

London Borough of Hillingdon

Bellmore Allotments, Burns Close

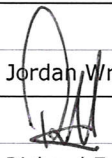
Geoenvironmental and Geotechnical Assessment



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Bellmore Allotments, Burns Close

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1 INTRODUCTION

1.1.1 Tweedie Evans Consulting Ltd (TEC) has been appointed by Baily Garner LLP on behalf of London Borough of Hillingdon to undertake a geoenvironmental and geotechnical assessment of Bellmore Allotments, Burns Close. All works were undertaken in accordance with our proposal letter dated 29th January 2018 and referenced RE.1712003/1712004/1712005 (Rev A).

1.1.2 Subsequent to the issue of the report in April 2018, the proposed site layout has been amended and therefore this report has been up-dated accordingly.

1.1 Background

1.1.1 The site is located off Burns Close, to the east of Hayes End within the London Borough of Hillingdon. The site covers an area of approximately 1.2 hectares, with the centre situated at approximate National Grid Reference 510190, 182000. The nearest postcode is UB4 0EJ (Figure 1).

1.1.2 The site comprises a rectangular parcel of land lain primarily to rough grass. A number of mature and semi mature trees were recorded along the northern boundary of the site, while large shrubs and fencing were observed along the remaining boundaries. It should be noted that the new layout includes additional land to the south where additional parking and soft landscaping are proposed, which is excluded from this study.

1.1.3 The proposed development is understood to comprise the construction of a number of low rise, ie up to 3 storeys in height, residential properties, with associated soft landscaping (both public amenity areas and private gardens) and hard infrastructure (Figure 2).

1.1.4 A Preliminary Geoenvironmental and Geotechnical Assessment of the site was prepared by TEC in April 2018, as detailed within the following report:

- TEC – Preliminary Geoenvironmental and Geotechnical Assessment, Bellmore Allotments, Burns Close, Hayes. Prepared for London Borough of Hillingdon. Document reference 1712003.001.01.

1.1.5 This phase of assessment involved the development of an outline conceptual site model, based upon desk study research and a reconnaissance survey.

1.1.6 Potentially contaminative land uses were identified on and in proximity to the site including allotments gardens and a number of electrical substations.

1.1.7 Based upon the conceptual understanding of the site and the proposed site end use, the main potential Significant Pollutant Linkage was considered to be as follows:

- Human Health (future site users and construction workers) – potential exposure to contaminants potentially present within the underlying ground materials associated with the development history of the site through the ingestion, inhalation and dermal pathways;

1.1.8 Given the assessment provided within the report, additional works were recommended to fully define the potential geoenvironmental and geotechnical issues associated with the site.

1.1.9 Therefore, the aim of this phase of works it to provide information on the geoenvironmental constraints and considerations associated with the site is relation

to the proposed development, to enable refinement of the risk assessment undertaken within the preliminary geoenvironmental and geotechnical assessment report and provide additional information of engineering considerations and constraints associated within the proposed development.

1.2 Scope of Works

1.2.1 The scope of work undertaken as part of this report is presented below:

- Generic Quantitative Risk Assessment. This phase of assessment involves refinement of the site conceptual model developed as part of the Preliminary Risk Assessment based on the findings of an intrusive investigation. Generic assessment criteria and assumptions, if appropriate, are used to evaluate potentially unacceptable risks. Should unacceptable risks be identified, a feasible remediation options appraisal is provided and/or a Detailed Quantitative Risk Assessment is recommended. The purpose of the Detailed Quantitative Risk Assessment is to further refine the conceptual model and use more detailed site specific information and criteria to determine whether there are unacceptable risks.
- Preliminary Geotechnical Assessment. General recommendations regarding likely engineering abnormalities are provided based on the findings of an intrusive investigation, together with preliminary foundation design recommendations for the proposed development.

1.2.2 The above scope of work has been undertaken in accordance with current guidance such as CLR 11 'Model Procedures for the Management of Land Contamination' (Environment Agency, 2004), BS10175+A2 (2017) and, where appropriate NHBC and Eurocode 7.

1.2.3 The report is presented in the following format.

- Generic Quantitative Risk Assessment:

Section 2 - Desk Study Information

Section 3 - Intrusive Investigation

Section 4 - Encountered Ground Conditions

Section 5 - Contamination Characterisation

Section 6 - Refined Conceptual Model

- Preliminary Geotechnical Assessment:

Section 7 - Ground Engineering

Section 8 - Conclusions and Recommendations

2 DESK STUDY INFORMATION

- 2.1.1 A review of salient information from the previous available desk study phases of assessment undertaken for the site are summarised below in Table 2.1. Reference should be made to the report for full details.

Table 2.1 Desk Study – Site Setting and Environmental Data

Site History	Earliest available mapping (1868) indicates the site has remained undeveloped. A water feature (later recorded as 'drain') is depicted along the north-eastern boundary of the site flowing in a roughly north-east/south-east orientation. From 1961, a number of tracks are depicted on site and is recorded to be located within a wider Allotment Garden.
Surrounding Land Use	The site is bound to the north by mature and semi-mature trees; and to the east, south and west by fencing and housing. Identified potentially contaminative current and historic processes in proximity to the site include nearby allotment gardens and a number of electrical sub-stations.
Geology and Hydrogeology	The published geology for the site is shown on British Geological Survey (BGS) Sheet No. 255 (Beaconsfield) as the London Clay Formation within the Thames Group, described by the BGS as poorly laminated blue-grey and grey-brown, slightly calcareous, silty to very silty clay, clayey silt, with some layers of sandy clay. The London Clay Formation is designated by the Environment Agency as Unproductive Strata. There are no recorded licensed groundwater abstraction points within 250m of the site and no Source Protection Zones within 500m of the site.
Hydrology	The nearest surface water feature is the Yeading Brook located approximately 185m north-east of the site. It is anticipated that any hydraulic gradient will follow in a typically north-east direction towards the nearby Yeading Brook.
Ground Gas	The reported natural geology of the London Clay Formation is not considered likely to provide a significant potential source of ground gas generation at the site. Notwithstanding this, made ground if present, may provide a potential source of ground gas generation subject to thickness and composition. The site area is reported to be located within a lower probability radon affected area as less than 1% of homes are above the Action Level. Therefore, it is reported that no radon protection measures are necessary in the construction of new dwellings or extensions.
Overall Environmental Setting	Based on the above environmental and site setting – the overall environmental setting of the site is considered to be low.

3 INTRUSIVE INVESTIGATION**3.1 Background**

3.1.1 The ground investigation was undertaken in general accordance with the scope of investigation outlined by Tully De'Ath Consultants, as detailed within the document titled 'Specification for Site Investigation – Bellmore Allotment, Hayes' dated 30 November 2018. It should be noted that the new layout includes additional land to the south where further parking and soft landscaping are proposed. This area was not included within the Tully De'Ath Consultants scope of investigation and was not assessed as part of the current phase of works.

3.1.2 The stated aim of the investigation was to advise on the contamination potential of the site and include recommendations for further testing or remediation strategy if necessary as well as providing an interpretative geological and engineering report to allow a foundation and retaining wall design to be developed.

3.1.3 All site works were undertaken in accordance with BS5930:2015, BS10175+A2 (2017) and, where appropriate, Eurocode 7. Works were supervised by a suitably experienced geoenvironmental consultant from TEC.

3.2 Methodology

3.2.1 The intrusive investigation was undertaken between 13th and 15th February 2018 and comprised the advancement of 2No. cable percussive boreholes to c.15m depth, 8No. dynamic sample boreholes to a maximum depth of 5.0mbgl and 5No. trial pits to a maximum depth of 4.0mbgl within the approximate locations outlined by Tully De'Ath within the specification for site investigation.

3.2.2 Exploratory hole locations are presented in Figure 3 and the reasoning behind each investigation location is given in Table 3.1, as follows:

Table 3.1: Exploratory Hole Rationale

Location	Location Rationale
BH01 and BH02	- Description and classification of underlying ground materials; - Sampling of deeper natural ground materials for geotechnical laboratory testing; and - In situ testing of the deeper natural materials.
WS01 to WS08	- Description and classification of underlying materials; - Sampling of shallow ground materials for chemical and geotechnical laboratory testing; and - In-situ testing of the underlying natural materials.
TP01 to TP05	- Description and classification of underlying materials; and - Sampling of shallow ground materials for chemical and geotechnical laboratory testing.

3.2.3 A detailed description of encountered ground conditions is shown on exploratory hole logs presented in Appendix C.

3.3 Field Testing

- 3.3.1 Standard Penetration Testing (SPT) was carried out at standard intervals within cable percussive and dynamic sample boreholes to allow an indicative strength profile of the underlying materials to be obtained.
- 3.3.2 Hand shear vane (HSV) and pocket penetrometer (PP) testing was carried out on encountered cohesive deposits to provide preliminary strength values of the underlying natural materials.
- 3.3.3 2No. in situ California Bearing Ratio (CBR) tests were undertaken by a specialist geotechnical contractor (K4 Soils) to assist with preliminary pavement and road design Appendix F.

3.4 Chemical Testing

- 3.4.1 Laboratory testing was scheduled on the basis of field observations.
- 3.4.2 Representative soil samples were collected and chemically tested at i2 Analytical, a UKAS/MCERTS accredited laboratory, for a selection of the following parameters:

Soils (Totals)

- *Heavy metals and metalloids;*
- *Total Organic Carbon (TOC);*
- *Phenols (monohydric);*
- *Total Cyanide;*
- *Sulphate, sulphide, elemental sulphur and pH;*
- *Speciated Polyaromatic Hydrocarbons (PAH);*
- *Total Petroleum Hydrocarbons (TPH-CWG); and*
- *Asbestos Screen.*

- 3.4.3 Geochemical certificates of analysis are presented Appendix D.

3.5 Geotechnical Testing

- 3.5.1 As outlined in the Tully de'Ath specification, selected soil samples were submitted for geotechnical analysis at K4 Soils. Laboratory testing was scheduled upon the basis of field observations for a selection of the following:
- *Moisture content;*
 - *Atterberg Limits;*
 - *Quick Undrained Triaxial (Multi-stage) tests; and*
 - *Oedometer Consolidation.*

- 3.5.2 Soil geotechnical certificates of analysis are presented in Appendix E.

3.6 General Sampling

- 3.6.1 Soil samples were collected directly into pre-labelled sample containers. During the course of the sampling care was taken to minimise head space of the sample

containers. Once filled sample containers were placed within cool boxes containing ice packs to maintain as cool a temperature as possible, nominally 4°C.

- 3.6.2 Samples were collected by courier for delivery to the selected laboratories. All samples were accompanied by detailed chain of custody sheets.

4 ENCOUNTERED GROUND CONDITIONS**4.1 Introduction**

4.1.1 A summary of encountered ground conditions for the site is provided below.

4.1.2 Detailed descriptions of encountered ground conditions are shown on exploratory hole logs presented in Appendix C. Photographs of the materials encountered are presented within Appendix A.

Made Ground

4.1.3 Made ground materials were encountered within all exploratory locations across the site to depths of between 0.3mbgl and 0.9mbgl, although typically <0.5mbgl. The encountered materials were generally observed to comprise dark brown gravelly sandy clay with gravel of red brick, black carbonaceous material, fabric fragments, ceramic tile, glass, clinker, tarmacadam and chert with frequent fine rootlets throughout.

Natural Ground

4.1.4 The underlying natural ground materials were encountered from a depth of 0.2mbgl (TP02) and were generally observed to comprise superficial deposits underlain by the London Clay Formation.

4.1.5 Superficial deposits were encountered within all exploratory locations to maximum observed depths of between 1.8mbgl (TP05) and >4.0mbgl (TP01) and was generally recorded to comprise soft to firm grey mottled orange-brown gravelly sandy clay with gravel of subangular chert. This was often observed to be interbedded with orange-brown and brown clayey sandy fine to coarse gravel of angular to subrounded chert across the site area at depths of between 1.0mbgl and 3.3mbgl.

4.1.6 The underlying London Clay Formation was observed from depths of 1.8mbgl and was generally recorded to comprise firm to stiff grey and blue-grey mottled brown sandy gravelly clay, with rare angular tabular cobbles of claystone to a maximum observed depth of 7.1mbgl. This was observed to be underlain by stiff grey-brown sandy gravelly clay, with gravel of subangular to subrounded lithorelicts of stiff brown clay.

4.1.7 Occasional fine selenite crystals were observed throughout the London Clay materials.

4.2 Generalised Ground Profile

4.2.1 The general ground profile encountered at the site is summarised in Table 4.1 below.

Table 4.1: Generalised Ground Profile

Depth (mbgl)	Encountered Material
0.0 – 0.2 / 0.9	Made Ground: dark brown gravelly sandy clay with gravel of red brick, black carbonaceous material, fabric fragments, ceramic tile, glass, clinker, tarmacadam and chert. Frequent fine rootlets throughout.
0.2 / 0.9 – 1.0 / 4.0	Superficial Deposits: Soft to firm grey mottled orange-brown gravelly sandy clay with gravel of subangular chert.
1.0 / 3.0 – 1.5 / 3.3	Orange-brown and brown clayey sandy fine to coarse gravel of angular to subrounded chert. Sand is coarse.

