					5.0
4.7				D					5.5
	Stiff, dark grey, silty CLAY.	10.3		D	SPT	N = 22			6.0
				D					7.0
	Becoming very stiff from 7.5m.				SPT	N = 31			7.5
				D					8.0

Drawn by: JF **Approved by:** JH

Remarks:

CONTINUED ON SHEET 2 OF 2

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Chelmer Site Investigations 'Groundbreaking Services'

Client: London Green Ltd	**Scale:** N.T.S.	**Sheet No:** 2 of 2	**Weather:** Fine	**Date:** 14.05.15
Site: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	**Job No:** 5338	**Borehole No:** 3	**Boring method:** GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
				D	SPT	N = 32			9.0
				D					10.0
					SPT	N = 37			10.5
				D					11.0
				D	SPT	N = 37			12.0
				D					13.0
					SPT	N = 38			13.5
				D					14.0
15.0	Borehole ends at 15.0 m			D	SPT	N = 40			15.0

Drawn by: JF **Approved by:** JH

Remarks: *Groundwater strike at 1.5m.*
Groundwater standing at 1.8m.
Borehole collapsed to 11.0m on completion.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale:	N.T.S.	Sheet No:	1 of 2	Weather:	Rain	Date:	14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No:	5338	Borehole No:	4	Boring method:	GEO 205 150mmØ CFA		

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.									
0.4	TARMAC over CONCRETE	0.4					No roots observed.		
	TYPE 1/CRUSHED CONCRETE	0.4		D					0.5
0.8	MADE GROUND: Soft, moist, brown, slightly sandy silty clay with occasional brick fragments.	0.6		D					1.0
1.4				D	CPT	N = 28			1.5
	Medium dense, moist, orange brown, sandy fine to coarse GRAVEL.	1.5		D				*1.8*	2.0
				D					2.5
2.9				D	CPT	N = 34			3.0
	Dense, orange brown, medium to coarse GRAVEL.	1.6		D					3.5
				D					4.0
4.5				D	CPT	N = 35			4.5
	Dense, orange brown, slightly sandy medium to coarse GRAVEL.	0.2		D					
4.7									5.0
				D					5.5
				D	SPT	N = 27			6.0
	Stiff, dark grey, silty CLAY.	10.3							
				D					7.0
					SPT	N = 34			7.5
	Becoming very stiff from 8.0m.			D					8.0

Drawn by: JF **Approved by:** JH

Remarks:

CONTINUED ON SHEET 2 OF 2

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 2 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 4	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
				D	SPT	N = 33			9.0
				D					10.0
					SPT	N = 35			10.5
				D					11.0
				D	SPT	N = 38			12.0
				D					13.0
					SPT	N = 37			13.5
				D					14.0
15.0	Borehole ends at 15.0 m			D	SPT	N = 41			15.0

Drawn by: JF **Approved by:** JH

Remarks: *Groundwater strike at 1.8m.*
Groundwater standing at 1.8m.
Borehole collapsed to 11.0m on completion.
Standpipe installed to 10.0m.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale:	N.T.S.	Sheet No:	1 of 2	Weather:	Fine	Date:	14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No:	5338	Borehole No:	5	Boring method:	GEO 205 150mmØ CFA		

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.	TARMAC over CONCRETE	0.4					No roots observed.		
0.4	TYPE 1/CRUSHED CONCRETE	0.4		D					0.5
0.9	MADE GROUND: Dense, brown, sandy fine to medium gravel with brick fragments.	0.5		D					1.0
1.4				D	CPT	N = 34			1.5
				D				*2.0*	2.0
	Dense, orange brown, sandy medium to coarse GRAVEL.	2.3		D					2.5
				D	CPT	N = 35			3.0
				D					3.5
3.7				D					4.0
				D	SPT	N = 20			4.5
				D					5.0
				D					5.5
	Stiff, dark grey, silty CLAY.			D	SPT	N = 25			6.0
		5.3		D					7.0
					SPT	N = 28			7.5
				D					8.0

Drawn by:	JF	Approved by:	JH

Remarks:

CONTINUED ON SHEET 2 OF 2

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client: London Green Ltd	**Scale:** N.T.S.	**Sheet No:** 2 of 2	**Weather:** Fine	**Date:** 14.05.15
Site: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	**Job No:** 5338	**Borehole No:** 5	**Boring method:** GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
				D	SPT	N = 32			9.0
				D					10.0
					SPT	N = 35			10.5
				D					11.0
				D	SPT	N = 38			12.0
				D					13.0
					SPT	N = 40			13.5
				D					14.0
15.0	Borehole ends at 15.0 m			D	SPT	N = 39			15.0

Drawn by: JF **Approved by:** JH

Remarks: *Groundwater standing at 2.0m.*
Borehole collapsed to 6.0m on completion.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 1 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 6	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
G.L.	TARMAC over CONCRETE	0.4					No roots observed.		
0.4	TYPE 1/CRUSHED CONCRETE	0.4		D					0.5
0.9	MADE GROUND: Soft, moist, orange brown, slightly gravelly silty clay with occasional brick fragments.	0.5		D					1.0
1.9	Medium dense, brown, medium to coarse GRAVEL.	2.3		D	CPT	N = 13			1.5
				D				*2.0*	2.0
				D					2.5
				D	CPT	N = 21			3.0
3.2	Stiff, dark grey, silty CLAY.	11.8		D					3.5
				D					4.0
				D	SPT	N = 21			4.5
				D					5.0
				D					5.5
				D	SPT	N = 30			6.0
				D					7.0
					SPT	N = 31			7.5
				D					8.0

Drawn by: JF **Approved by:** JH

Remarks:

CONTINUED ON SHEET 2 OF 2

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

Client:	London Green Ltd	Scale: N.T.S.	Sheet No: 2 of 2	Weather: Fine	Date: 14.05.15
Site:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No: 5338	Borehole No: 6	Boring method: GEO 205 150mmØ CFA	

Depth Mtrs.	Description of Strata	Thick-ness	Legend	Sample	Test Type	Test Result	Root Information	Depth to Water	Depth Mtrs
				D	SPT	N = 35			9.0
				D					10.0
					SPT	N = 35			10.5
				D					11.0
				D					12.0
				D					13.0
					SPT	N = 39			13.5
				D					14.0
15.0	Borehole ends at 15.0 m			D	SPT	N = 39			15.0

Drawn by: JF **Approved by:** JH

Remarks: *Groundwater strike at 2.0m.*
Groundwater standing at 2.0m.
Borehole wet and collapsed to 6.0m on completion.
Standpipe installed to 10.0m.

Key: T.D.T.D. Too Dense to Drive
D Small Disturbed Sample J Jar Sample
B Bulk Disturbed Sample V Pilcon Vane (kPa)
U Undisturbed Sample (U100) M Mackintosh Probe
W Water Sample N Standard Penetration Test Blow Count

UKAS TESTING
8284

Chelmer Geotechnical Laboratories
'Groundbreaking Services'

Content Summary

This report contains all test results as indicated on the test instruction/summary.

CGL Reference : CGL5338

Client Reference : CSI5338

For the attention of : London Green Ltd

This report comprises of the following :

Notes :

General

Please refer to report summary notes for details pertaining to methods undertaken and their subsequent accreditations

Samples were supplied by Chelmer Site Investigations

All tests performed in-house unless otherwise stated

Deviant Samples

Samples were received in suitable containers	Yes
A date and time of sampling was provided	Yes
Arrived damaged and/or denatured	No

Laboratory Testing Results

BS 1377 : 1990

Chelmer Geotechnical Laboratories "Groundbreaking Services"

Job Number : CGL5338
Client : London Green Ltd
Client Reference : CSI5338
Site Name : Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2

Date Received : 02/06/2015
Date Testing Started : 05/06/2015
Date Testing Completed : 10/06/2015
Laboratory Used : Chelmer Geotechnical, CM3 8AB

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
BH1	2.0	63255	D	15	53	39	20	19	-0.25	9	CI								
BH1	3.0	63256	D		<5											9.6	0.20	0.24	DS-1
BH1	12.0	63258	D	29	23	65	25	39	0.08	30	CH					8.5	0.18	0.22	DS-1

Notes :- *UKAS Accredited Tests

[1] BS 1377 : Part 2 : 1990, Test No 3.2
[2] Estimated if <5%, otherwise measured
[3] BS 1377 : Part 2 : 1990, Test No 4.4
[4] BS 1377 : Part 2 : 1990, Test No 5.3
[5] BS 1377 : Part 2 : 1990, Test No 5.4
[6] BRE Digest 240 : 1993
[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils
[8] In-house method S9a adapted from BRE IP 4/93
[9] Values of shear strength were determined in situ by Chelmer Site Investigations using a Pilcon hand vane or Geonor vane (GV).
[10] BS 1377 : Part 3 : 1990, Test No 4
[11] BS 1377 : Part 2 : 1990, Test No 9
[12] BS 1377 : Part 3 : 1990, Test No 5.6
[13] $SO_4 = 1.2 \times SO_3$
[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key

D - Disturbed sample
B - Bulk sample
U - U100 (undisturbed sample)
W - Water sample
ENP - Essentially Non-Plastic
U/S - Underside Foundation

UKAS TESTING 8284

Comments :-

Technician :- HS/LE/MT
Checked By :- MC
Date Checked :- 10-Jun-15

Laboratory Testing Results

BS 1377 : 1990

Chelmer Geotechnical Laboratories "Groundbreaking Services"

Job Number : CGL5338
Client : London Green Ltd
Client Reference : CSI5338
Site Name : Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2

Date Received : 02/06/2015
Date Testing Started : 05/06/2015
Date Testing Completed : 10/06/2015
Laboratory Used : Chelmer Geotechnical, CM3 8AB