Depth (mbgl)	Encountered Material
1.5 / 4.7 – 2.5 / 7.1	London Clay Formation: Firm to stiff grey and blue-grey mottled brown slightly gravelly sandy gravelly clay. Gravel of subrounded chert and rare angular tabular cobbles of medium strong claystone. Occasional fine selenite throughout. Stiff grey-brown sandy gravelly clay. Gravel of subangular to subrounded lithorelicts of stiff brown clay and weak angular claystone. Occasional fine selenite throughout.
2.5 / 7.1 – 3.9 / 15.0	

4.3 Groundwater and Perched Water

- 4.3.1 A single perched water strike was encountered within BH01 at a depth of 0.2mbgl. Groundwater strikes encountered during the site works are shown on the exploratory hole logs in Appendix C and summarised in Table 4.2 below.

Table 4.2: Groundwater Strikes

Location	Date	Groundwater Strike (mbgl)	Strata
TP01	14/02/2018	3.0	Superficial Deposits
TP02	14/02/2018	2.7	Superficial Deposits
TP03	14/02/2018	2.2	Superficial Deposits
TP04	14/02/2018	1.0	Superficial Deposits
WS02	13/02/2018	2.5	Superficial Deposits
WS03	13/02/2018	2.4	Superficial Deposits
WS04	13/02/2018	3.0	Superficial Deposits

- 4.3.2 A number of groundwater strikes were recorded within the granular materials of the superficial deposits at depths of between 1.0mbgl and 3.0mbgl.

4.4 Contamination Summary

- 4.4.1 No visual or olfactory evidence of potential gross contamination was observed during the intrusive works.

5 CONTAMINATION CHARACTERISATION**5.1 Legislation**

5.1.1 Contaminated Land is defined in Part IIA of the Environmental Protection Act (1990) as:

5.1.2 “Any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reasons of substances in, on or under the land that:

- Significant harm is being caused or there is a significant possibility of such harm being caused;

or

- *significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused.”

**Section 86 of the Water Act 2003 amends section 78A of Environmental Protection Act 1990 for Controlled Waters.*

5.2 Generic Quantitative Risk AssessmentHuman Health Screening

5.2.1 Current legislation and guidance on the assessment of contaminated land promotes a tiered risk approach (CLR 11). The generic quantitative risk assessment comprises a screening of identified contaminants against generic guideline values that are appropriate to the site setting and the receptors concerned. For risks to human health the basis for these generic guideline values are the methodologies set out by the Environment Agency’s Contaminated Land Exposure Assessment (CLEA) guidelines.

5.2.2 The following regulatory and industry guidance has been utilised for the selection of Generic Assessment Criteria utilised as part of the GQRA. The order of the guidance listed is in terms of hierarchy for selection of GACs (where the land uses and parameters are considered most applicable).

1. *Category 4 Screen Levels (C4SLs) – DEFRA (2014)*
2. *Soil Guidance Values (SGVs) – Environment Agency (2009)*
3. *Suitable for Use Levels (S4ULs) – LQM/CIEH (2015)*
4. *EIC/AGS/CL:AIRE GAC (2009)*

5.2.3 The C4SLs for arsenic, cadmium, chromium (VI) and lead have been utilised as part of the GQRA. Benzene and benzo(a)pyrene C4SLs have not been utilised as part of the Tier 1 screening as they are based upon 6% soil organic matter (SOM) as opposed to 1% SOM utilised by LQM/CIEH (2015).

5.2.4 SGVs have been utilised, where appropriate, for dioxins, furans and dioxin-like PCBs; nickel; inorganic mercury and selenium (residential SGV used for proposed residential end use). SGVs for organic compounds are not utilised as they are derived using a 6% soil organic matter as opposed to 1% SOM utilised by LQM/CIEH (2015).

5.2.5 In the absence of a published UK derived GAC for cyanide, the GQRA for total cyanide is based upon comparison of recorded values against the Dutch Intervention Value for free cyanide (VROM 2000).

5.2.6 S4ULs and EIC/AGS/CL:AIRE GACs are adopted for the remaining potential contaminants using the hierarchy noted above.

5.2.7 The purpose of the site investigation was to provide information to establish the suitability of the site for a residential development. Therefore, the standard land use for the site, for use in the generic assessment, has been defined as “*Residential with homegrown produce*” in accordance with current guidance.

Ground Gas Screening

5.2.8 An initial qualitative risk screening assessment based upon the methodology for characterising gassing sites detailed within the following documents has been undertaken:

- CIRIA Report C665 (2007) ‘*Assessing risks posed by hazardous ground gases to buildings (revised)*’;
- NHBC (March 2007) ‘*Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present*’;
- BS8485:2015 ‘*Code of Practice for the characterisation and remediation from ground gas in affected developments*’;
- BS8576:2013 ‘*Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)*’; and
- Wilson S., Card C. and Haines S. (2009) ‘*Ground Gas Handbook*’.

5.2.9 The objectives of the screening assessment are to provide a general characterisation of the ground materials within the site based on the investigation works undertaken to-date. This information is used to provide a preliminary assessment of gassing potential for the materials encountered at the site. This, together with ground gas data collected as part of the monitoring undertaken to-date, is used to provide a qualitative conceptual model of identified risk in relation to the proposed development.

5.3 Soil Analysis - Human Health

5.3.1 Soil samples were collected and analysed from made ground materials. Certificates of analysis for samples are contained within Appendix D.

5.3.2 Current regulatory guidance for the statistical assessment of environmental data within a contaminated land context is detailed within the CIEH and CL:AIRE joint publication titled ‘*Guidance on Comparing Soil Concentration Data with a Critical Concentration*’ (2008). However, as judgemental sampling has been undertaken, statistical assessment as detailed in CL:AIRE (2008) has not been carried out as part of this assessment. Therefore, to identify Contaminants of Potential Concern (COPC) as part of this preliminary assessment, the analytical results for the ground materials sampled have been assessed by the screening of individual analyses against the relevant Tier 1 Site Screening Values (SSVs) adopted.

5.3.3 For generic assessment purposes, SSVs have been conservatively selected, where appropriate, based upon a sandy soil and Soil Organic Matter (SOM) of 1%.

Made Ground

5.3.4 8No. samples of made ground were scheduled for analysis from the site. The results obtained from made ground are summarised in Table 5.1 below:

Table 5.1: Soil Analysis Summary

Contaminant	Max (mg / kg)	Min (mg / kg)	SSV ¹ (mg / kg)	No. of Tests	No. of Exceedances
Arsenic	9.3	7.7	37 ⁽¹⁾	8	0
Boron	2.7	1.4	290 ⁽³⁾	8	0
Cadmium	1.2	<0.2	22 ⁽¹⁾	8	0
Chromium (total)	34	24	910 ⁽³⁾	8	0
Chromium (VI)	<1.2	<1.2	21 ⁽¹⁾	8	0
Copper	53	27	2400 ⁽³⁾	8	0
Lead	230	41	200 ⁽¹⁾	8	1
Mercury	<0.3	<0.3	170 ⁽²⁾	8	0
Nickel	25	19	130 ⁽²⁾	8	0
Selenium	<1.0	<1.0	350 ⁽²⁾	8	0
Zinc	180	84	3700 ⁽³⁾	8	0
Beryllium	1.1	0.85	1.7 ⁽³⁾	8	0
Vanadium	39	34	410 ⁽³⁾	8	0
Barium	190	86	1300 ⁽⁴⁾	8	0
Cyanide (Total)	<1	<1	20 ⁽⁵⁾	8	0
Total Phenol (Monohydric)	<1	<1	120 ⁽³⁾	8	0
Water Soluble Sulphate (SO ₄) – g/l	0.055	0.0094	-	8	-
Total Sulphate (SO ₄)	1100	550	-	4	-
Sulphide	2.0	<1.0	-	8	-
pH	7.7	6.7	-	8	-
Naphthalene	<0.05	<0.05	2.3 ⁽³⁾	8	0
Acenaphthylene	<0.05	<0.05	170 ⁽³⁾	8	0
Acenaphthene	<0.05	<0.05	210 ⁽³⁾	8	0
Fluorene	<0.05	<0.05	170 ⁽³⁾	8	0
Phenanthrene	0.54	0.21	95 ⁽³⁾	8	0
Anthracene	<0.05	<0.05	2400 ⁽³⁾	8	0
Fluoranthene	2.0	0.3	280 ⁽³⁾	8	0
Pyrene	1.6	0.25	620 ⁽³⁾	8	0
Benzo(a)anthracene	1.3	0.17	7.2 ⁽³⁾	8	0
Chrysene	1.1	0.14	15 ⁽³⁾	8	0
Benzo(b)fluoranthene	1.6	<0.05	2.6 ⁽³⁾	8	0
Benzo(k)fluoranthene	1.0	<0.05	77 ⁽³⁾	8	0
Benzo(a)pyrene	1.5	<0.05	2.2 ⁽³⁾	8	0
Indeno(1,2,3-cd)pyrene	0.73	<0.05	27 ⁽³⁾	8	0
Dibenz(a,h)anthracene	<0.05	<0.05	0.24 ⁽³⁾	8	0
Benzo(g,h,i)perylene	0.9	<0.05	320 ⁽³⁾	8	0
Total PAH	11.6	0.86	-	8	-
Benzene	<1.0	<1.0	0.087 ⁽³⁾	4	0
Toluene	<1.0	<1.0	130 ⁽³⁾	4	0
Ethylbenzene	<1.0	<1.0	47 ⁽³⁾	4	0
p & m-xylene	<1.0	<1.0	56 ⁽³⁾	4	0
o-xylene	<1.0	<1.0	60 ⁽³⁾	4	0
MTBE	<1.0	<1.0	49 ⁽⁴⁾	4	0
TPH Aliphatic C5-C6	<0.001	<0.001	42 ⁽³⁾	4	0
TPH Aliphatic C6-C8	<0.001	<0.001	100 ⁽³⁾	4	0
TPH Aliphatic C8-C10	<0.001	<0.001	27 ⁽³⁾	4	0
TPH Aliphatic C10-C12	<1.0	<1.0	130 ⁽³⁾	4	0
TPH Aliphatic C12-C16	<2.0	<2.0	1100 ⁽³⁾	4	0

Contaminant	Max (mg / kg)	Min (mg / kg)	SSV ¹ (mg / kg)	No. of Tests	No. of Exceedances
TPH Aliphatic C16-C21	<8.0	<8.0	65000 ⁽³⁾	4	0
TPH Aliphatic C21-C35	<8.0	<8.0	65000 ⁽³⁾	4	0
TPH Aromatic C5-C7	<0.001	<0.001	70 ⁽³⁾	4	0
TPH Aromatic C7-C8	<0.001	<0.001	130 ⁽³⁾	4	0
TPH Aromatic C8-C10	<0.001	<0.001	34 ⁽³⁾	4	0
TPH Aromatic C10-C12	<1.0	<1.0	74 ⁽³⁾	4	0
TPH Aromatic C12-C16	<2.0	<2.0	140 ⁽³⁾	4	0
TPH Aromatic C16-C21	<10	<10	260 ⁽³⁾	4	0
TPH Aromatic C21-C35	<10	<10	1100 ⁽³⁾	4	0
TPH (C10-C40)	<10	<10	-	4	-

Notes:

- 1 DEFRA C4SLs (2014) based on "Residential with homegrown produce" end use
- 2 Environment Agency SGVs (2009) based on "Residential" end use
- 3 LQM/CIEH S4ULs (2015) based on "Residential with homegrown produce" end use
- 4 CL:AIRE, AGS & EIS (2009) based on "Residential" end use
- 5 Dutch Intervention Value for free cyanide (VROM 2000)

5.3.5 Laboratory analysis recorded a single exceedance of lead when considering a residential site end use, as detailed below:

- WS08 at 0.2m (230mg/kg).

5.3.6 An asbestos screen undertaken on all sampled made ground materials recorded asbestos as 'not-detected'.

5.4 Ground Gas

5.4.1 In accordance with the guidance presented within the CL:AIRE Research Bulletin RB17 (2012) and BS8485:2015, bulk ground gas monitoring has not been undertaken as part of this assessment as;

- No significant thickness of made ground was encountered at the site (maximum of 0.9mbgl). Made ground materials were observed to be of generally low degradable content with recorded TOCs between 1.7% and 3.0%.
- No potential source of significant ground gas generation has been identified within proximity of the site; and
- Given the generally cohesive nature of the underlying ground materials, significant lateral migration of ground gas is considered unlikely and no credible pathway has been identified based on the conceptual understanding of the site.

6 REFINED CONCEPTUAL MODEL**6.1 Introduction**

- 6.1.1 The Preliminary Risk Assessment undertaken as part of this report identified the presence of potential significant pollutant linkages associated with the site and surrounds. Therefore, in accordance with the approach recommended in CLR11, additional information was collected about the site and its surroundings as part of a Generic Quantitative Risk Assessment. Based upon this additional information, the site conceptual model has been refined and pollutant linkages confirmed for evaluation where considered necessary.

6.2 Hazard Identification

- 6.2.1 Potential sources of contamination have been identified on and within the vicinity of the site and are presented in Table 6.1.

Table 6.1: Identified Hazards

Identified Hazard / Source	Location	Details
Made Ground	On site	Made ground was encountered across the site to a maximum observed depth of 0.9mbgl. While no visual or olfactory evidence of potential gross contamination was recorded during the investigation, laboratory analysis of representative made ground materials recorded a single exceedance of the SSV limit for human health for lead (WS08). The encountered made ground materials is not considered to comprise a significant source of ground gas generation.
Potentially contaminative land uses	On and off site	Potentially contaminative current and historic processes (allotment gardens and electrical sub-stations) have been identified in close proximity to site. Notwithstanding this, laboratory test results and visual/ olfactory observations made during the intrusive investigation suggest no potential on-site contaminant migration from identified sources.