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
BH2	2.0	63259	D	16	60	39	18	22	-0.08	9	CI								
BH2	3.0	63260	D	28	26	66	24	42	0.11	31	CH								
BH2	4.0	63261	D	24	35	67	24	43	0.00	28	CH								
BH2	6.0	63262	D	25	40	65	22	43	0.05	26	CH						8.1	0.22	0.27	DS-1

Notes :- *UKAS Accredited Tests

[1] BS 1377 : Part 2 : 1990, Test No 3.2
[2] Estimated if <5%, otherwise measured
[3] BS 1377 : Part 2 : 1990, Test No 4.4
[4] BS 1377 : Part 2 : 1990, Test No 5.3
[5] BS 1377 : Part 2 : 1990, Test No 5.4
[6] BRE Digest 240 : 1993
[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils
[8] In-house method S9a adapted from BRE IP 4/93
[9] Values of shear strength were determined in situ by Chelmer Site Investigations using a Pilcon hand vane or Geonor vane (GV).
[10] BS 1377 : Part 3 : 1990, Test No 4
[11] BS 1377 : Part 2 : 1990, Test No 9
[12] BS 1377 : Part 3 : 1990, Test No 5.6
[13] $SO_4 = 1.2 \times SO_3$
[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key
D - Disturbed sample
B - Bulk sample
U - U100 (undisturbed sample)
W - Water sample
ENP - Essentially Non-Plastic
U/S - Underside Foundation

UKAS TESTING 8284

Comments :-

Technician :- HS/LE/MT
Checked By :- MC
Date Checked :- 10-Jun-15

Laboratory Testing Results

BS 1377 : 1990

Chelmer Geotechnical Laboratories "Groundbreaking Services"

Job Number : CGL5338
Client : London Green Ltd
Client Reference : CSI5338
Site Name : Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2

Date Received : 02/06/2015
Date Testing Started : 05/06/2015
Date Testing Completed : 10/06/2015
Laboratory Used : Chelmer Geotechnical, CM3 8AB

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
BH3	1.5	63264	D		<5											9.1	0.21	0.25	DS-1
BH3	5.0	63267	D	28	27	63	23	41	0.13	30	CH								
BH3	15.0	63268	D	24	12	54	20	34	0.13	30	CH								

Notes :- *UKAS Accredited Tests

[1] BS 1377 : Part 2 : 1990, Test No 3.2
[2] Estimated if <5%, otherwise measured
[3] BS 1377 : Part 2 : 1990, Test No 4.4
[4] BS 1377 : Part 2 : 1990, Test No 5.3
[5] BS 1377 : Part 2 : 1990, Test No 5.4
[6] BRE Digest 240 : 1993
[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils
[8] In-house method S9a adapted from BRE IP 4/93
[9] Values of shear strength were determined in situ by Chelmer Site Investigations using a Pilcon hand vane or Geonor vane (GV).
[10] BS 1377 : Part 3 : 1990, Test No 4
[11] BS 1377 : Part 2 : 1990, Test No 9
[12] BS 1377 : Part 3 : 1990, Test No 5.6
[13] $SO_4 = 1.2 \times SO_3$
[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key
D - Disturbed sample
B - Bulk sample
U - U100 (undisturbed sample)
W - Water sample
ENP - Essentially Non-Plastic
U/S - Underside Foundation

UKAS TESTING 8284

Comments :-

Technician :- HS/LE/MT
Checked By :- MC
Date Checked :- 10-Jun-15

Laboratory Testing Results

BS 1377 : 1990

Chelmer Geotechnical Laboratories "Groundbreaking Services"

Job Number : CGL5338
Client : London Green Ltd
Client Reference : CSI5338
Site Name : Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2

Date Received : 02/06/2015
Date Testing Started : 05/06/2015
Date Testing Completed : 10/06/2015
Laboratory Used : Chelmer Geotechnical, CM3 8AB

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
BH4	3.0	63271	D		<5											9.6	0.14	0.16	DS-1
BH4	5.5	63273	D	26	42	68	23	45	0.06	26	CH								
BH4	10.0	63274	D	28	23	64	22	42	0.14	33	CH								

Notes :- *UKAS Accredited Tests

[1] BS 1377 : Part 2 : 1990, Test No 3.2
[2] Estimated if <5%, otherwise measured
[3] BS 1377 : Part 2 : 1990, Test No 4.4
[4] BS 1377 : Part 2 : 1990, Test No 5.3
[5] BS 1377 : Part 2 : 1990, Test No 5.4
[6] BRE Digest 240 : 1993
[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils
[8] In-house method S9a adapted from BRE IP 4/93
[9] Values of shear strength were determined in situ by Chelmer Site Investigations using a Pilcon hand vane or Geonor vane (GV).
[10] BS 1377 : Part 3 : 1990, Test No 4
[11] BS 1377 : Part 2 : 1990, Test No 9
[12] BS 1377 : Part 3 : 1990, Test No 5.6
[13] $SO_4 = 1.2 \times SO_3$
[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key
D - Disturbed sample
B - Bulk sample
U - U100 (undisturbed sample)
W - Water sample
ENP - Essentially Non-Plastic
U/S - Underside Foundation

UKAS TESTING 8284

Comments :-

Technician :- HS/LE/MT
Checked By :- MC
Date Checked :- 10-Jun-15

Laboratory Testing Results

BS 1377 : 1990

Chelmer Geotechnical Laboratories "Groundbreaking Services"

Job Number : CGL5338
Client : London Green Ltd
Client Reference : CSI5338
Site Name : Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2

Date Received : 02/06/2015
Date Testing Started : 05/06/2015
Date Testing Completed : 10/06/2015
Laboratory Used : Chelmer Geotechnical, CM3 8AB

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
BH5	1.0	63275	D		<5											8.4	0.03	0.04	DS-1
BH5	3.0	63277	D		<5											8.3	0.03	0.04	DS-1
BH5	4.0	63278	D	23	32	63	22	42	0.02	28	CH								
BH5	6.0	63279	D	29	18	67	23	44	0.15	36	CH								

Notes :- *UKAS Accredited Tests

[1] BS 1377 : Part 2 : 1990, Test No 3.2
[2] Estimated if <5%, otherwise measured
[3] BS 1377 : Part 2 : 1990, Test No 4.4
[4] BS 1377 : Part 2 : 1990, Test No 5.3
[5] BS 1377 : Part 2 : 1990, Test No 5.4
[6] BRE Digest 240 : 1993
[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils
[8] In-house method S9a adapted from BRE IP 4/93
[9] Values of shear strength were determined in situ by Chelmer Site Investigations using a Pilcon hand vane or Geonor vane (GV).
[10] BS 1377 : Part 3 : 1990, Test No 4
[11] BS 1377 : Part 2 : 1990, Test No 9
[12] BS 1377 : Part 3 : 1990, Test No 5.6
[13] $SO_4 = 1.2 \times SO_3$
[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key

D - Disturbed sample
B - Bulk sample
U - U100 (undisturbed sample)
W - Water sample
ENP - Essentially Non-Plastic
U/S - Underside Foundation

UKAS TESTING 8284

Comments :-

Technician :- HS/LE/MT
Checked By :- MC
Date Checked :- 10-Jun-15

Laboratory Testing Results

BS 1377 : 1990

Chelmer Geotechnical Laboratories "Groundbreaking Services"

Job Number : CGL5338
Client : London Green Ltd
Client Reference : CSI5338
Site Name : Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2

Date Received : 02/06/2015
Date Testing Started : 05/06/2015
Date Testing Completed : 10/06/2015
Laboratory Used : Chelmer Geotechnical, CM3 8AB

Sample Ref			Sample Type	*Moisture Content (%) [1]	*Soil Faction > 0.425mm (%) [2]	*Liquid Limit (%) [3]	*Plastic Limit (%) [4]	*Plasticity Index (%) [5]	*Liquidity Index (%) [5]	*Modified Plasticity Index (%) [6]	*Soil Class [7]	Filter Paper Contact Time (h) [8]	*Soil Sample Suction (kPa)	Insitu Shear Vane Strength (kPa) [9]	Organic Content (%) [10]	*pH Value [11]	*Sulphate Content (g/l)		
BH/TP/WS	Depth (m)	UID															SO_3 [12]	SO_4 [13]	Class [14]
BH6	2.5	63281	D		<5											8.4	0.06	0.08	DS-1
BH6	3.5	63282	D	28	19	65	21	43	0.15	35	CH								
BH6	4.5	63283	D	27	25	66	22	44	0.10	33	CH					8.2	0.21	0.25	DS-1
BH6	6.0	63284	D	31	17	68	22	46	0.18	38	CH								
BH6	15.0	63285	D	35	14	71	25	47	0.22	40	CV								

Notes :- *UKAS Accredited Tests

[1] BS 1377 : Part 2 : 1990, Test No 3.2
[2] Estimated if <5%, otherwise measured
[3] BS 1377 : Part 2 : 1990, Test No 4.4
[4] BS 1377 : Part 2 : 1990, Test No 5.3
[5] BS 1377 : Part 2 : 1990, Test No 5.4
[6] BRE Digest 240 : 1993
[7] BS 5930 : 1981 : Figure 31 - Plasticity Chart for the classification of fine soils
[8] In-house method S9a adapted from BRE IP 4/93
[9] Values of shear strength were determined in situ by Chelmer Site Investigations using a Pilcon hand vane or Geonor vane (GV).
[10] BS 1377 : Part 3 : 1990, Test No 4
[11] BS 1377 : Part 2 : 1990, Test No 9
[12] BS 1377 : Part 3 : 1990, Test No 5.6
[13] $SO_4 = 1.2 \times SO_3$
[14] BRE Special Digest One (Concrete in Aggressive Ground) 2005

Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4m or DS-5m class respectively unless water soluble magnesium testing is undertaken to prove otherwise

Key
D - Disturbed sample
B - Bulk sample
U - U100 (undisturbed sample)
W - Water sample
ENP - Essentially Non-Plastic
U/S - Underside Foundation

UKAS TESTING 8284

Comments :-

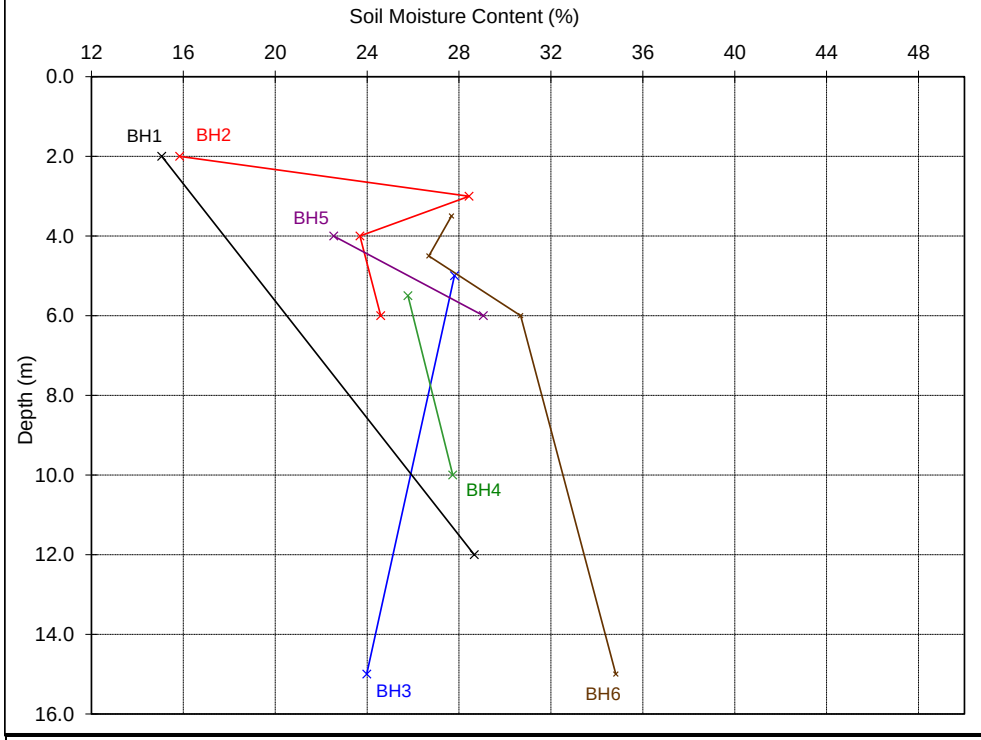
Technician :- HS/LE/MT
Checked By :- MC
Date Checked :- 10-Jun-15

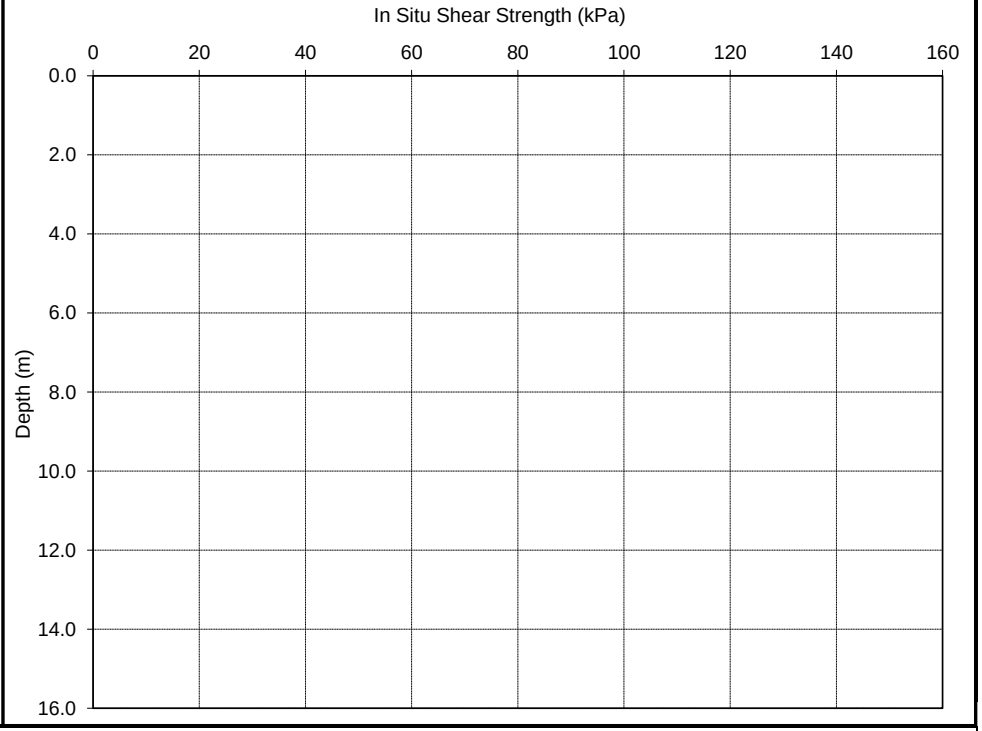
Laboratory Testing Results

Moisture Content/Shear Strength Profile

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL5338	Date Received :	02/06/2015
Client :	London Green Ltd	Date Testing Started :	05/06/2015
Client Reference :	CSI5338	Date Testing Completed :	10/06/2015
Site Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Laboratory :	Chelmer Geotechnical Laboratories, CM3 8AB





Notes :-

1. If the Soil Fraction > 0.425mm exceeds 5% the Equivalent Moisture Content of the remainder (calculated in accordance with BS 1377: Part 2 : 1990, cl.3.2.4 note 1) is also plotted and the alternative profile additionally shown as an appropriately coloured broken line.
2. If plotted, 0.4 LL and PL+2 (after Driscoll, 1983) should only be applied to London Clay (and similarly over consolidated clays) at shallow depths.

Unless otherwise stated, values of Shear Strength were determined in situ by Chelmer Site Investigations using a Pilcon Hand Vane the calibration of which is limited to a maximum reading of 140 kPa. (Not UKAS accredited)

UKAS TESTING 8284

Comments :-

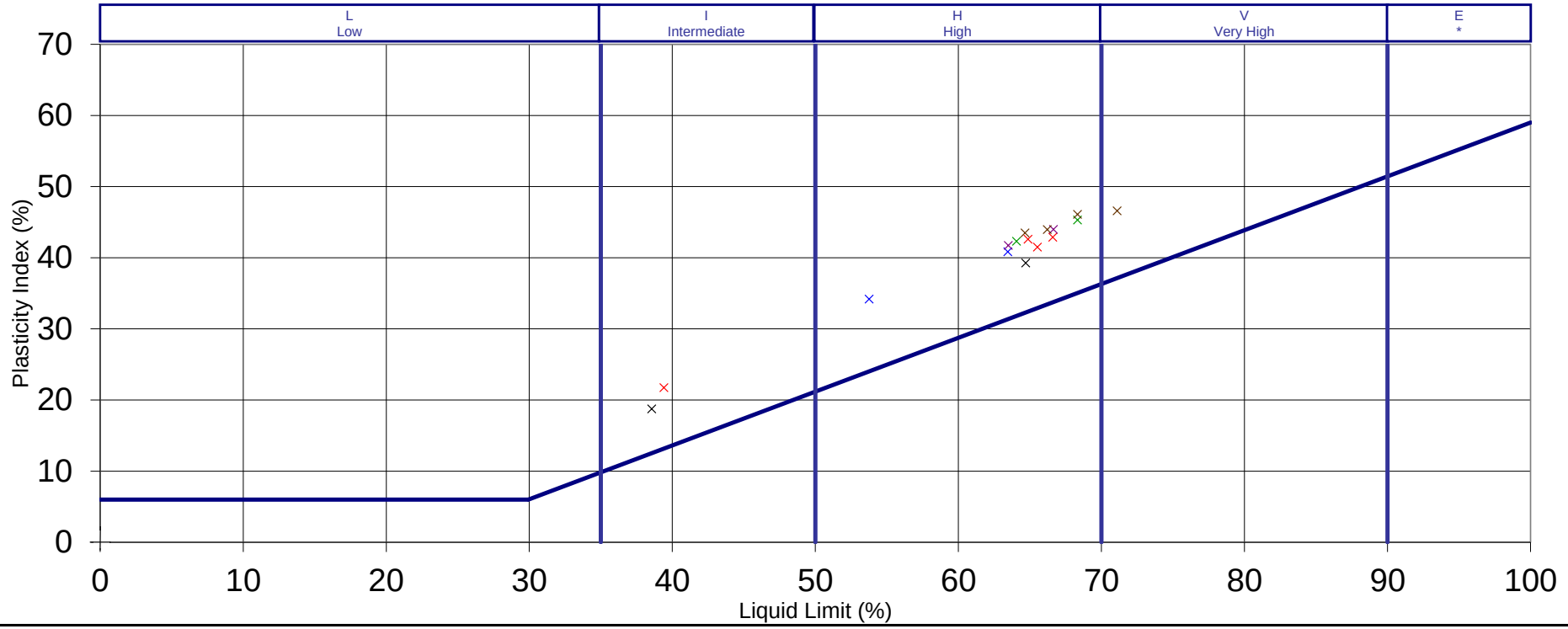
Checked By :- MC Date Checked :- 10-Jun-15

Laboratory Testing Results

Plasticity Chart for the classification of fine soils and the finer part of coarse soils
In Compliance with BS5930 : 1999

Chelmer Geotechnical Laboratories
'Groundbreaking Services'

Job Number :	CGL5338	Date Received :	02/06/2015
Client :	London Green Ltd	Date Testing Started :	05/06/2015
Client Reference :	CSI5338	Date Testing Completed :	10/06/2015
Site Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Laboratory :	Chelmer Geotechnical Laboratories, CM3 8AB



Notes :-

SILT (M-SOIL), M, plots below A-Line
CLAY, C, plots above A-Line }M and C may be combined as FINE SOIL, F.