6.3 Identified Potential Receptors and Pathways

- 6.3.1 Potential receptors identified as part of the generic risk assessment are:
- Current/future site users;
 - Construction workers; and
 - Controlled waters (surface waters - Yeading Brook).
- 6.3.2 Potential contaminant pathways relating to the identified receptors and contaminants of concern include:
- Dermal contact – contact with soil, dust or water;

- Ingestion - ingestion of soil, dust or water;
- Inhalation – inhalation of soil, dust or vapours;
- Vertical migration – e.g. seepage of contaminants at the ground surface (i.e. leakage/spillage of hydrocarbons) through cracks in hardstanding and/or leaching of contaminants within the unsaturated zone resulting in vertical contaminant migration; and
- Horizontal migration – e.g. lateral migration of contaminants within the saturated zone and along preferential pathways such as drainage pipe bedding.

6.4 Hazard Assessment and Risk Estimation

- 6.4.1 Potential significant pollutant linkages identified as part of this preliminary risk assessment are summarised in the Outline Site Conceptual Model presented in Table 6.2. References to risk estimations are made in accordance with the methodology presented in CIRIA publication C552 (2001) titled '*Contaminated Land Risk Assessment: A Guide to Good Practice*' and summarised in Appendix B.

Table 6.2: Refined Conceptual Model (Hazard Assessment and Risk Estimation)

Identified Hazard / Source	Identified Receptor	Potential Pathway to Receptors	Associated Hazard	Scale of Impact	Potential Consequence of Source-Receptor Linkage	Potential Likelihood for Significant Source-Receptor Linkage	Risk Classification
Made Ground – Lead	Construction workers and current site end users	Exposure to potential contaminants through ingestion, inhalation and dermal contact.	Risk of harm to human health.	Local	Medium	Low Likelihood: A single exceedance of lead has been recorded within the made ground when considering a residential site end use. Therefore, where made ground remains in areas of proposed soft landscaping, after finished site levels have been achieved within this localised area, exposure to potential contaminants by future site end users cannot be discounted. The recorded concentrations of determinands within the made ground are considered unlikely to pose an acute risk to construction workers provided appropriate brownfield working practices are adopted.	Low to Moderate Risk
	Controlled waters	Leaching of potential contaminants through the saturated zone and subsequent vertical and horizontal migration to controlled water sources.	Risk of harm to controlled waters (Yeading Brook).	Local to Regional	Medium	Unlikely: The contaminant identified within the made ground is not considered to be of a concentration or nature to be significantly mobile in an aqueous environment.	Low Risk
	Future site end users and proposed development	Ingress, accumulation and inhalation of ground gasses.	Risk of harm to human health and proposed structures.	Local	Medium to Severe	Unlikely: The made ground is considered unlikely to act as a significant source of ground gas based upon the recorded thickness and observed composition.	Low Risk
Potentially Contaminative Current and Historic Processes – on and off site	Current and future site users	Exposure to potential contamination through ingestion, inhalation and dermal contact.	Risk to human health and controlled waters on site	Local	Medium	Unlikely: While a number of potentially contaminative current and historic process have been recorded in close proximity to the site, no visual or olfactory evidence of potentially significant contamination was observed within the ground materials encountered at the site. In addition, no elevated total contaminant concentrations were recorded in samples tested.	Low Risk

7 GROUND ENGINEERING**7.1 Proposed Development**

7.1.1 The proposed development is understood to comprise the construction of a number of low rise, ie up to 3 storeys in height, residential properties, with associated soft landscaping and hard infrastructure.

7.1.2 Information provided within the Tully De'Ath 'specification for site investigation' indicates that it is proposed to utilise traditional strip and pad footings within the proposed development and line loads of approximately 150kN/m run are anticipated. It is assumed that is applicable following the changes to the site layout included in this revision of the report.

Site Preparation

7.1.3 A number of semi-mature and mature trees were observed along the northern boundary of the site and within the east and south-east of the site. Consideration to these features should be taken into account within the proposed development.

7.2 Ground Conditions

7.2.1 The general ground profile encountered at the site is summarised in Table 7.1 below.

Table 7.1: Generalised Ground Profile

Depth (mbgl)	Encountered Material
0.0 – 0.2 / 0.9	Made Ground: dark brown gravelly sandy clay with gravel of red brick, black carbonaceous material, fabric fragments, ceramic tile, glass, clinker, tarmacadam and chert. Frequent fine rootlets throughout.
0.2 / 0.9 – 1.0 / 4.0	Superficial Deposits: Soft to firm grey mottled orange-brown gravelly sandy clay with gravel of subangular chert.
1.0 / 3.0 – 1.5 / 3.3	Orange-brown and brown clayey sandy fine to coarse gravel of angular to subrounded chert. Sand is coarse.
1.5 / 4.7 – 2.5 / 7.1	London Clay Formation: Firm to stiff grey and blue-grey mottled brown slightly gravelly sandy gravelly clay. Gravel of subrounded chert and rare angular tabular cobbles of medium strong claystone. Occasional fine selenite throughout.
2.5 / 7.1 – 3.9 / 15.0	Stiff grey-brown sandy gravelly clay. Gravel of subangular to subrounded lithorelicts of stiff brown clay and weak angular claystone. Occasional fine selenite throughout.

Made Ground

7.2.2 No geotechnical testing was undertaken on samples of the made ground. However, as a part of the geochemical testing undertaken for the site, pH and sulphate testing was undertaken on samples of encountered made ground. The test data indicated sulphate concentrations in the range of 0.0094g/l to 0.055g/l and pH values of 6.7 to 7.7.

Natural Strata

- 7.2.3 Geotechnical test results are discussed below. Geotechnical laboratory test certificates are provided in Appendix E with in situ tests being presented on the exploratory hole logs in Appendix C.
- 7.2.4 Laboratory analysis was undertaken on 14No. samples of the superficial deposits and underlying London Clay Formation (natural strata). The results of these analyses are presented in Table 7.2 below.

Table 7.2: Summary of Test Results - Natural Strata

Test	Number of Tests	Range of Results
Plasticity Index (%)		
<i>Superficial Deposits</i>	3	19 – 23
<i>London Clay Formation</i>	5	48 - 51
Moisture Content (%)		
<i>Superficial Deposits</i>	3	21 – 23
<i>London Clay Formation</i>	5	24 - 30
% passing 425µm sieve		
<i>Superficial Deposits</i>	3	35 – 99
<i>London Clay Formation</i>	5	97 - 100
SPT 'N' Values		
<i>Superficial Deposits</i>	22	5 - 14
<i>London Clay Formation</i>	34	8 - 32
Undrained Shear Strength – (kN/m ²)		
<i>Superficial Deposits</i>	1	43
<i>London Clay Formation</i>	3	84 - 145
Coefficient of compressibility - m_v (m ² /MN)		
<i>Superficial Deposits</i>	1	0.43
<i>London Clay Formation</i>	3	0.11 – 0.16
pH		
<i>Superficial Deposits</i>	4	6.4 – 7.6
<i>London Clay Formation</i>	2	7.3 – 8.2
Water Soluble Sulphate (g/l)		
<i>Superficial Deposits</i>	4	0.031 – 0.085
<i>London Clay Formation</i>	2	0.091 – 0.37
Total Sulphate (%)		
<i>Superficial Deposits</i>	4	0.025 – 0.056
<i>London Clay Formation</i>	2	0.046 – 0.083

Test	Number of Tests	Range of Results
Total Sulphur (%)		
<i>Superficial Deposits</i>	4	0.009 – 0.019
<i>London Clay Formation</i>	2	0.019 – 0.379

- 7.2.5 Plasticity Indices of the encountered superficial deposits ranged between 19% and 23%, corresponding to Modified Plasticity Indices of between 8% (WS08 at 2.0mbgl) and 23% (WS01 at 1.5mbgl), suggesting these materials to be non-plastic to Medium Volume Change Potential as defined by the NHBC (2018) and indicative of their variability.
- 7.2.6 Plasticity Indices of the underlying London Clay Formation were recorded between 48% and 51%, corresponding to Modified Plasticity Indices of between 47% (WS05 at 2.4mbgl) and 51% (BH01 at 4.5mbgl, BH01 at 8.0mbgl, BH02 at 6.0mbgl and BH02 at 10.0mbgl), suggesting materials are of High Volume Change Potential (NHBC, 2018).
- 7.2.7 Standard Penetration Testing (SPT) within the superficial deposits recorded 'N' values of between 5 and 14 suggesting the materials are soft becoming firm in consistency where cohesive in nature.
- 7.2.8 Hand shear vane (HSV) testing on this material recorded undrained shear strengths of between 15kPa and 150kPa, while pocket penetrometer (PP) testing recorded unconfined compressive strengths of between 1.0kg/cm² and 3.75kg/cm², indicating the underlying superficial deposits to be variable in strength with low to high strengths being recorded.
- 7.2.9 A single quick undrained triaxial test undertaken on a disturbed sample of the encountered cohesive superficial deposits recorded a strength of 43kN/m², which is noted to be generally within the range recorded with in situ testing within that material. Based upon the available data, it is suggested that a characteristic strength for the superficial deposits of 50kN/m² is considered to be appropriate.
- 7.2.10 SPT's undertaken within the underlying London Clay Formation recorded 'N' values of between 8 and 32, suggesting the encountered materials are generally firm becoming stiff with depth.
- 7.2.11 Quick undrained triaxial tests were undertaken on three undisturbed samples of the underlying London Clay at depths of 3.0mbgl, 6.5mbgl and 12.5mbgl. The results indicate undrained strengths of between 84kN/m² and 145kN/m².
- 7.2.12 The hand shear vane testing is noted to be relatively consistent with both the laboratory undrained triaxial and correlated strengths based on the SPT data (Stroud 1988) and suggest the cohesive materials to be of medium to high strength becoming high strength below approximately 3.0mbgl. Based upon the available data, it is suggested that a characteristic strength for the London Clay may be given by:
- Undrained strength, $c_u = 25 + 8.75z$ - where z is depth in metres
- 7.2.13 Standard correlations with the SPT data, e.g. Stroud (1988), suggests the underlying superficial deposits to be of medium compressibility, with a coefficient of compressibility, m_v , of between 0.13m²/MN and 0.3m²/MN given and it is considered that a characteristic coefficient of compressibility of 0.2m²/MN may be appropriate for design. Notwithstanding this, a single oedometer test undertaken on the encountered

superficial deposits recorded coefficient of compressibility of $0.43\text{m}^2/\text{MN}$ at a pressure of 100kPa, suggesting the material to be of high compressibility.

- 7.2.14 Within the underlying London Clay, based on standard correlations, the encountered materials are generally considered to be of low to medium compressibility with a coefficient of compressibility, m_v , of between $0.27\text{m}^2/\text{MN}$ and $0.07\text{m}^2/\text{MN}$ recorded.
- 7.2.15 Oedometer testing within the underlying London Clay at depths of 3.0mbgl, 4.0mbgl and 5.0mbgl recorded a coefficient of compressibility of between $0.11\text{m}^2/\text{MN}$ and $0.16\text{m}^2/\text{MN}$, at a pressure of 100kPa, suggesting the materials to be of medium compressibility.
- 7.2.16 In situ CBR testing was undertaken at 2No locations within the upper materials of the site. CBR values of between 3.0% (CBR2) and 3.7% (CBR1) were recorded.
- 7.2.17 The geotechnical testing included the analysis for water soluble sulphate and pH testing within the natural ground. The results indicate sulphate concentrations of between 0.031g/l and 0.085g/l within the superficial deposits and 0.091g/l and 0.37g/l within the London Clay and pH values of between 6.4 and 7.6 within the superficial deposits and 7.3 and 8.2 within the London Clay. In addition, given the identified presence of selenite crystals within the underlying London Clay, all chemical analysis within the natural ground included testing for total sulphate and total sulphur. Within the superficial deposits, total sulphate was recorded between 0.025% and 0.056% and total sulphur was recorded between 0.009% and 0.019%, while in the London Clay, total sulphate was recorded between 0.046% and 0.083% and total sulphur was recorded between 0.019% and 0.379%.

7.3 Foundations

Ground Conditions

- 7.3.1 Made ground was recorded across the site to a maximum recorded depth of 0.9mbgl. This was recorded to be underlain by superficial deposits soft to firm grey mottled orange-brown gravelly sandy clay with gravel of subangular chert. This was often observed to be interbedded with orange-brown and brown clayey sandy fine to coarse gravel of angular to subrounded chert across the site area at depths of between 1.0mbgl and 3.3mbgl.
- 7.3.2 The London Clay Formation was observed from depths of 1.8mbgl and was generally observed to comprise firm to stiff grey and blue-grey mottled brown sandy gravelly clay, with rare angular tabular cobbles of claystone to a maximum observed depth of 7.1mbgl. This was observed to be underlain by stiff grey-brown sandy gravelly clay, with gravel of subangular to subrounded lithorelicts of stiff brown clay.
- 7.3.3 Occasional fine selenite crystals were observed throughout the London Clay materials.
- 7.3.4 Perched water was recorded within a single location at a depth of 0.2mbgl, while minor groundwater ingress was recorded within a number of locations at depths of between 1.0mbgl and 3.0mbgl and was generally noted to be associated with the granular superficial deposits.