Key :- BH1 BH2 BH3 BH4 BH5 BH6

UKAS TESTING
8284

Comments :-

Checked By :- MC Date Checked :- 12-Jun-15

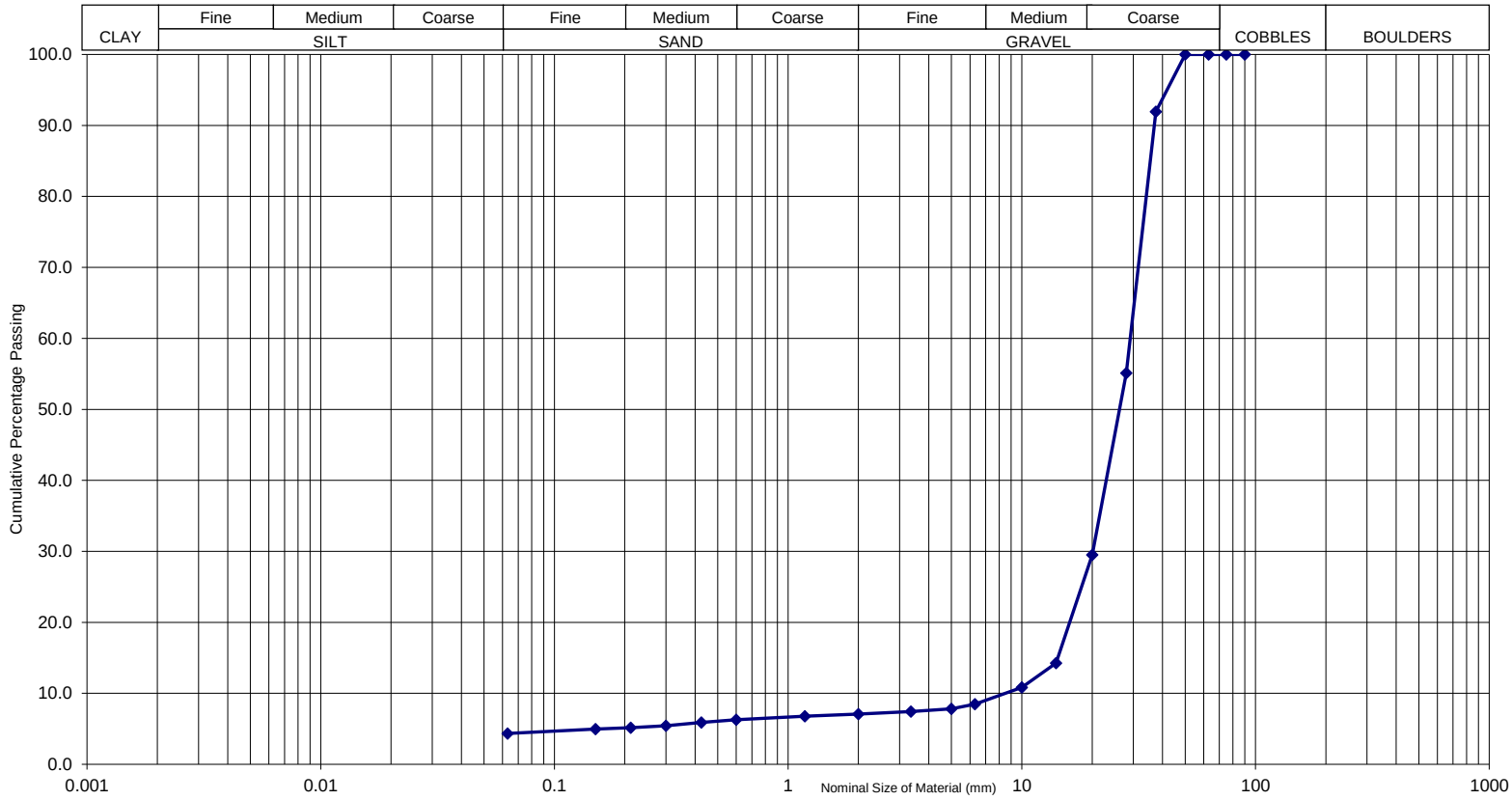
PARTICLE SIZE DISTRIBUTION

BS 1377-2:1990

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL5338	Site Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH
Sample Number :	BH1	Soil Description :	Brown, medium to coarse GRAVEL.
Depth (m) :	4.00		
Sample UID :	63257		

Type of Sieving :	Washed
Date :	04-Jun-15
Tested By :	LE
Laboratory :	Chelmer Geotechnical CM3 8AB



Sieve Size (mm)	% Passing
90.0	100.0
75.0	100.0
63.0	100.0
50.0	100.0
37.5	91.9
28.0	55.1
20.0	29.5
14.0	14.2
10.0	10.8
6.3	8.5
5.0	7.8
3.35	7.4
2.00	7.1
1.18	6.8
0.600	6.3
0.425	5.9
0.300	5.4
0.212	5.1
0.150	5.0
0.063	4.3

UKAS TESTING 8284

Calculations :-

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100$$

$f = 100P/M_1$ (dry sieving)

f = Percentage of fines passing 0.063mm
M_1 = Mass of dried test sample before washing (kg)
M_2 = Mass of dried residue retained on the 0.063m (kg)
P = Mass of screened material remaining in the pan (kg)

Comments :-

Checked By :- MC

Date Checked :- 10-Jun-15

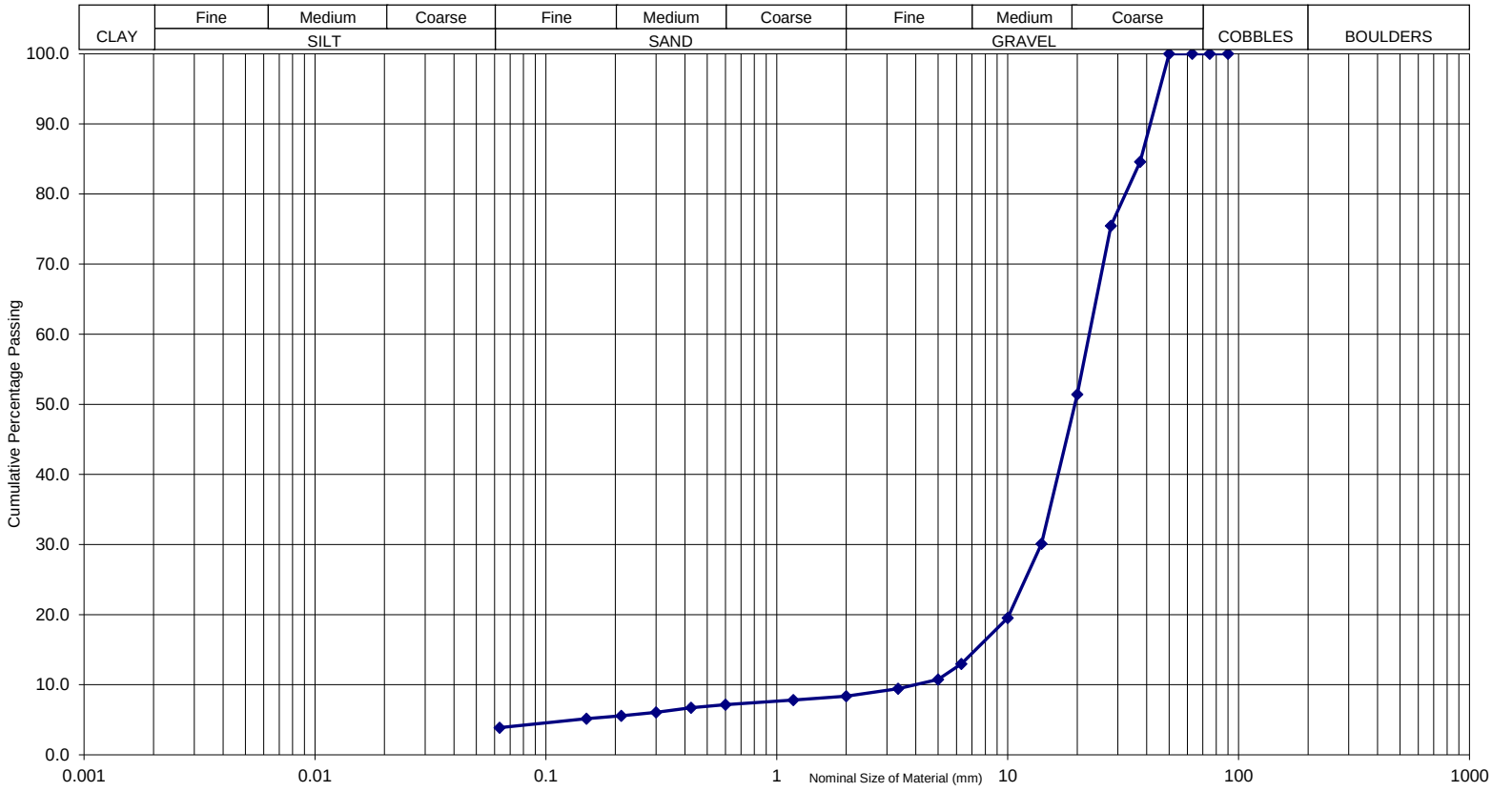
PARTICLE SIZE DISTRIBUTION

BS 1377-2:1990

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL5338	Site Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH
Sample Number :	BH3	Soil Description :	Orange brown, slightly sandy, medium to coarse GRAVEL.
Depth (m) :	2.50		
Sample UID :	63265		

Type of Sieving :	Washed
Date :	04-Jun-15
Tested By :	LE
Laboratory :	Chelmer Geotechnical CM3 8AB



Sieve Size (mm)	% Passing
90.0	100.0
75.0	100.0
63.0	100.0
50.0	100.0
37.5	84.6
28.0	75.5
20.0	51.4
14.0	30.1
10.0	19.5
6.3	13.0
5.0	10.8
3.35	9.4
2.00	8.4
1.18	7.8
0.600	7.2
0.425	6.7
0.300	6.1
0.212	5.6
0.150	5.1
0.063	3.9

UKAS TESTING 8284

Calculations :-

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100$$

$f = 100P/M_1$ (dry sieving)

f = Percentage of fines passing 0.063mm
M_1 = Mass of dried test sample before washing (kg)
M_2 = Mass of dried residue retained on the 0.063m (kg)
P = Mass of screened material remaining in the pan (kg)

Comments :-

Checked By :- MC Date Checked :- 10-Jun-15

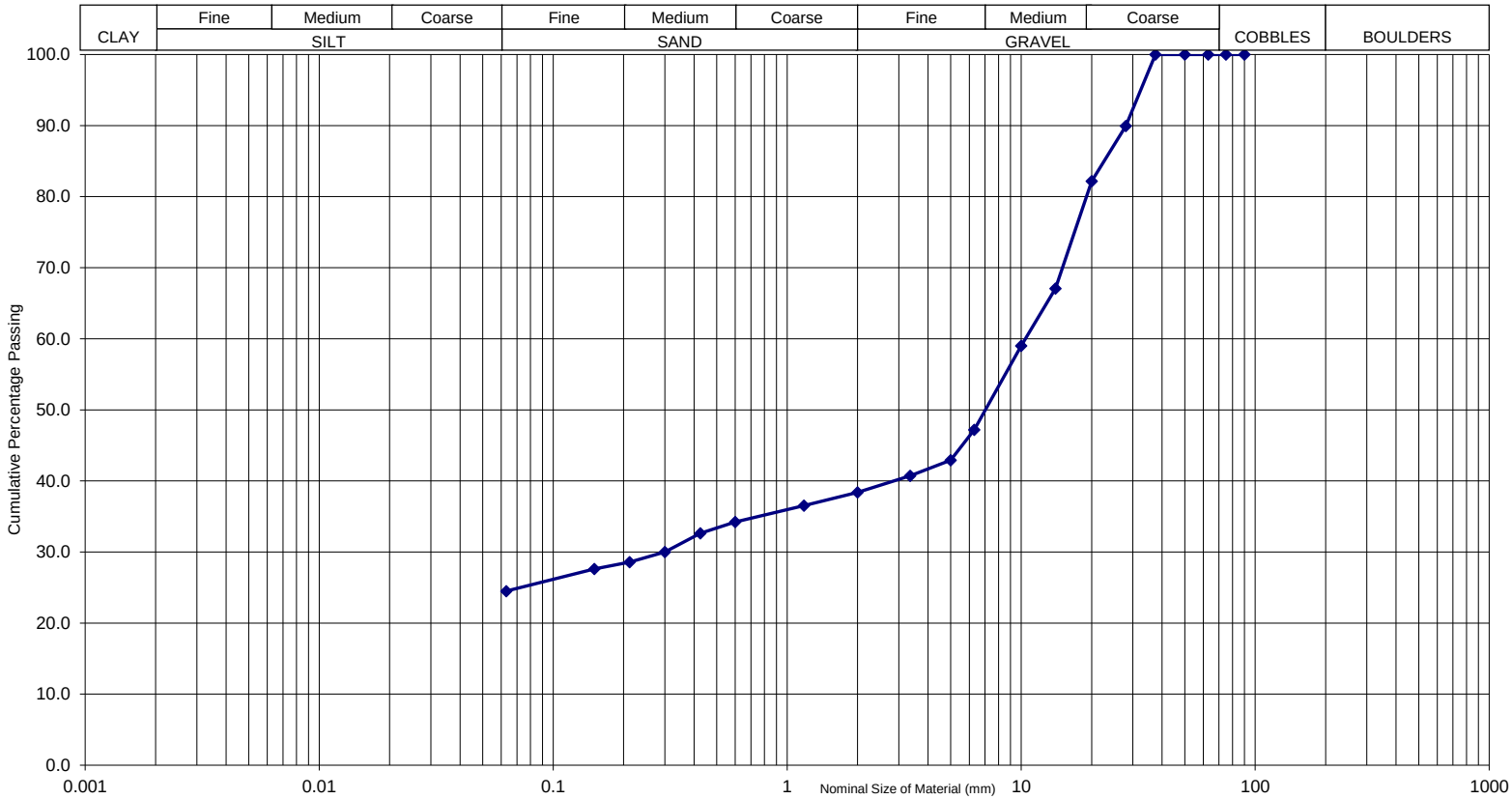
PARTICLE SIZE DISTRIBUTION

BS 1377-2:1990

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL5338	Site Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH
Sample Number :	BH4	Soil Description :	Orange brown, sandy, fine to coarse GRAVEL.
Depth (m) :	2.00		
Sample UID :	63270		

Type of Sieving :	Washed
Date :	04-Jun-15
Tested By :	LE
Laboratory :	Chelmer Geotechnical CM3 8AB



Sieve Size (mm)	% Passing
90.0	100.0
75.0	100.0
63.0	100.0
50.0	100.0
37.5	100.0
28.0	90.0
20.0	82.2
14.0	67.1
10.0	59.0
6.3	47.2
5.0	42.9
3.35	40.7
2.00	38.4
1.18	36.5
0.600	34.2
0.425	32.6
0.300	30.0
0.212	28.6
0.150	27.6
0.063	24.5

UKAS TESTING 8284

Calculations :-

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100$$

$f = 100P/M_1$ (dry sieving)

f = Percentage of fines passing 0.063mm
M_1 = Mass of dried test sample before washing (kg)
M_2 = Mass of dried residue retained on the 0.063m (kg)
P = Mass of screened material remaining in the pan (kg)

Comments :-

Checked By :- MC

Date Checked :- 10-Jun-15

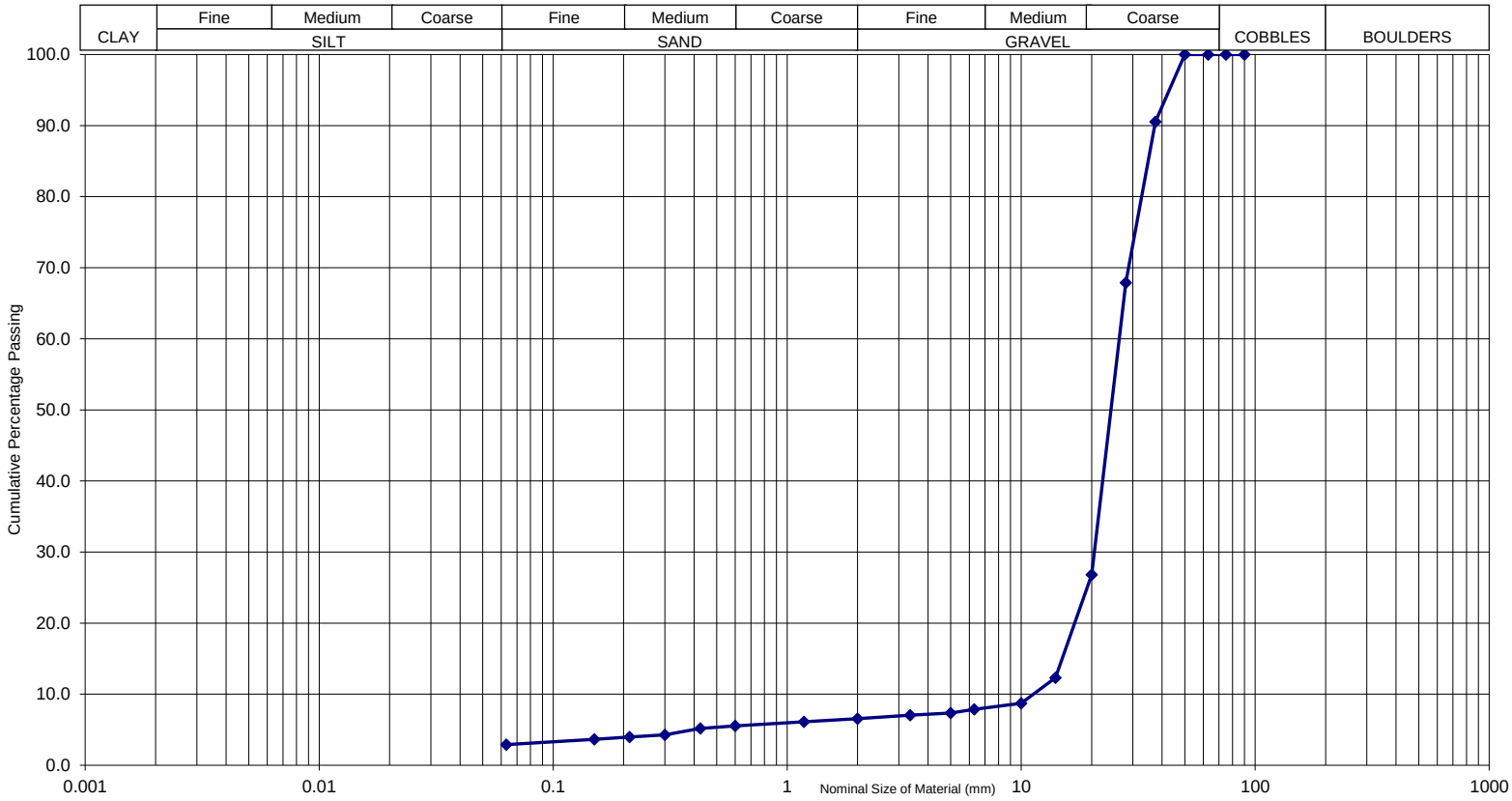
PARTICLE SIZE DISTRIBUTION

BS 1377-2:1990

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL5338	Site Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH
Sample Number :	BH4	Soil Description :	Orange brown, slightly sandy, medium to coarse GRAVEL.
Depth (m) :	4.50		
Sample UID :	63272		