Preliminary Foundation Design Recommendations

- 7.3.5 On the basis of these field observations of ground conditions encountered and the potential loads associated with the proposed development, it is considered that conventional foundations may not be suitable for loads proposed within the Tully De'Ath 'specification for site investigation'.

- 7.3.6 It is considered that a piled solution may be most appropriate for the proposed development and it is suggested that a specialist piling contractor should be consulted regarding the piling options and detailed design of the most appropriate option. However, it is considered likely that CFA piles would be most suitable at the site.
- 7.3.7 Consequently, based on the available information and for *budget purposes only*, when utilising a single CFA pile, an estimated resistance of approximately 300kN can be derived for a 300mm diameter pile in excess of 10m. It should be noted that where pile groups are utilised, depending on the pile spacing, there may be the need to deepen and/or widen the piles to achieve the same resistance per pile.
- 7.3.8 Given the recorded medium volume change of the near surface deposits, a minimum void of 25mm against the side and 100mm below ground beams would be recommended.

7.4 Ground Floor Slabs

- 7.4.1 As a result of the anticipated foundation depth/type, the use of suspended floors are considered appropriate. The underlying superficial ground materials were recorded as medium volume change potential and it is suggested that a minimum void of 100mm should be utilised below suspended in situ concrete flooring where incorporated in the design. Where pre-cast concrete suspended floors are used a minimum void space of 250mm should be utilised to allow for 150mm of ventilation.

7.5 Preliminary Pavement Design

- 7.5.1 4No. in situ CBR tests (CBR1 at 0.5mbgl, CBR1 at 0.75mbgl, CBR2 at 0.5mbgl and CBR 2 at 0.75mbgl) within the approximate locations outlined within the Tully De'Ath specification.
- 7.5.2 CBR values of between 3.0% (CBR2 at 0.5mbgl) and 3.7% (CBR1 at 0.75mbgl) were recorded.
- 7.5.3 In addition, based on correlations with plasticity indices using the Design Manual for Roads and Bridges IAN 73/06 Revision 1 (2009) and observations made on site during the intrusive works, a CBR value of 4% to 5% may be considered appropriate for the encountered shallow natural ground materials.
- 7.5.4 Based on the CBR data collected to date, an estimated CBR value of 3% is suggested for preliminary design purposes at likely formation depth where within the natural ground.
- 7.5.5 Where formation depth is within made ground a CBR of <2.5% should be assumed due to the likely material variability.
- 7.5.6 It should be noted that all road formations should be proof rolled and soft spots removed and replaced with selected granular fill and, where adoptable, a pavement of sufficient thickness to prevent the penetration of frost should be employed.

7.6 Excavations

- 7.6.1 Excavations at the site for conventional foundations may be achievable using conventional equipment without the use of breakers.
- 7.6.2 Given the presence of groundwater within underlying superficial deposits within a number of locations, there may be a requirement for localised dewatering during the excavation works.

7.7 Protection of Buried Concrete

- 7.7.1 The results of the water-soluble sulphate content and pH testing carried out on the samples of the made ground and superficial deposits indicate that in accordance with BRE Special Digest 1 (2005), the underlying encountered materials generally yield an Aggressive Chemical Environment for Concrete (ACEC) of AC-1 requiring a Design Sulphate Class of DS-1m while the London Clay Formation would generally yield an ACEC of between AC-1 and AC-3, requiring a Design Sulphate Class of DS-3.
- 7.7.2 However, the test data would suggest the presence of pyrite within the underlying London Clay Formation based upon the average concentrations of oxidisable sulphides present. Therefore, where concrete is to be exposed to disturbed ground within the London Clay a higher design sulphate class will be required. Given the range of oxidisable sulphides within the encountered natural ground materials (maximum 1.054%) DS-4 would be required for an ACEC of AC-5, which should be utilised where concrete is to be exposed to disturbed ground.

8 CONCLUSIONS & RECOMMENDATIONS**8.1 Conclusions**

- 8.1.1 Tweedie Evans Consulting Ltd (TEC) has been appointed by Baily Garner LLP on behalf of London Borough of Hillingdon to undertake a geoenvironmental and geotechnical assessment of Bellmore Allotments, Burns Close. All works were undertaken in accordance with our proposal letter dated 29th January 2018 and referenced RE.1712003/1712004/1712005 (Rev A).
- 8.1.2 Subsequent to the issue of the report in April 2018, the proposed site layout has been amended and therefore this report has been up-dated accordingly. It should be noted that the new layout includes additional land to the south where further parking and soft landscaping are proposed, which is excluded from the scope of this study.
- 8.1.3 The site is located off Burns Close, to the east of Hayes End within the London Borough of Hillingdon. The site covers an area of approximately 1.2 hectares, with the centre situated at approximate National Grid Reference 510190, 182000. The nearest postcode is UB4 0EJ (Figure 1).
- 8.1.4 The site comprises a rectangular parcel of land lain primarily to rough grass. A number of mature and semi mature trees were recorded along the northern boundary of the site, while large shrubs and fencing were observed along the remaining boundaries.
- 8.1.5 The proposed development is understood to comprise the construction of a number of low rise, ie up to 3 storeys in height, residential properties, with associated soft landscaping (both public amenity areas and private gardens) and hard infrastructure (Figure 2).
- 8.1.6 A Preliminary Geoenvironmental and Geotechnical Assessment of the site was prepared by TEC in April 2018 and was up-dated in January 2019 following changes to the proposed site layout, as detailed within the following report:
- TEC – Preliminary Geoenvironmental and Geotechnical Assessment, Bellmore Allotments, Burns Close, Hayes. Prepared for London Borough of Hillingdon. Document reference 1712003.001.01A.
- 8.1.7 The preliminary assessment recorded the presence of a number of potentially contaminative land uses within proximity of the site.
- 8.1.8 Notwithstanding this, the site was considered to be of low environmental sensitivity due primarily to the underlying materials being classed as Unproductive Strata, the site not being recorded within a Source Protection Zone (SPZ), and the absence of historic development within the site area.
- 8.1.9 Intrusive works undertaken by TEC recorded the presence of made ground materials to a maximum observed depth of 0.9mbgl. Notwithstanding this, no visual or olfactory evidence of potentially gross contamination was recorded during the works.
- 8.1.10 Laboratory analysis of representative made ground materials recorded the single exceedance of the tier 1 SSVs for a residential site end use for lead. No further elevated contaminant concentrations were recorded and asbestos was recorded as 'not detected' within all samples.
- 8.1.11 Based upon our current conceptual understanding of the site, the main potential Significant Pollutant Linkages identified are considered to be:

- Human health (including construction workers and future site end users) – localised exposure to lead through ingestion, inhalation and dermal contact pathways.

8.2 Geoenvironmental Risk Management Recommendations

Identification of Feasible Remediation Options

- 8.2.1 Significant risks identified within the conceptual model can be mitigated through the breaking of the significant pollution linkage by the removal of at least the source, receptor or pathway. Within reference to the site's conceptual models the following preliminary remediation approach has been prepared. This preliminary remediation approach will need to be presented in more detail within a Remediation Strategy, the content of which will require agreement in writing of the Regulatory Authorities prior to commencing any remediation on site.

Human Health

- 8.2.2 An elevated concentration of lead was recorded within the made ground sampled within a single location when considering the SSVs for a residential with homegrown produce end use.
- 8.2.3 Therefore, where soft landscaping is proposed and where made ground remains after finished site levels have been achieved, exposure to potential contaminants cannot be discounted.
- 8.2.4 Notwithstanding this, given the localised nature of the identified contamination and the limited made ground recorded on site (<0.9mbgl), site clearance and preparation works are likely to remove the bulk of the made ground on site. In addition, based upon the current proposed development layout, the identified contamination is located within the proposed building footprint of Plot B, which would also mitigate against the potential risks to site end users from the identified contamination within the made ground.
- 8.2.5 Therefore, additional testing would be recommended following site preparation works to potentially refine the remedial requirements for any such areas of soft landscaping at the site given the localised nature of the identified contamination.
- 8.2.6 Given the presence of general made ground together with elevated contaminant concentrations within the made ground encountered, good brownfield site working practices should be adopted by construction workers to mitigate against identified potential risks.
- 8.2.7 Should water pipes be placed within the made ground on site, due consideration should be given to the UK Water Industry Research Ltd (UKWIR) guidance.

8.3 Ground Engineering

Ground Conditions

- 8.3.1 Made ground was recorded across the site to a maximum recorded depth of 0.9mbgl. This was recorded to be underlain by superficial deposits soft to firm grey mottled orange-brown gravelly sandy clay with gravel of subangular chert. This was often observed to be interbedded with orange-brown and brown clayey sandy fine to coarse gravel of angular to subrounded chert across the site area at depths of between 1.0mbgl and 3.3mbgl.

- 8.3.2 The London Clay Formation was observed from depths of 1.8mbgl and was generally observed to comprise firm to stiff grey and blue-grey mottled brown sandy gravelly clay, with rare angular tabular cobbles of claystone to a maximum observed depth of 7.1mbgl. This was observed to be underlain by stiff grey-brown sandy gravelly clay, with gravel of subangular to subrounded lithorelicts of stiff brown clay.
- 8.3.3 Occasional fine selenite crystals were observed throughout the London Clay materials.
- 8.3.4 Perched water was recorded within a single location at a depth of 0.2mbgl, while minor groundwater ingress was recorded within a number of locations at depths of between 1.0mbgl and 3.0mbgl and was generally noted to be associated with the granular superficial deposits.

Preliminary Foundation Design Recommendations

- 8.3.5 On the basis of these field observations of ground conditions encountered and the potential loads associated with the proposed development, it is considered that conventional foundations may not be suitable for use within the development.
- 8.3.6 It is considered that a piled solution may be most appropriate for the proposed development loads and it is suggested that a specialist piling contractor should be consulted regarding the piling options and detailed design of the most appropriate option. However, it is considered likely that CFA piles would be most suitable at the site.
- 8.3.7 Consequently, based on the available information and for *budget purposes only*, when utilising a single CFA pile, an estimated resistance of approximately 300kN can be derived for a 300mm diameter pile in excess of 10m. It should be noted that where pile groups are utilised, depending on the pile spacing, there may be the need to deepen and/or widen the piles to achieve the same resistance per pile.
- 8.3.8 Given the recorded medium volume change of the near surface deposits, a minimum void of 25mm against the side and 100mm below ground beams would be recommended.

Ground Floor Slabs

- 8.3.9 As a result of the anticipated foundation depth/type, the use of suspended floors are considered appropriate. The underlying superficial ground materials were recorded as medium volume change potential and it is suggested that a minimum void of 100mm should be utilised under ground beams or suspended in situ concrete flooring where incorporated in the design. Where pre-cast concrete suspended floors are used a minimum void space of 250mm should be utilised to allow for 150mm of ventilation.

Preliminary Pavement Design

- 8.3.10 Based on the CBR data collected to date, an estimated CBR value of 3% is suggested for preliminary design purposes at likely formation depth where within the natural ground.
- 8.3.11 Where formation depth is within made ground a CBR of <2.5% should be assumed due to the likely material variability.
- 8.3.12 It should be noted that all road formations should be proof rolled and soft spots removed and replaced with selected granular fill and, where adoptable, a pavement of sufficient thickness (>450mm) to prevent the penetration of frost should be employed.

Excavations

8.3.13 Excavations at the site for conventional foundations may be achievable using conventional equipment without the use of breakers.

8.3.14 Given the presence of groundwater within underlying superficial deposits within a number of locations, there may be a requirement for localised dewatering during the excavation works.

Protection of Buried Concrete

8.3.15 The results of the water-soluble sulphate content and pH testing carried out on the samples of the made ground and superficial deposits indicate that in accordance with BRE Special Digest 1 (2005), the underlying encountered materials generally yield an Aggressive Chemical Environment for Concrete (ACEC) of AC-1 requiring a Design Sulphate Class of DS-1m while the London Clay Formation would generally yield an ACEC of between AC-1 and AC-3, requiring a Design Sulphate Class of DS-3.

8.3.16 However, the test data would suggest the presence of pyrite within the underlying London Clay Formation based upon the average concentrations of oxidisable sulphides present. Therefore, where concrete is to be exposed to disturbed ground within the London Clay a higher design sulphate class will be required. Given the range of oxidisable sulphides within the encountered natural ground materials (maximum 1.054%) DS-4 would be required for an ACEC of AC-5, which should be utilised where concrete is to be exposed to disturbed ground.