Type of Sieving :	Washed
Date :	04-Jun-15
Tested By :	LE
Laboratory :	Chelmer Geotechnical CM3 8AB



Sieve Size (mm)	% Passing
90.0	100.0
75.0	100.0
63.0	100.0
50.0	100.0
37.5	90.5
28.0	67.9
20.0	26.8
14.0	12.3
10.0	8.7
6.3	7.9
5.0	7.4
3.35	7.0
2.00	6.6
1.18	6.1
0.600	5.6
0.425	5.2
0.300	4.3
0.212	4.0
0.150	3.7
0.063	2.9

UKAS TESTING 8284

Calculations :-

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100$$

$f = 100P/M_1$ (dry sieving)

f = Percentage of fines passing 0.063mm
M_1 = Mass of dried test sample before washing (kg)
M_2 = Mass of dried residue retained on the 0.063m (kg)
P = Mass of screened material remaining in the pan (kg)

Comments :-

Checked By :- MC Date Checked :- 10-Jun-15

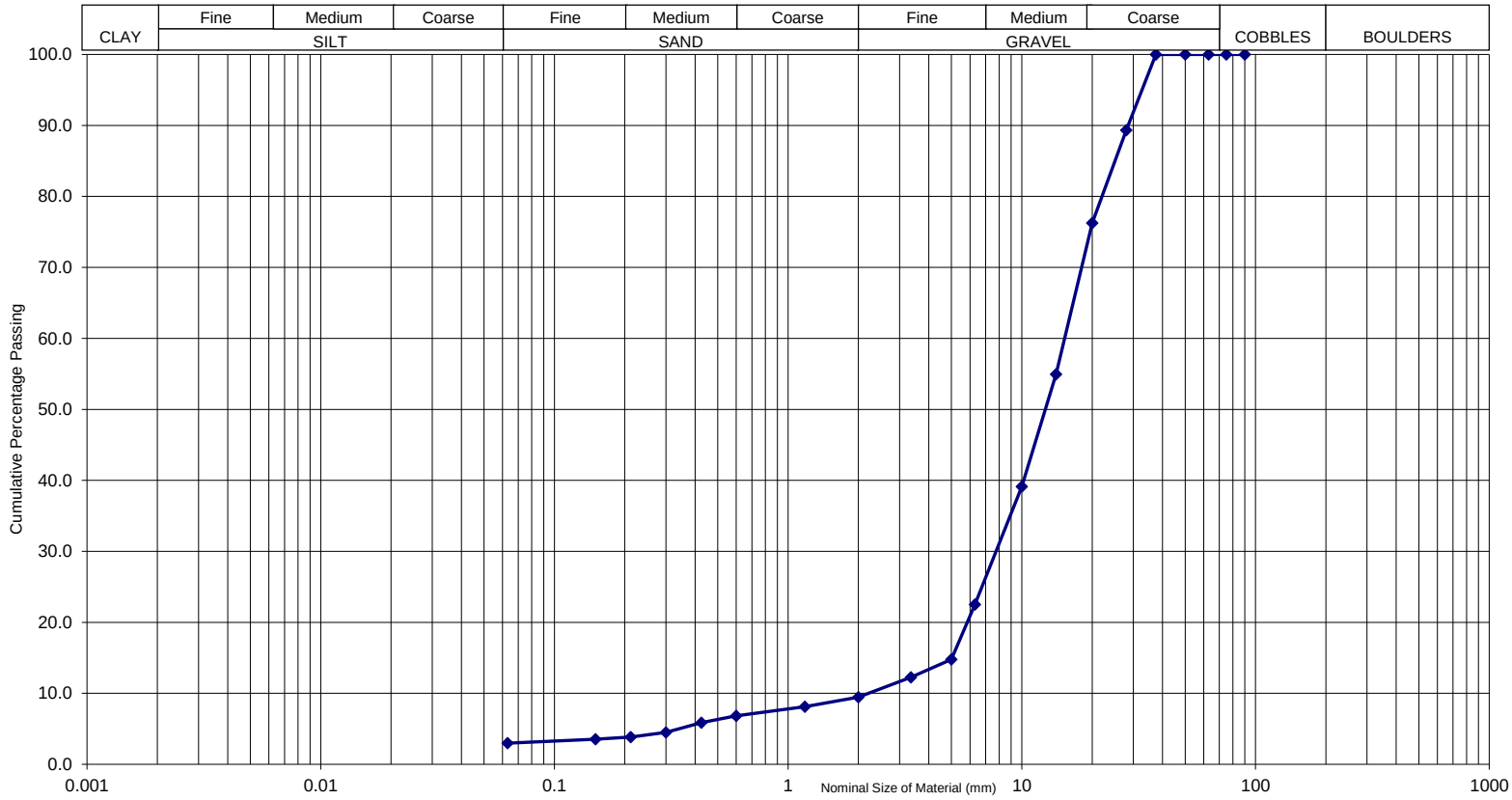
PARTICLE SIZE DISTRIBUTION

BS 1377-2:1990

Chelmer Geotechnical Laboratories 'Groundbreaking Services'

Job Number :	CGL5338	Site Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH
Sample Number :	BH5	Soil Description :	Orange brown, sandy, medium to coarse GRAVEL.
Depth (m) :	2.00		
Sample UID :	63276		

Type of Sieving :	Washed
Date :	04-Jun-15
Tested By :	LE
Laboratory :	Chelmer Geotechnical CM3 8AB



Sieve Size (mm)	% Passing
90.0	100.0
75.0	100.0
63.0	100.0
50.0	100.0
37.5	100.0
28.0	89.3
20.0	76.3
14.0	54.9
10.0	39.1
6.3	22.5
5.0	14.8
3.35	12.3
2.00	9.5
1.18	8.1
0.600	6.8
0.425	5.9
0.300	4.5
0.212	3.8
0.150	3.5
0.063	3.0

UKAS TESTING 8284

Calculations :-

$$f = \frac{(M_1 - M_2) + P}{M_1} \times 100$$

$f = 100P/M_1$ (dry sieving)

f = Percentage of fines passing 0.063mm
M_1 = Mass of dried test sample before washing (kg)
M_2 = Mass of dried residue retained on the 0.063m (kg)
P = Mass of screened material remaining in the pan (kg)

Comments :-

Checked By :- MC

Date Checked :- 10-Jun-15

Mark Collyer
Chelmer Site Investigation Laboratories Ltd
Unit 15
East Hanningfield Industrial Estate
Old Church Road
East Hanningfield
Essex
CM3 8AB

QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 15-32093

Site Reference:	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH
Project / Job Ref:	CGL5338
Order No:	4518
Sample Receipt Date:	05/06/2015
Sample Scheduled Date:	05/06/2015
Report Issue Number:	1
Reporting Date:	11/06/2015

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate							
QTS Environmental Report No: 15-32093	**Date Sampled**	14/05/15	14/05/15	14/05/15	14/05/15	14/05/15
Chelmer Site Investigation Laboratories Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	**TP / BH No**	63254	63255	63260	63263	63266
Project / Job Ref: CGL5338	**Additional Refs**	1	1	2	3	3
Order No: 4518	**Depth (m)**	1.00	2.00	3.00	1.00	4.50
Reporting Date: 11/06/2015	**QTSE Sample No**	151443	151444	151445	151446	151447

Determinand	**Unit**	**RL**	**Accreditation**					
pH	pH Units	N/a	**MCERTS**	7.5	8.4	8.0	7.8	8.0
Total Sulphate as SO_4	mg/kg	< 200	NONE	1185	399	848	726	1579
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	**MCERTS**	0.27	0.13	0.23	0.15	0.38
Total Sulphur	mg/kg	< 200	NONE	508	< 200	1940	353	1006
Ammonium as NH_4	mg/kg	< 0.5	NONE	4.5	3.3	< 0.5	69.7	4.3
W/S Chloride (2:1)	mg/kg	< 1	**MCERTS**	23	18	21	15	16
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	**MCERTS**	7	3	< 3	4	< 3
W/S Magnesium	mg/l	< 0.1	NONE	0.8	1.3	3.4	2.3	16

Analytical results are expressed on a dry weight basis where samples are dried at less than $30^{O}C$
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate							
QTS Environmental Report No: 15-32093	**Date Sampled**	14/05/15	14/05/15	14/05/15	14/05/15	14/05/15
Chelmer Site Investigation Laboratories Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	**TP / BH No**	63268	63269	63274	63278	63280
Project / Job Ref: CGL5338	**Additional Refs**	3	4	4	5	6
Order No: 4518	**Depth (m)**	15.00	1.50	10.00	4.00	1.50
Reporting Date: 11/06/2015	**QTSE Sample No**	151448	151449	151450	151451	151452

Determinand	**Unit**	**RL**	**Accreditation**					
pH	pH Units	N/a	**MCERTS**	7.7	8.3	7.9	7.9	8.0
Total Sulphate as SO_4	mg/kg	< 200	NONE	343	2195	3204	1037	358
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	**MCERTS**	0.09	0.38	0.40	0.22	0.03
Total Sulphur	mg/kg	< 200	NONE	381	1270	9148	2286	< 200
Ammonium as NH_4	mg/kg	< 0.5	NONE	20.2	3.3	16.7	5.9	6.6
W/S Chloride (2:1)	mg/kg	< 1	**MCERTS**	7	16	18	19	7
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	**MCERTS**	< 3	< 3	< 3	< 3	< 3
W/S Magnesium	mg/l	< 0.1	NONE	2.3	16	16	8.2	1

Analytical results are expressed on a dry weight basis where samples are dried at less than $30^{O}C$
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate							
QTS Environmental Report No: 15-32093	**Date Sampled**	14/05/15					
Chelmer Site Investigation Laboratories Ltd	**Time Sampled**	None Supplied					
Site Reference: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	**TP / BH No**	63285					
Project / Job Ref: CGL5338	**Additional Refs**	6					
Order No: 4518	**Depth (m)**	15.00					
Reporting Date: 11/06/2015	**QTSE Sample No**	151453					

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	8.0				
Total Sulphate as SO_4	mg/kg	< 200	NONE	1012				
W/S Sulphate as SO4 (2:1)	g/l	< 0.01	MCERTS	0.23				
Total Sulphur	mg/kg	< 200	NONE	375				
Ammonium as NH_4	mg/kg	< 0.5	NONE	22.9				
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	20				
Water Soluble Nitrate (2:1) as NO_3	mg/kg	< 3	MCERTS	< 3				
W/S Magnesium	mg/l	< 0.1	NONE	8.8				

Analytical results are expressed on a dry weight basis where samples are dried at less than $30^{O}C$
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 15-32093	
Chelmer Site Investigation Laboratories Ltd	
Site Reference: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	
Project / Job Ref: CGL5338	
Order No: 4518	
Reporting Date: 11/06/2015	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 151443	63254	1	1.00	19.1	Brown clay
$ 151444	63255	1	2.00	12.9	Brown clay with stones
$ 151445	63260	2	3.00	19.4	Grey clay
$ 151446	63263	3	1.00	19.3	Grey clay
$ 151447	63266	3	4.50	24.8	Grey clay
$ 151448	63268	3	15.00	10	Light brown gravelly clay with stones
$ 151449	63269	4	1.50	21.4	Grey clay
$ 151450	63274	4	10.00	20.2	Grey clay
$ 151451	63278	5	4.00	20.3	Grey clay
$ 151452	63280	6	1.50	11.8	Light brown clay with stones
$ 151453	63285	6	15.00	25.1	Grey clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample I/S

Unsuitable Sample U/S

$ samples exceeded recommended holding times

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
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Lenham Heath
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Tel : 01622 850410

4480

Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 15-32093
Chelmer Site Investigation Laboratories Ltd
Site Reference: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH
Project / Job Ref: CGL5338
Order No: 4518
Reporting Date: 11/06/2015

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

8284

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Where our involvement consists exclusively of testing samples, the results and comments (if provided) relate only to the samples tested.

Any samples that are deemed to be subject to deviation will be recorded as such within the test summary.

Mark Collyer
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QTS Environmental Report No: 15-32653

Site Reference:	Union Park, 1 - 8 Packet Boat Lane, Uxbridge, UB8 2GH
Project / Job Ref:	CGL5338-C
Order No:	4604
Sample Receipt Date:	22/06/2015
Sample Scheduled Date:	22/06/2015
Report Issue Number:	2
Reporting Date:	09/07/2015

Authorised by:

Russell Jarvis
Director
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Director
On behalf of QTS Environmental Ltd

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mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING 4480

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

QTS Environmental Report No: 15-32653	**Date Sampled**	09/06/15	
Chelmer Site Investigation Laboratories Ltd	**Time Sampled**	None Supplied	
Site Reference: Union Park, 1 - 8 Packet Boat Lane, Uxbridge, UB8 2GH	**TP / BH No**	63751	
Project / Job Ref: CGL5338-C	**Additional Refs**	BH6	
Order No: 4604	**Depth (m)**	1.00	
Reporting Date: 09/07/2015	**QTSE Sample No**	153985	

Determinand	**Unit**	**MDL**		**Landfill Waste Acceptance Criteria Limits**		
				Inert Waste Landfill	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
TOC[MU]	%	< 0.1	0.8	3%	5%	6%
Loss on Ignition	%	< 0.01	1.80	--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05	6	--	--
Sum of PCBs	mg/kg	< 0.7	< 0.7	1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10	500	--	--
Total PAH[MU]	mg/kg	< 1.7	< 1.7	100	--	--
pH[MU]	pH Units	N/a	9.1	--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	2	--	To be evaluated	To be evaluated

Eluate Analysis	**2:1 mg/l**	**8:1 mg/l**		**Cumulative 10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic[U]	< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]	0.06	0.02		0.3	20	100	300
Cadmium[U]	< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]	0.020	< 0.005		< 0.20	0.5	10	70
Copper[U]	< 0.01	< 0.01		< 0.5	2	50	100
Mercury[U]	< 0.005	< 0.005		< 0.01	0.01	0.2	2
Molybdenum[U]	0.053	0.009		0.1	0.5	10	30
Nickel[U]	< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]	< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]	< 0.005	< 0.005		< 0.06	0.06	0.7	5
Selenium[U]	0.006	< 0.005		< 0.1	0.1	0.5	7
Zinc[U]	< 0.005	< 0.005		< 0.2	4	50	200
Chloride[U]	11	2		29	800	15000	25000
Fluoride[U]	0.5	< 0.5		< 1	10	150	500
Sulphate[U]	126	33		414	1000	20000	50000
TDS	190	217		2145	4000	60000	100000
Phenol Index	< 0.01	< 0.01		< 0.5	1	-	-
DOC	8.7	4		44.4	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.22						
Dry Matter (%)	80.9						
Moisture (%)	23.8						
Stage 1							
Volume Eluate L2 (litres)	0.31						
Filtered Eluate VE1 (litres)	0.16						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING 4480

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

QTS Environmental Report No: 15-32653	**Date Sampled**	09/06/15	
Chelmer Site Investigation Laboratories Ltd	**Time Sampled**	None Supplied	
Site Reference: Union Park, 1 - 8 Packet Boat Lane, Uxbridge, UB8 2GH	**TP / BH No**	63752	
Project / Job Ref: CGL5338-C	**Additional Refs**	BH2	
Order No: 4604	**Depth (m)**	1.00	
Reporting Date: 09/07/2015	**QTSE Sample No**	153986	

Determinand	**Unit**	**MDL**		**Landfill Waste Acceptance Criteria Limits**		
				Inert Waste Landfill	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
TOC[MU]	%	< 0.1	1.4	3%	5%	6%
Loss on Ignition	%	< 0.01	2.90	--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05	6	--	--
Sum of PCBs	mg/kg	< 0.7	< 0.7	1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10	500	--	--
Total PAH[MU]	mg/kg	< 1.7	< 1.7	100	--	--
pH[MU]	pH Units	N/a	8.3	--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	< 1	--	To be evaluated	To be evaluated

Eluate Analysis	**2:1 mg/l**	**8:1 mg/l**		**Cumulative 10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic[U]	< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]	0.03	< 0.02		0.1	20	100	300
Cadmium[U]	< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]	0.006	< 0.005		< 0.20	0.5	10	70
Copper[U]	< 0.01	< 0.01		< 0.5	2	50	100
Mercury[U]	< 0.005	< 0.005		< 0.01	0.01	0.2	2
Molybdenum[U]	0.003	0.003		< 0.1	0.5	10	30
Nickel[U]	< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]	< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]	< 0.005	< 0.005		< 0.06	0.06	0.7	5
Selenium[U]	< 0.005	< 0.005		< 0.1	0.1	0.5	7
Zinc[U]	< 0.005	< 0.005		< 0.2	4	50	200
Chloride[U]	5	1		15	800	15000	25000
Fluoride[U]	0.8	< 0.5		< 1	10	150	500
Sulphate[U]	53	9		115	1000	20000	50000
TDS	125	209		2037	4000	60000	100000
Phenol Index	< 0.01	< 0.01		< 0.5	1	-	-
DOC	3.3	3.1		31.1	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.23						
Dry Matter (%)	77.3						
Moisture (%)	29.4						
Stage 1							
Volume Eluate L2 (litres)	0.30						
Filtered Eluate VE1 (litres)	0.11						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 15-32653	
Chelmer Site Investigation Laboratories Ltd	
Site Reference: Union Park, 1 - 8 Packet Boat Lane, Uxbridge, UB8 2GH	
Project / Job Ref: CGL5338-C	
Order No: 4604	
Reporting Date: 09/07/2015	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 153985	63751	BH6	1.00	19.1	Light brown clay
$ 153986	63752	BH2	1.00	22.7	Brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample I/S

Unsuitable Sample U/S

$ samples exceeded recommended holding times

QTS Environmental Ltd
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Soil Analysis Certificate - Methodology & Miscellaneous Information
QTS Environmental Report No: 15-32653
Chelmer Site Investigation Laboratories Ltd
Site Reference: Union Park, 1 - 8 Packet Boat Lane, Uxbridge, UB8 2GH
Project / Job Ref: CGL5338-C
Order No: 4604
Reporting Date: 09/07/2015

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Groundwater/Ground Gas Monitoring Results Sheet