8.4 Further Works

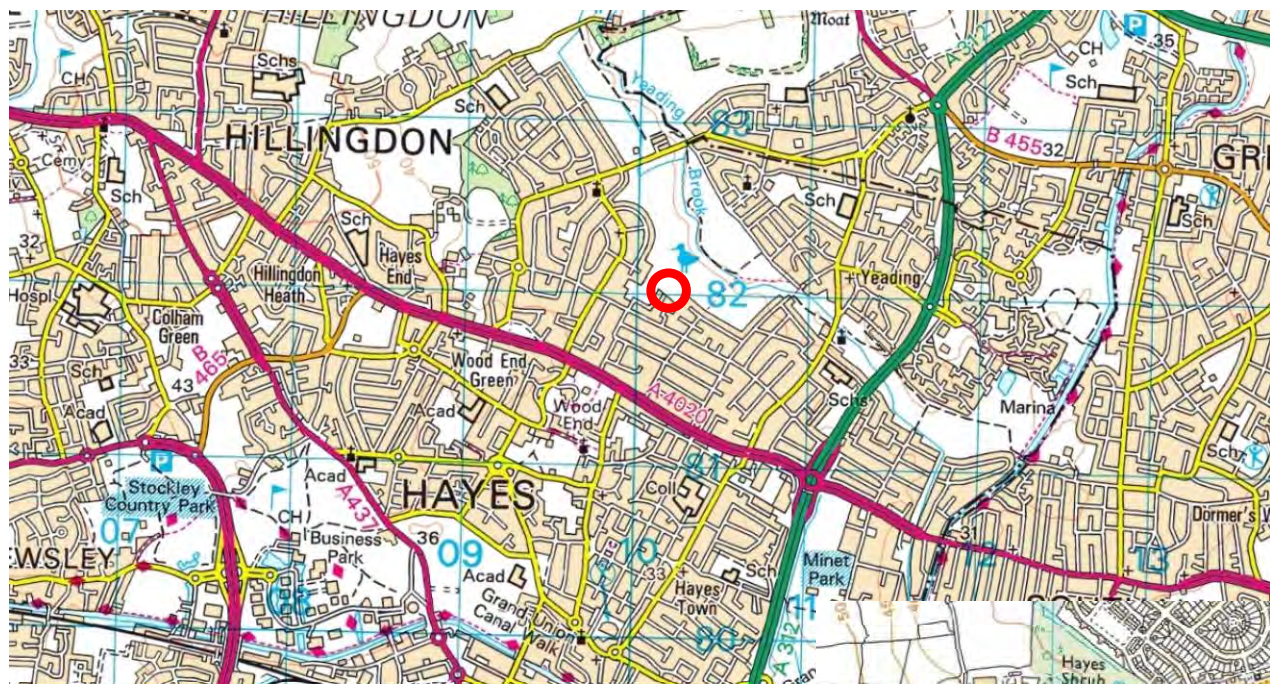
8.4.1 It should be noted that the new layout, as detailed on Figure 2, includes additional land to the south where further parking and soft landscaping are proposed. This area was not included within the Tully De'Ath Consultants scope of investigation and therefore has not been assessed as part of the current phase of works.

TWEEDIE EVANS CONSULTING LIMITED

BIBLIOGRAPHY

- British Geological Survey (BGS) Lexicon of rocks: www.bgs.ac.uk/lexicon.
- BRE Special Digest 1 (2005) Concrete in aggressive ground.
- BRE 414 (2001) Protective measures for housing on gas contaminated land.
- BSEN 1997-1 (2004) Eurocode 7. Geotechnical Design. General rules.
- BSEN 1997-2 (2007) Eurocode 7. Geotechnical Design. Ground investigation and testing.
- BSEN 22475 (2006) Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution.
- BSEN 22476-3 (2005) Geotechnical investigation and testing. Field testing. Standard penetration test.
- BS10175 British Standards Institute (2011+A2:2017) Investigation of Potentially Contaminated Land - Code of Practice.
- BS1377 British Standards Institute (1990) Methods of Test for Soils for Civil Engineer Purposes
- BS5930 British Standards Institute (2015) Code of Practice for Site Investigation.
- BS8485 British Standards Institute (2015) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- BS8576 British Standards Institute (2013) Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs).
- CIEH & CL:AIRE (2008) Guidance on Comparing Soil Contamination Data with a Critical Concentration.
- CIRIA Funders Reports CP7 (1993) The Standard Penetration Test (SPT): Methods and Use.
- CIRIA C552 (2001) Contaminated Land Risk Assessment: A Guide to Good Practice.
- CIRIA C733 (2014) Asbestos in soil and made ground: a guide to the understanding and management of risks.
- CL:AIRE, AGS & EIC (2009) The Soil Generic Assessment Criteria for Human Health Risk Assessment.
- DEFRA (2014) SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (March 2014).
- DEFRA and the Environment Agency (2004) Model Procedures for the Management of Land Contamination.
- Department for the Environment (1995/1996) DOE Industry Profiles.
- Environment Agency (2003) Review of the fate and transport of selected contaminants in the soil environment. Draft Technical Report P5-079/TR1. Bristol: Environment Agency.
- Environment Agency (2006) Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination.
- Environment Agency (2009) Soil Guideline Values.
- Environment Agency (2010) GPLC1: Guiding Principles for Land Contamination (March 2010).
- Environment Agency (2009) Updated technical background to the CLEA model. Science Report SC050021/SR3. Bristol: Environment Agency.
- Environment Agency (2009) CLEA Software (Version 1.05) Handbook. Science Report SC050021/SR4.
- Environment Agency (2015) CLEA Software Version 1.071.
- LQM & CIEH (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment.
- NHBC (2019) NHBC Standards.
- NHBC, Environment Agency & CIEH (2008) Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66.
- Norbury, D (2010) Soil and Rock Description in Engineering Practice, Whittles Publishing R&D Publication CLR11.
- Stroud (1988) The Standard Penetration Test – its application and interpretation. Proc. ICE Conference on Penetration Testing in the UK, Birmingham. Thomas Telford, London.
- Tomlinson, M.J. (2001) Foundation Design and Construction, 7th edition, Prentice Hall.
- Warren, G. (2007) Ground Engineering Technical Note; Vol. 40; No. 3; March 2007.
- Wilson, Card and Haines (2009) Ground Gas Handbook.

FIGURES



Approximate Site Location:



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Site Name: Bellmore Allotments,
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Drawing Name: Site Location Plan

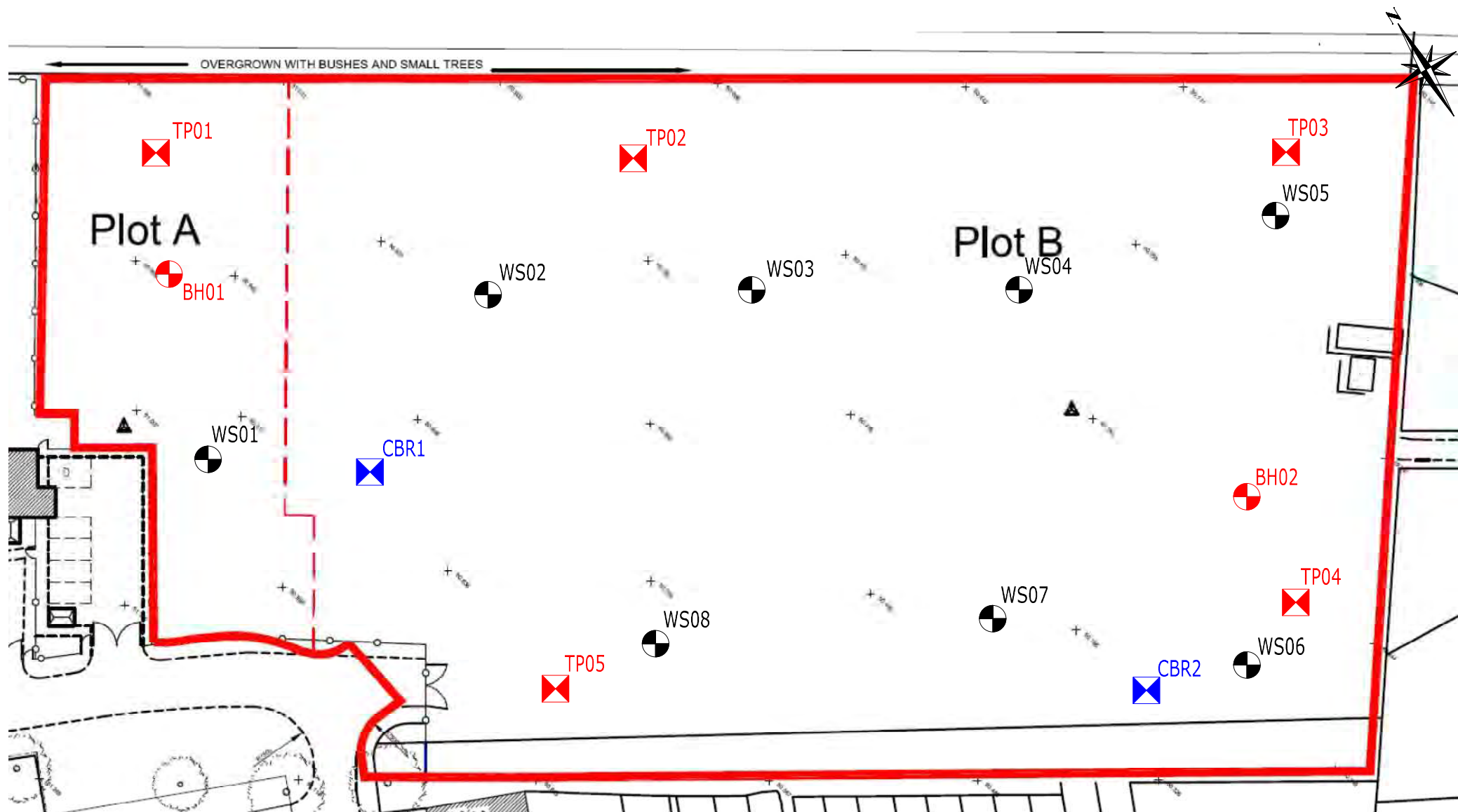
Client Name: London Borough of Hillingdon

Project No: 1712003

Figure No: 1

Date: April 2018

Scale: NTS



TEC Trial Pit Location:



TEC Cable Percussive Location:



TEC Dynamic Sample Location:



TEC In-Situ CBR Test Location:



Extract of Hillingdon Council Major Construction Projects
Drawing 'Bellmore Allotment Site - Existing Site Plan'
(Drawing No. 2011/D81/S/P/02).

APPENDIX A
Site Photographs



Photograph 1: Location of WS02.



Photograph 2: Materials encountered at WS02.



Photograph 3: Location of WS04.



Photograph 4: Materials encountered at WS04.



Photograph 5: Location of WS07.



Photograph 6: Materials encountered at WS07.



Photograph 7: Location of BH01.



Photograph 8: Location of TP01 and encountered materials.



Photograph 9: View of TP01.



Photograph 10: View of TP02.



Photograph 11: Location of TP02 and encountered materials.



Photograph 12: View of TP03.



Photograph 13: Location of TP03 and encountered materials.



Photograph 14: View of TP04.



Photograph 15: Location of TP04 and encountered materials.



Photograph 16: View of TP05.



Photograph 17: Location of TP05 and encountered materials.

APPENDIX B
Risk Evaluation

Risk Evaluation

The qualitative assessment methodology presented in Ciria publication C552 (2001) titled '*Contaminated Land Risk Assessment: A Guide to Good Practice*' has been used by TEC for the basis of evaluating potential risk.

The method requires an assessment of the:

- magnitude of the probability or likelihood of the risk occurring (Table 1); and
- magnitude of the potential consequence or severity of the risk occurring (Table 2)

Table 1. Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the short-term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 2. Classification of Consequence

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. (Note: Water Resources Act contains no scope for considering significance of pollution). Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organisation forming part of such ecosystem (note: the definitions of ecological systems within the draft circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to human health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources. (Note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem, (note: the definitions of ecological systems within draft circular on Contaminated Land, DETR, 2000).	Concentration of a contaminant from site exceeding the generic or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the draft circular on Contaminated Land, DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc), easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discolouration of concrete.

The combination of the two factors is determined using Table 3 and the resulting level of risk is described in Table 4. The evaluation can be applied to each of the scenarios identified in the risk model and the overall risk assessed.

Table 3. Combination of Consequence with Probability

		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

Table 4. Description of risks and likely action required

Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the long-term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Using the risk model the pollutant linkages are identified and a preliminary estimate of risk undertaken. If there is no pollutant linkage identified, then there is no risk. If the estimate of risk for all the linkages and exposure scenarios is very low at this stage then it is likely that no further assessment will be required.