Site Ref: 5338
Site Name: Union Park

Well	Date	Methane Peak	Methane Steady	Methane GSV	Carbon Dioxide Peak	Carbon Dioxide Steady	Carbon Dioxide GSV	Oxygen	Atmos.	Flow	Response Zone	Depth to Water	CO	H2S
		%v/v	%v/v	l/hr	%v/v	%v/v	l/hr	%v/v	mbar	l/hr	m bgl	m bgl	ppm	ppm
BH1	26/05/2015	0.1	0.1	0.0001	0.1	0.1	0.0001	20.5	1021	0.1	1.00-10.00	5.92	0	0
	05/06/2015	0.1	0.1	0.0002	0.1	0.1	0.0002	20.2	1013	0.2		5.90	11	0
BH4	26/05/2015	0.1	0.1	0.0001	0.1	0.1	0.0001	20.3	1021	0.1	1.00-10.00	3.22	3	0
	05/06/2015	0.1	0.1	0.0002	0.1	0.1	0.0002	19.7	1012	0.2		3.20	0	0
BH6	26/05/2015	0.1	0.1	0.0001	0.2	0.2	0.0002	19.5	1021	0.1	1.00-10.00	1.28	11	0
	05/06/2015	0.1	0.1	0.0002	0.5	0.5	0.0010	14.1	1012	0.2		2.80	14	1

Notes

NR = Not recorded
Values in Bold exceed the CO_2 Building Regulations threshold (>1.5%)
Values in Red exceed the Buildings Regulations Action Level (CO_2 >5.0% and CH_4 >1.5%)

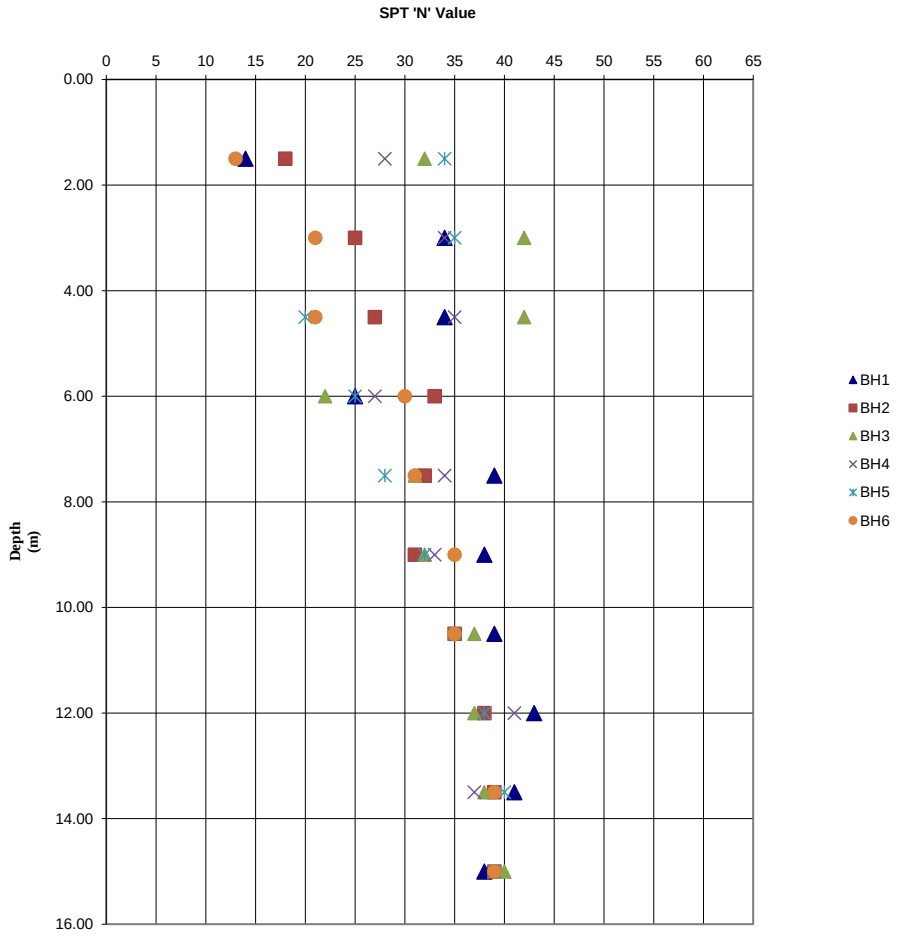
CHELMER SITE INVESTIGATIONS	Penetration Test versus Depth Profile	Unit 15, East Hanningfield Industrial Estate, Old Church Road, East Hanningfield, Essex CM3 8AB Tel - (01245 400930) Fax - (01245 400933)

Project Name :	Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	Job No. :	GEO 5338
		Date :	July 2015

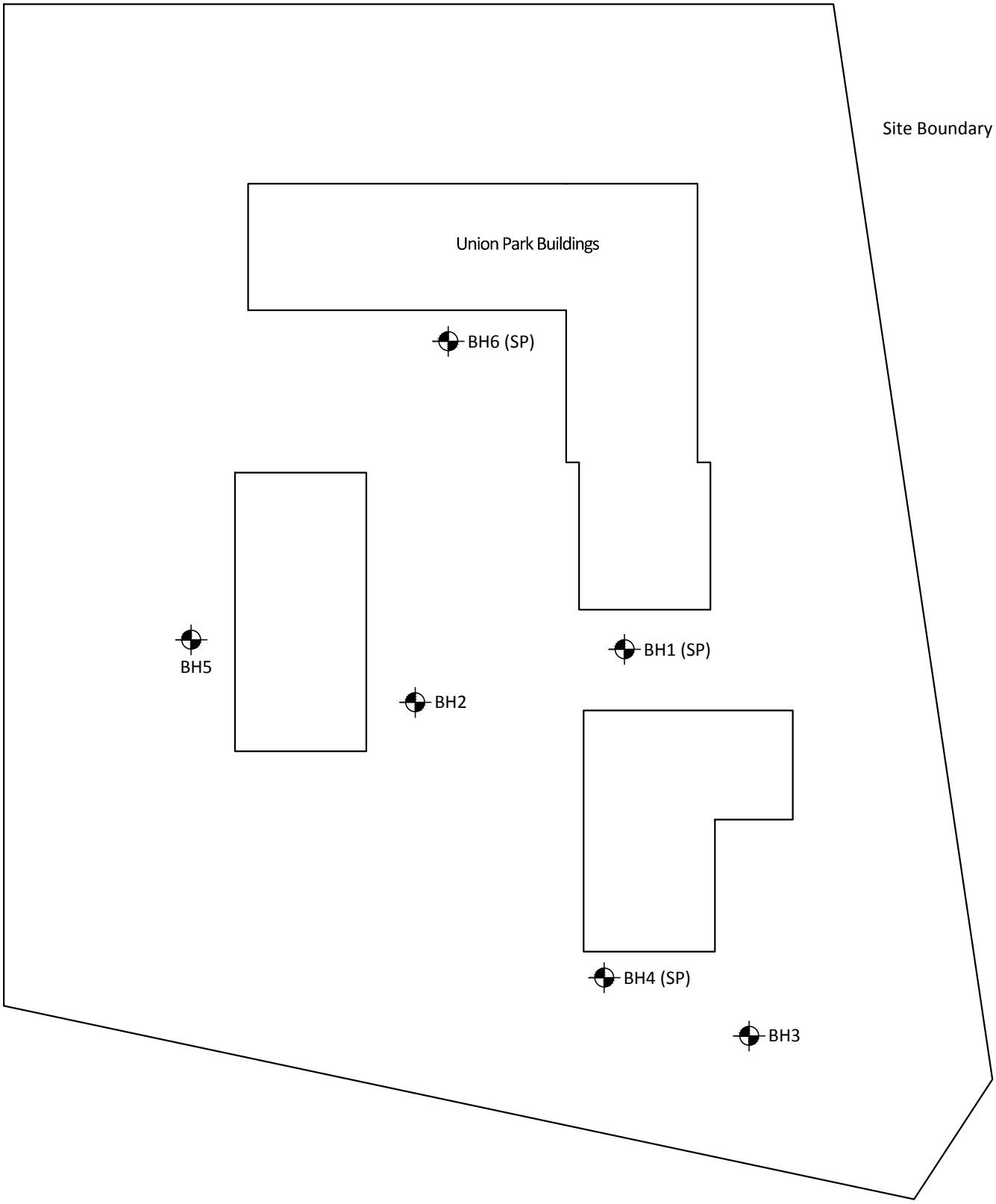
BH1		BH2		BH3	
Depth (m)	CPT/SPT 'N' value	Depth (m)	CPT/SPT N' value	Depth (m)	CPT/SPT N' value
1.50	14	1.50	18	1.50	32
3.00	34	3.00	25	3.00	42
4.50	34	4.50	27	4.50	42
6.00	25	6.00	33	6.00	22
7.50	39	7.50	32	7.50	31
9.00	38	9.00	31	9.00	32
10.50	39	10.50	35	10.50	37
12.00	43	12.00	38	12.00	37
13.50	41	13.50	39	13.50	38
15.00	38	15.00	39	15.00	40

BH4		BH5		BH6	
1.50	28	1.50	34	1.50	13
3.00	34	3.00	35	3.00	21
4.50	35	4.50	20	4.50	21
6.00	27	6.00	25	6.00	30
7.50	34	7.50	28	7.50	31
9.00	33	9.00	32	9.00	35
10.50	35	10.50	35	10.50	35
12.00	38	12.00	38		
13.50	37	13.50	40	13.50	39
12.00	41	15.00	39	15.00	39

NB : 'N' values greater than 50 reported as 50 above



Client: Union Park, 1-8 Packet Boat Lane, Uxbridge, UB8 2GH	**Scale:** N.T.S.	**Sheet:** 1 of 1	**Date:** 09.06.15	
Location: London Green Ltd	**Job No:** 5338	**Weather:** Overcast	**Drawn by: JH**	**Checked by: ME**



Notes: *On site tree identification for guidance only. Not authenticated.*

Key:

Tree/Shrub | Borehole | Trial Pit | G Gully | Tree Stump | Rain Water/ Soil Pipe | MH Manhole