APPENDIX C
Exploratory Hole Logs

CABLE PERCUSSIVE BOREHOLE RECORD	
Project Title: Bellmore Allotments, Burns Close	Borehole: BH01
Project No: 1712003.002	Dates: 14th February 2018
Client: London Borough of Hillingdon	



TWEEDIE EVANS CONSULTING

www.tecon.co.uk
info@tecon.co.uk

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.80	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material, fabric fragments, ceramic tile and chert. Frequent fine rootlets. Soft to firm low strength grey mottled orange-brown slightly gravelly sandy CLAY. Gravel of subangular chert.			0.8	(2) 2, 1, 1, 2	6	HSV at 0.8m - 15, 30, 20 PP at 0.8m - 1.0, 1.25, 1.0, 1.25, 1.0	
				1.0			HSV at 1.5m - 30, 35, 25 PP at 1.5m - 1.25, 1.5, 1.25, 1.0, 1.0	
			U	2.0	U100 in 45 blows			
3.30				3.0	(4) 2, 3, 3, 4	12	HSV at 3.3m - 75, 100, 100	
	Stiff high strength brown sandy CLAY. Occasional fine selenite throughout.		U	4.0	U100 in 78 blows		PP at 3.3m - 3.5, 3.5, 3.5, 3.5, 3.75	
				5.0	(7) 4, 4, 5, 4	17	HSV at 5.5m - 100, 137.5, 125 PP at 5.5m - 3.5, 3.75, 3.5, 3.5, 3.75	
			U	6.0	U100 in 100 blows			
7.10				7.0		21	HSV at 7.1m - 137.5, 137.5, 150 PP at 7.1m - 3.75, 4.25, 4.0, 4.25, 4.25	
	Stiff high strength grey-brown sandy gravelly CLAY. Gravel of subangular to subrounded lithorelicts of very stiff clay. Occasional fine selenite throughout. weak grey claystone from 11.3m to 11.5m.			8.0	(8) 5, 4, 6, 6	25	HSV at 9.5m - 137.5, 175, 137.5 PP at 9.5m - 4.5, 4.25, 4.5, 4.5, 4.5	
				9.0	(8) 5, 5, 7, 8			
			U	10.0	U100 in 100 blows		HSV at 11.5m - 137.5, 137.5, 150 PP at 11.5m - 3.5, 4.25, 4.0, 4.0, 4.0	
				11.0		26	HSV at 13.5m - 150, 162.5, 150 PP at 13.5m - 4.0, 4.0, 4.25, 4.0, 4.0	
				12.0	(8) 5, 5, 7, 9			
				13.0	(10) 7, 6, 7, 6	26	HSV at 15.0m - 137.5, 125, 150 PP at 15.0m - 4.0, 3.75, 4.5, 3.75, 4.5	
				14.0				
15.00				15.0	(10) 7, 7, 8, 9	31		
	Borehole Terminated							

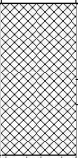
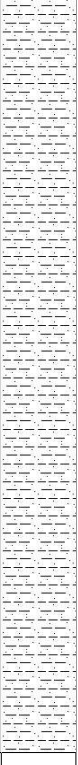
Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) B: Bulk Sample U: Undisturbed Sample SPT: Standard Penetration Test HSV: Hand Shear Vane	Plant: Dando 3000		
	Water observations: Perched water at 0.2mbgl.		
	General remarks: HSV units = kPa, PP units = kg/cm ²		
	Logged by: JW	Checked by: CH	Approved by: RE

CABLE PERCUSSIVE BOREHOLE RECORD		 TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: BH02	
Project No: 1712003.002	Dates: 15th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.90	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material and chert. Frequent fine rootlets.			1.0	(1, 0) 1, 1, 1, 2	5	HSV at 0.9m - 45, 50, 40 PP at 0.9m - 2.5, 2.25, 2.25, 2.75, 2.0	
2.50	Soft low to medium strength grey mottled orange-brown slightly gravelly sandy CLAY. Gravel of subangular chert.			2.0	(1, 1) 2, 1, 1, 2	6	HSV at 1.5m - 45, 50, 60 PP at 1.5m - 2.5, 2.5, 2.75, 2.75, 2.5	
	Firm to stiff high strength brown sandy CLAY. Occasional fine selenite throughout.		U	3.0	U100 in 70 blows		HSV at 2.5m - 87.5, 112.5, 100 PP at 2.5m - 3.5, 3.5, 3.25, 3.25, 3.0	
				4.0	(2, 3) 3, 3, 4, 3	13	HSV at 4.5m - 125, 100, 137.5 PP at 4.5m - 3.25, 3.75, 4.0, 3.75, 4.5	
			U	5.0	U100 in 100 blows			
6.50				6.0			HSV at 6.5m - 125, 112.5, 125 PP at 6.5m - 4.0, 3.75, 3.5, 4.0, 3.5	
	Stiff high strength grey-brown sandy gravelly CLAY. Gravel of subangular to subrounded lithorelicts of stiff clay. Occasional fine selenite throughout.		U	8.0	U100 in 100 blows		HSV at 8.5m - 100, 112.5, 125 PP at 8.5m - 3.75, 3.5, 3.75, 3.75, 3.0	
				9.0				
				10.0	(4, 4) 5, 5, 6, 8	24	HSV at 10.5m - 112.5, 137.5, 112.5 PP at 10.5m - 4.25, 3.75, 4.0, 4.0, 3.5	
				11.0	(4, 4) 5, 6, 6, 6	23		
				12.0			HSV at 12.5m - 137.5, 150, 150 PP at 12.5m - 4.0, 4.0, 3.75, 4.0, 3.5	
			U	13.0	U100 in 100 blows			
				14.0	(5, 5) 6, 6, 7, 7	26	HSV at 14.5m - 112.5, 112.5, 150 PP at 14.5m - 4.25, 4.0, 4.0, 4.25, 4.25	
15.00				15.0	(5, 5) 7, 8, 8, 9	32		
	Borehole Terminated							

Notes:		Plant: Dando 3000	
A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) B: Bulk Sample U: Undisturbed Sample SPT: Standard Penetration Test HSV: Hand Shear Vane		Water observations: No groundwater encountered.	
		General remarks: HSV units = kPa, PP units = kg/cm ²	
Logged by: JW		Checked by: CH	Approved by: RE

DYNAMIC SAMPLING RECORD		 TEC TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS01	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.60	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, tarmacadam, black carbonaceous material, clinker and chert. Frequent fine rootlets.		A					
	Soft low to medium strength grey and orange-brown slightly gravelly sandy CLAY. Gravel of subrounded chert.			1.0	(1, 1) 1, 1, 1, 2	5	HSV at 0.6m - 60, 70, 70 PP at 0.6m - 2.25, 2.0, 2.5, 2.75, 2.5	
			T				HSV at 1.5m - 25, 30, 40 PP at 1.5m - 1.75, 2.0, 2.0, 1.5, 1.75	
2.00	Firm to stiff medium to high strength grey mottled brown slightly gravelly sandy CLAY. Gravel of subrounded chert.			2.0	(1, 2) 2, 3, 3, 4	12	HSV at 2.0m - 75, 80, 85 PP at 2.0m - 3.0, 2.75, 3.0, 3.25, 3.25	
				3.0	(1, 2) 2, 3, 4, 4	13		
				4.0	(1, 2) 3, 3, 4, 4	14	HSV at 4.0m - 70, 85, 95 PP at 4.0m - 2.75, 3.0, 3.5, 3.5, 3.5	
5.00				5.0	(1, 2) 3, 4, 4, 4	15		
	Borehole Terminated							

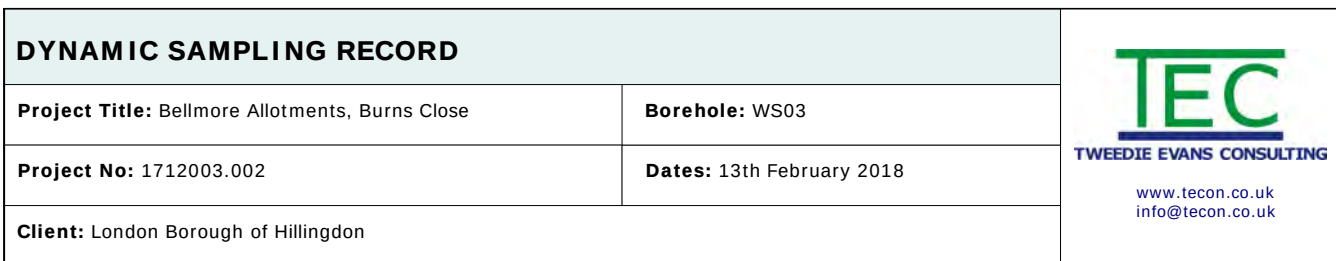
Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) SPT: Standard Penetration Test HSV: Hand Shear Vane (kPa) PP: Pocket Penetrometer (kg/cm2) PID: Photo-Ionisation Detector (ppm) B: Large disturbed sample	Plant:		
	Water observations: No groundwater encountered.		
	General remarks:		
	Logged by: JW	Checked by: CH	Approved by: RE

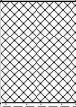
DYNAMIC SAMPLING RECORD		 TEC TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS02	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.30	MADE GROUND Dark brown gravelly sandy clay. Gravel of tarmacadam, black carbonaceous material, red brick, clinker and chert. Frequent fine rootlets. Soft to firm low to medium strength grey mottled orange-brown gravelly sandy CLAY. Gravel of subrounded chert.						HSV at 0.5m - 65, 70, 65 PP at 0.5m - 2.25, 2.0, 2.0, 2.0, 2.25 HSV at 1.5m - 30, 35, 25 PP at 1.5m - 2.0, 1.75, 1.75, 1.5, 1.75 HSV at 2.7m - 75, 85, 80 PP at 2.7m - 3.0, 3.0, 2.75, 3.25, 3.25 HSV at 4.0m - 90, 90, 80 PP at 4.0m - 3.5, 3.5, 3.25, 3.25, 3.5	
			T	1.0	(1, 1) 1, 2, 2, 2	7		
			A					
2.30				2.0	(1, 1) 2, 2, 3, 3	10		
	Orange-brown sandy clayey GRAVEL of angular chert.						HSV at 0.5m - 65, 70, 65 PP at 0.5m - 2.25, 2.0, 2.0, 2.0, 2.25 HSV at 1.5m - 30, 35, 25 PP at 1.5m - 2.0, 1.75, 1.75, 1.5, 1.75 HSV at 2.7m - 75, 85, 80 PP at 2.7m - 3.0, 3.0, 2.75, 3.25, 3.25 HSV at 4.0m - 90, 90, 80 PP at 4.0m - 3.5, 3.5, 3.25, 3.25, 3.5	
2.70								
	Firm high strength grey mottled brown sandy CLAY.			3.0	(1, 2) 2, 3, 3, 3	11		
				4.0	(2, 2) 3, 3, 3, 3	12		
5.00								
	Borehole Terminated			5.0	(2, 3) 3, 3, 3, 4	13		

Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) SPT: Standard Penetration Test HSV: Hand Shear Vane (kPa) PP: Pocket Penetrometer (kg/cm2) PID: Photo-Ionisation Detector (ppm) B: Large disturbed sample	Plant:		
	Water observations: Minor water seepage at 2.5mbgl.		
	General remarks:		
	Logged by: JW	Checked by: CH	Approved by: RE

DYNAMIC SAMPLING RECORD		 TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS03	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		



Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.40	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material, ceramic tile and chert. Frequent fine rootlets.			0.0				
	Soft to firm low to medium strength grey mottled orange-brown slightly gravelly sandy CLAY. Gravel of subangular chert.			1.0	(1, 0) 1, 1, 2, 2	6	HSV at 0.5m - 55, 60, 70 PP at 0.5m - 2.5, 2.25, 2.75, 2.5, 2.5	
	band of orange very gravelly very sandy clay from 2.4m to 2.6mbgl.			2.0	(1, 2) 3, 3, 4, 4	14	HSV at 1.5m - 40, 45, 45 PP at 1.5m - 1.5, 1.5, 1.25, 2.0, 1.25	
				3.0	(2, 2) 3, 3, 3, 3	12	HSV at 2.6m - 100, 100, 112.5 PP at 2.6m - 2.5, 3.25, 3.25, 3.25, 3.25	
3.50				3.50			HSV at 3.5m - 100, 112.5, 100 PP at 3.5m - 3.0, 3.5, 3.25, 3.75, 3.0	
	Stiff high strength grey mottled brown sandy CLAY.			4.0	(2, 2) 3, 4, 5, 5	17	HSV at 4.5m - 100, 87.5, 100 PP at 4.5m - 3.25, 2.75, 3.0, 3.25, 3.0	
5.00				5.0	(2, 3) 4, 4, 4, 5	17		
	Borehole Terminated							

Notes:

A:	250ml and 60ml Amber Glass Jars
T:	Plastic Tub (1Kg)
SPT:	Standard Penetration Test
HSV:	Hand Shear Vane (kPa)
PP:	Pocket Penetrometer (kg/cm ²)
PID:	Photo-Ionisation Detector (ppm)
B:	Large disturbed sample

Plant:
Water observations: Minor water seepage at 2.4mbgl, rising to 2.15mbgl.

General remarks:

Logged by: JW	Checked by: CH	Approved by: RE
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DYNAMIC SAMPLING RECORD		 TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS04	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.35	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material, ceramic tile and chert. Frequent fine rootlets. Soft to firm low to medium strength grey mottled orange-brown slightly gravelly sandy CLAY. Gravel of subrounded to subangular chert.		A					
			T	1.0	(1, 1) 1, 2, 2, 2	7	HSV at 0.5m - 50, 55, 60 PP at 0.5m - 1.5, 1.75, 1.75, 2.0, 2.5	
			A					
			T	2.0	(1, 2) 2, 2, 3, 4	11	HSV at 1.5m - 40, 50, 55 PP at 1.5m - 2.0, 2.0, 2.5, 2.5, 2.25	
3.00			T	3.0	(1, 2) 2, 2, 3, 3	10	HSV at 3.0m - 75, 100, 100 PP at 3.0m - 3.0, 3.25, 3.0, 3.25, 2.75	
	Firm high strength grey mottled brown sandy CLAY.		T	4.0	(2, 2) 2, 2, 2, 2	8	HSV at 4.0m - 100, 112.5, 87.5 PP at 4.0m - 3.5, 3.25, 3.5, 3.5, 3.25	
5.00			T	5.0	(2, 2) 2, 3, 3, 4	12		
	Borehole Terminated							

Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) SPT: Standard Penetration Test HSV: Hand Shear Vane (kPa) PP: Pocket Penetrometer (kg/cm2) PID: Photo-Ionisation Detector (ppm) B: Large disturbed sample	Plant:		
	Water observations: Minor water seepage at 3.0mbgl.		
	General remarks:		
	Logged by: JW	Checked by: CH	Approved by: RE

DYNAMIC SAMPLING RECORD		 TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS05	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.30	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material and chert. Frequent fine rootlets. Soft to firm medium strength grey mottled orange-brown gravelly sandy CLAY. Gravel of subangular chert.							
				1.0	(0, 1) 1, 1, 2, 2	6	HSV at 0.5m - 55, 65, 70 PP at 0.5m - 2.25, 2.25, 2.0, 2.25, 2.25	
				2.0	(1, 2) 2, 2, 2, 3	9	HSV at 1.5m - 50, 45, 55 PP at 1.5m - 1.25, 1.25, 2.0, 1.5, 1.25	
2.40							HSV at 2.4m - 95, 150, 137.5 PP at 2.4m - 3.0, 3.25, 3.25, 3.25, 3.25	
	Firm high strength grey mottled brown sandy CLAY.		T	3.0	(1, 2) 2, 2, 3, 3	10		
				4.0	(1, 2) 2, 3, 3, 4	12		
5.00				5.0	(1, 2) 3, 3, 3, 4	13	HSV at 4.5m - 112.5, 137.5, 125 PP at 4.5m - 3.0, 3.75, 3.75, 3.75, 4.0	
	Borehole Terminated							

Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) SPT: Standard Penetration Test HSV: Hand Shear Vane (kPa) PP: Pocket Penetrometer (kg/cm2) PID: Photo-Ionisation Detector (ppm) B: Large disturbed sample	Plant:		
	Water observations:		
	General remarks:		
	Logged by: JW	Checked by: CH	Approved by: RE

DYNAMIC SAMPLING RECORD		 TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS06	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.30	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material and chert. Frequent fine rootlets. Firm medium to high strength grey mottled orange-brown gravelly sandy CLAY. Gravel of angular chert.		A				HSV at 0.5m - 45, 65, 70 PP at 0.5m - 1.5, 1.25, 1.25, 1.5, 2.0	
				1.0	(1, 2) 2, 2, 3, 3	10	HSV at 1.5m - 85, 85, 90 PP at 1.5m - 2.5, 3.0, 2.75, 2.75, 3.0	
				2.0	(1, 1) 2, 2, 3, 3	10		
2.50							HSV at 2.5m - 125, 137.5, 137.5 PP at 2.5m - 3.75, 3.25, 3.5, 3.5, 3.75	
	Firm to stiff high strength grey mottled brown sandy CLAY.			3.0	(1, 2) 2, 3, 3, 3	11		
				4.0	(2, 2) 2, 2, 3, 3	10		
5.00							HSV at 4.5m - 125, 137.5, 137.5 PP at 4.5m - 3.75, 3.5, 3.5, 3.5, 3.75	
	Borehole Terminated			5.0	(4, 5) 5, 5, 6, 5	21		

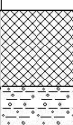
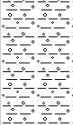
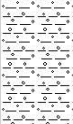
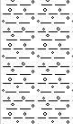
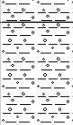
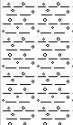
Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) SPT: Standard Penetration Test HSV: Hand Shear Vane (kPa) PP: Pocket Penetrometer (kg/cm2) PID: Photo-Ionisation Detector (ppm) B: Large disturbed sample	Plant:		
	Water observations: No groundwater encountered.		
	General remarks:		
	Logged by: JW	Checked by: CH	Approved by: RE

DYNAMIC SAMPLING RECORD		 TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS07	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.40	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material and chert. Frequent fine rootlets.							
	Soft to firm medium to high strength grey mottled orange-brown gravelly sandy CLAY. Gravel of subangular chert.							
				1.0	(1, 1) 2, 2, 2, 2	8	HSV at 0.5m - 65, 50, 70 PP at 0.5m - 2.25, 2.5, 2.5, 2.5, 2.5	
			T					
			A					
				2.0	(1, 1) 2, 3, 3, 3	11	HSV at 1.5m - 85, 85, 90 PP at 1.5m - 3.5, 4.0, 3.75, 3.75, 3.75	
2.50								
	Firm high strength grey mottled brown sandy CLAY.							
				3.0	(1, 2) 2, 3, 3, 3	11	HSV at 2.5m - 125, 150, 137.5 PP at 2.5m - 4.0, 4.25, 3.75, 3.75, 4.25	
				4.0	(1, 2) 2, 3, 3, 3	11		
5.00								
				5.0	(2, 2) 3, 3, 3, 3	12	HSV at 4.5m - 137.5, 162.5, 125 PP at 4.5m - 4.5, 4.5, 4.25, 4.0, 4.0	
	Borehole Terminated							

Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) SPT: Standard Penetration Test HSV: Hand Shear Vane (kPa) PP: Pocket Penetrometer (kg/cm2) PID: Photo-Ionisation Detector (ppm) B: Large disturbed sample	Plant:		
	Water observations: No groundwater encountered.		
	General remarks:		
	Logged by: JW	Checked by: CH	Approved by: RE

DYNAMIC SAMPLING RECORD		 TEC TWEEDIE EVANS CONSULTING www.tecon.co.uk info@tecon.co.uk
Project Title: Bellmore Allotments, Burns Close	Borehole: WS08	
Project No: 1712003.002	Dates: 13th February 2018	
Client: London Borough of Hillingdon		

Depth (m)	Description	Legend	Sample Details	Depth (m)	SPT Results		Remarks/ Data	Installation
					Blow Count	N Value		
0.00	Ground Surface			0.0				
0.30	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material and chert. Frequent fine rootlets.		A					
	Soft to firm medium to high strength grey mottled orange-brown sandy gravelly CLAY. Gravel of subangular chert.		T					
	band of very soft clay from 1.9m to 2.0m.			1.0	(1, 2) 2, 2, 2, 2	8	HSV at 0.5m - 70, 85, 85 PP at 0.5m - 3.0, 3.25, 3.25, 3.0, 3.5	
2.00								
	Firm orange-brown sandy very gravelly CLAY. Gravel of angular to subangular chert.		T	2.0	(2, 2) 2, 3, 3, 3	11	HSV at 1.5m - 65, 65, 65 PP at 1.5m - 2.0, 1.5, 2.75, 2.5, 2.5	
3.00								
	NO RECOVERY			3.0	(1, 2) 3, 2, 3, 3	11		
3.80								
4.00	Firm high strength grey mottled orange-brown sandy CLAY.							
	NO RECOVERY			4.0	(2, 2) 3, 3, 4, 4	14	HSV at 3.8m - 87.5, 137.5, 125 PP at 3.8m - 3.0, 3.0, 3.25, 2.75, 3.25	
4.70								
	Firm to stiff high strength grey mottled brown sandy CLAY.			5.0	(2, 3) 3, 4, 4, 4	15	HSV at 4.7m - 125, 137.5, 100 PP at 4.7m - 3.5, 3.75, 3.0, 3.75, 3.5	
5.00								
	Borehole Terminated							

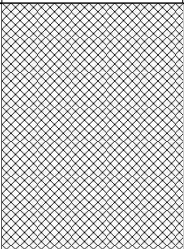
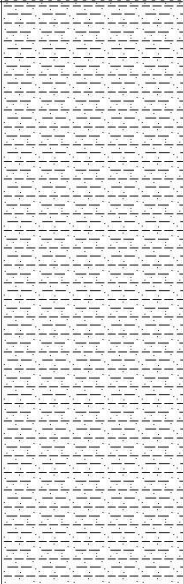
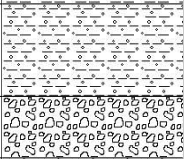
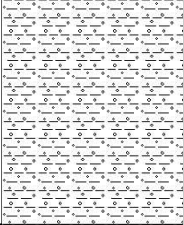
Notes: A: 250ml and 60ml Amber Glass Jars T: Plastic Tub (1Kg) SPT: Standard Penetration Test HSV: Hand Shear Vane (kPa) PP: Pocket Penetrometer (kg/cm2) PID: Photo-Ionisation Detector (ppm) B: Large disturbed sample	Plant:		
	Water observations: Water seepage at 5.0mbgl, rising to 0.76mbgl.		
	General remarks:		
	Logged by: JW	Checked by: CH	Approved by: RE

TRIAL PIT RECORD	
Project Title: Bellmore Allotments, Burns Close	Trial Pit: TP01
Project No: 1712003.002	Dates: 14th February 2018
Client: London Borough of Hillingdon	



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Depth (m)	Description	Legend Side B	Depth (m)	Sample Details	Remarks
0.00	Ground Surface		0.00		
0.80	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material, fabric fragments, ceramic tile and chert. Frequent fine rootlets.		0.00	A	HSV at 0.8m - 60, 85, 70 PP at 0.8m - 2.0, 2.0, 3.0, 2.5, 2.5
2.70	Soft to firm medium to high strength grey mottled orange-brown gravelly sandy CLAY. Gravel of subangular chert.		1.00	T	HSV at 1.5m - 35, 55, 50 PP at 1.5m - 1.25, 1.25, 1.5, 1.25, 1.25
			2.00	A	
3.00	Firm high strength grey mottled orange-brown sandy very gravelly CLAY. Gravel of angular to subangular chert.		3.00	T	HSV at 2.7m - 112.5, 112.5, 87.5 PP at 2.7m - 2.75, 3.0, 3.25, 3.25, 3.5
3.20	Orange-brown sandy clayey GRAVEL of angular to subangular chert. Sand is coarse.				HSV at 3.2m - 100, 100, 112.5 PP at 3.2m - 3.25, 3.5, 3.75, 3.75, 3.75
4.00	Firm high strength grey mottled orange-brown sandy very gravelly CLAY. Gravel of angular to subangular chert.		4.00		
	Trial Pit Terminated				

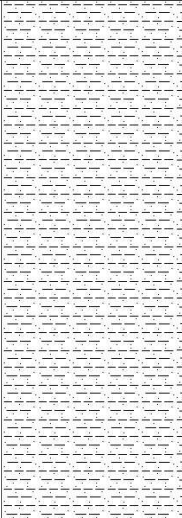
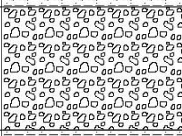
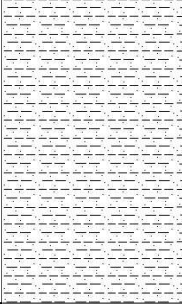
Excavation Details:		Dimensions:		Notes and Remarks: A = Amber jar, T = 1kg Plastic tub HSV = Hand Shear Vane, PP = Pocket Penetrometer HSV units = kPa, PP units = kg/cm ²		
Date excavated: 14th February 2018 Date backfilled: 14th February 2018 Plant: JCB 3CX Shoring: N/A Stability: Stable		B: 0.6m A: 3.3m		Water observations: Minor seepage at 3.0mbgl.		
Logged by: JW				Checked by: CH	Approved by: RE	

TRIAL PIT RECORD	
Project Title: Bellmore Allotments, Burns Close	Trial Pit: TP03
Project No: 1712003.002	Dates: 14th February 2018
Client: London Borough of Hillingdon	



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Depth (m)	Description	Legend Side B	Depth (m)	Sample Details	Remarks
0.00	Ground Surface		0.00		
0.50	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material, fabric fragments, ceramic tile and chert. Frequent fine rootlets.			A	HSV at 0.5m - 45, 65, 65 PP at 0.5m - 2.75, 3.0, 2.75, 3.5, 3.0
	Soft to firm low to medium strength grey mottled orange-brown slightly gravelly sandy CLAY. Gravel of angular chert.		1.00	A	
2.20			2.00		
2.60	Orange-brown sandy clayey GRAVEL of angular to subangular chert. Sand is coarse.				
	Firm to stiff high strength grey mottled brown sandy CLAY.		3.00		HSV at 2.6m - 125, 125, 100 PP at 2.6m - 3.0, 3.25, 3.5, 3.25, 3.25
3.60	cobbles of weak light brown angular tabular claystone from 3.4m to 3.5mbgl.				
	Trial Pit Terminated		4.00		HSV at 3.5m - 112.5, 100, 125 PP at 3.5m - 3.75, 4.25, 4.0, 3.75, 4.25

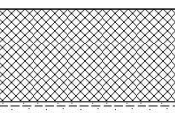
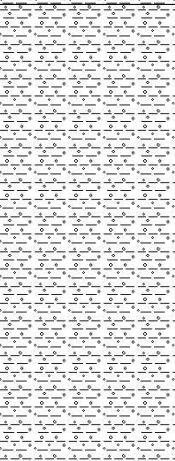
Excavation Details:		Dimensions:		Notes and Remarks: Trial pit terminated at 3.6m due to collapse. A = Amber jar, HSV = Hand Shear Vane, PP = Pocket Penetrometer, HSV units = kPa, PP units = kg/cm²			
Date excavated: 14th February 2018 Date backfilled: 14th February 2018 Plant: JCB 3CX Shoring: N/A Stability: Fairly Stable		B: 0.6m  A: 3.6m					
				Water observations: Minor seepage at 2.2mbgl.			
				Logged by: JW		Checked by: CH	Approved by: RE

TRIAL PIT RECORD	
Project Title: Bellmore Allotments, Burns Close	Trial Pit: TP04
Project No: 1712003.002	Dates: 14th February 2018
Client: London Borough of Hillingdon	



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Depth (m)	Description	Legend Side B	Depth (m)	Sample Details	Remarks
0.00	Ground Surface		0.00		
0.30	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material, fabric fragments, ceramic tile and chert. Frequent fine rootlets.			A	HSV at 0.5m - 45, 35, 50 PP at 0.5m - 2.0, 2.0, 2.25, 2.25, 2.25
1.00	Soft to firm low to medium strength grey mottled orange-brown slightly gravelly sandy CLAY. Gravel of angular to subangular chert.				
1.50	Brown and orange-brown sandy clayey GRAVEL of angular chert. Sand is coarse.		1.00	A	
2.50	Firm medium strength grey mottled brown sandy CLAY.		2.00		
4.00	Stiff high strength blue-grey mottled brown sandy gravelly CLAY. Gravel of subangular to subrounded lithorelicts of stiff brown clay.		3.00	T	HSV at 1.5m - 60, 60, 55 PP at 1.5m - 2.5, 2.25, 2.25, 2.5, 2.75 HSV at 2.5m - 100, 75, 87.5 PP at 2.5m - 3.0, 2.75, 3.25, 3.25, 3.0 HSV at 3.5m - 125, 137.5, 137.5 PP at 3.5m - 3.75, 4.0, 3.75, 4.0, 4.0
	Trial Pit Terminated		4.00		

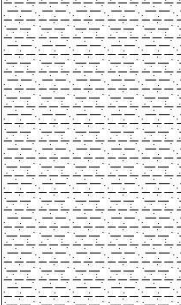
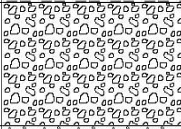
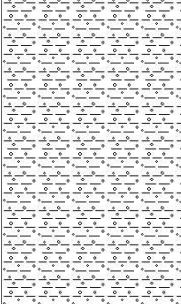
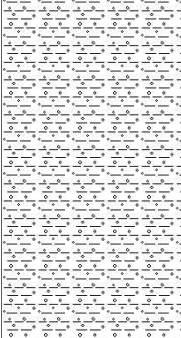
Excavation Details:	Dimensions:	Notes and Remarks: A = Amber jar, T = 1kg Plastic tub HSV = Hand Shear Vane, PP = Pocket Penetrometer HSV units = kPa, PP units = kg/cm ²		
Date excavated: 14th February 2018 Date backfilled: 14th February 2018 Plant: JCB 3CX Shoring: N/A Stability: Stable	B: 0.6m A: 3.6m	Water observations: Minor seepage at 1.0mbgl.		
		Logged by: JW	Checked by: CH	Approved by: RE

TRIAL PIT RECORD	
Project Title: Bellmore Allotments, Burns Close	Trial Pit: TP05
Project No: 1712003.002	Dates: 14th February 2018
Client: London Borough of Hillingdon	



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Depth (m)	Description	Legend Side B	Depth (m)	Sample Details	Remarks
0.00	Ground Surface		0.00		
0.40	MADE GROUND Dark brown gravelly sandy clay. Gravel of red brick, black carbonaceous material, fabric fragments, glass, ceramic tile, clinker and chert. Frequent fine rootlets.			A	
1.40	Firm medium to high strength grey mottled orange-brown gravelly sandy CLAY. Gravel of subangular chert.		1.00		HSV at 0.5m - 65, 60, 60 PP at 0.5m - 2.25, 2.25, 2.25, 2.0, 1.75
1.80	Orange-brown and brown clayey sandy GRAVEL of angular to subrounded chert. Sand is coarse.			T	HSV at 1.2m - 75, 75, 85 PP at 1.2m - 2.0, 1.25, 1.75, 2.0, 3.0
	Firm to stiff high to very high strength blue mottled brown sandy gravelly CLAY.		2.00		HSV at 1.8m - 112.5, 100, 100 PP at 1.8m - 2.5, 3.0, 2.75, 3.25, 3.0
3.90	subangular lithorelicts of stiff brown clay from 3.6m to 3.8mbgl. cobbles of weak light brown angular tabular claystone form 3.8m to 3.9mbgl.		3.00		HSV at 3.0m - 162.5, 137.5, 162.5 PP at 3.0m - 3.5, 3.5, 3.5, 3.75, 3.75
	Trial Pit Terminated		4.00		

Excavation Details:	Dimensions:	Notes and Remarks: Trial pit terminated at 3.9m on claystone. A = Amber jar, T = 1kg Plastic tub HSV = Hand Shear Vane, PP = Pocket Penetrometer HSV units = kPa, PP units = kg/cm ² Water observations: No groundwater encountered.		
Date excavated: 14th February 2018 Date backfilled: 14th February 2018 Plant: JCB 3CX Shoring: N/A Stability: Stable	B: 0.6m  A: 3.7m			
		Logged by: JW	Checked by: CH	Approved by: RE

APPENDIX D

Geochemical Certificates of Analysis

**Jordan Wright**

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Analytical Report Number : 18-77135

Project / Site name:	Bellmore Allotments, Burns Close	Samples received on:	22/02/2018
Your job number:	1712003.001	Samples instructed on:	22/02/2018
Your order number:		Analysis completed by:	08/03/2018
Report Issue Number:	1	Report issued on:	08/03/2018
Samples Analysed:	14 soil samples		

Signed:

Rexona Rahman
Head of Customer Services
For & on behalf of i2 Analytical Ltd.

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

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

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

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

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 18-77135

Project / Site name: Bellmore Allotments, Burns Close

Lab Sample Number				914656	914657	914658	914659	914660
Sample Reference				TP01	TP03	TP04	TP05	WS01
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.30	0.20	0.20	0.30
Date Sampled				14/02/2018	14/02/2018	14/02/2018	14/02/2018	13/02/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	18	18	22	17
Total mass of sample received	kg	0.001	NONE	0.50	0.52	0.47	0.54	0.53

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.7	7.6	7.1	7.2	7.4
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	610	-	890	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.015	0.0094	0.055	0.017	0.016
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	-	-	-	-
Total Sulphur	%	0.005	MCERTS	-	-	-	-	-
Ammonium as NH ₄	mg/kg	0.5	MCERTS	-	-	-	-	-
Ammonium as NH ₄ (leachate equivalent)	mg/l	0.05	MCERTS	-	-	-	-	-
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.7	1.7	1.9	2.5	1.4
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	-	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.21	0.54	0.51	0.36
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.30	0.65	2.0	1.1	0.87
Pyrene	mg/kg	0.05	MCERTS	0.25	0.54	1.6	1.0	0.76
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.17	0.41	1.0	0.75	0.46
Chrysene	mg/kg	0.05	MCERTS	0.14	0.35	1.1	0.91	0.53
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.60	1.6	1.2	0.70
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.27	0.74	0.72	0.32
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.52	1.4	1.4	0.63
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.28	0.73	0.58	0.30
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.37	0.90	0.86	0.39

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	0.86	4.20	11.6	9.04	5.32
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Analytical Report Number: 18-77135

Project / Site name: Bellmore Allotments, Burns Close

Lab Sample Number				914656	914657	914658	914659	914660
Sample Reference				TP01	TP03	TP04	TP05	WS01
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.30	0.20	0.20	0.30
Date Sampled				14/02/2018	14/02/2018	14/02/2018	14/02/2018	13/02/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.3	7.7	9.1	8.4	8.8
Barium (aqua regia extractable)	mg/kg	1	MCERTS	100	86	120	110	93
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.85	0.95	1.1	1.0	0.91
Boron (water soluble)	mg/kg	0.2	MCERTS	1.4	2.2	2.0	2.1	1.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.5	< 0.2	0.3	0.3	0.3
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	26	24	26	25	27
Copper (aqua regia extractable)	mg/kg	1	MCERTS	32	27	36	35	27
Lead (aqua regia extractable)	mg/kg	1	MCERTS	60	49	70	67	41
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	19	21	22	20	21
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	34	35	38	38	38
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	130	110	130	150	84
Magnesium (water soluble)	mg/kg	5	NONE	-	-	-	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	-	-	-	-

Monoaromatics

Benzene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
Toluene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
Ethylbenzene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
p & m-xylene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
o-xylene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	< 10	-	< 10	-	-
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	< 10	-	-
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	-	< 10	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	-	< 10	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	< 10	-	-

Analytical Report Number: 18-77135

Project / Site name: Bellmore Allotments, Burns Close

Lab Sample Number				914661	914662	914663	914664	914665
Sample Reference				WS04	WS06	WS08	TP01	TP03
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.20	0.20	2.00	1.00
Date Sampled				13/02/2018	13/02/2018	13/02/2018	14/02/2018	14/02/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	21	18	21	17	17
Total mass of sample received	kg	0.001	NONE	0.55	0.54	0.50	0.53	0.50

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	-	-
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.4	6.7	7.0	7.4	7.6
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	550	-	1100	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	-	0.037	0.025
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.010	0.012	0.015	0.053	0.0085
Sulphide	mg/kg	1	MCERTS	< 1.0	2.0	< 1.0	-	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	-	-	3.4	2.5
Total Sulphur	%	0.005	MCERTS	-	-	-	0.013	0.009
Ammonium as NH ₄	mg/kg	0.5	MCERTS	-	-	-	< 0.5	< 0.5
Ammonium as NH ₄ (leachate equivalent)	mg/l	0.05	MCERTS	-	-	-	< 0.05	< 0.05
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.8	1.8	3.0	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	-	-	-	< 2.0	< 2.0

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Phenanthrene	mg/kg	0.05	MCERTS	0.22	0.40	0.45	-	-
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Fluoranthene	mg/kg	0.05	MCERTS	0.57	1.3	1.5	-	-
Pyrene	mg/kg	0.05	MCERTS	0.48	1.2	1.6	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.26	0.62	1.3	-	-
Chrysene	mg/kg	0.05	MCERTS	0.33	0.91	1.0	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.37	0.92	1.4	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.29	0.71	1.0	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.38	1.0	1.5	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.51	0.69	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.67	0.87	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	2.90	8.26	11.3	-	-
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Analytical Report Number: 18-77135

Project / Site name: Bellmore Allotments, Burns Close

Lab Sample Number				914661	914662	914663	914664	914665
Sample Reference				WS04	WS06	WS08	TP01	TP03
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	0.20	0.20	2.00	1.00
Date Sampled				13/02/2018	13/02/2018	13/02/2018	14/02/2018	14/02/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.2	8.3	9.3	-	-
Barium (aqua regia extractable)	mg/kg	1	MCERTS	110	130	190	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.91	1.1	1.1	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	2.3	2.4	2.7	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.8	0.2	1.2	-	-
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	32	24	34	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	37	43	53	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	50	91	230	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23	22	25	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	36	39	38	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	120	180	-	-

Magnesium (water soluble)	mg/kg	5	NONE	-	-	-	15	5.9
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	-	-	7.4	2.9

Monoaromatics

Benzene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
Toluene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
Ethylbenzene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
p & m-xylene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
o-xylene	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	< 1.0	-	< 1.0	-	-

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	< 10	-	< 10	-	-
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TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	< 10	-	-

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	-	< 10	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	-	< 10	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	-	< 10	-	-

Analytical Report Number: 18-77135

Project / Site name: Bellmore Allotments, Burns Close

Lab Sample Number				914666	914667	914668	914669	
Sample Reference				TP04	WS01	BH01	BH02	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				1.00	1.50	4.00	10.00	
Date Sampled				14/02/2018	13/02/2018	14/02/2018	15/02/2018	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	19	16	20	18	
Total mass of sample received	kg	0.001	NONE	0.50	0.50	0.38	0.42	

Asbestos in Soil	Type	N/A	ISO 17025	-	-	-	-	
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	6.4	6.8	7.3	8.2	
Total Cyanide	mg/kg	1	MCERTS	-	-	-	-	
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	-	-	
Total Sulphate as SO ₄	%	0.005	MCERTS	0.031	0.056	0.046	0.083	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.019	0.037	0.091	0.37	
Sulphide	mg/kg	1	MCERTS	-	-	-	-	
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	5.0	2.7	23	72	
Total Sulphur	%	0.005	MCERTS	0.010	0.019	0.019	0.379	
Ammonium as NH ₄	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5	3.6	
Ammonium as NH ₄ (leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.36	
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	-	-	-	
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	< 2.0	< 2.0	

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	-	-	
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	-	-	
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Analytical Report Number: 18-77135

Project / Site name: Bellmore Allotments, Burns Close

Lab Sample Number				914666	914667	914668	914669	
Sample Reference				TP04	WS01	BH01	BH02	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				1.00	1.50	4.00	10.00	
Date Sampled				14/02/2018	13/02/2018	14/02/2018	15/02/2018	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	-	-	
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	-	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-	-	-	
Chromium (hexavalent)	mg/kg	1.2	MCERTS	-	-	-	-	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-	-	-	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	-	

Magnesium (water soluble)	mg/kg	5	NONE	8.6	14	31	62	
Magnesium (leachate equivalent)	mg/l	2.5	NONE	4.3	7.0	15	31	

Monoaromatics

Benzene	ug/kg	1	MCERTS	-	-	-	-	
Toluene	ug/kg	1	MCERTS	-	-	-	-	
Ethylbenzene	ug/kg	1	MCERTS	-	-	-	-	
p & m-xylene	ug/kg	1	MCERTS	-	-	-	-	
o-xylene	ug/kg	1	MCERTS	-	-	-	-	
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	-	-	-	-	

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	-	-	-	-	
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TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-	-	
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	-	
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	



Analytical Report Number : 18-77135

Project / Site name: Bellmore Allotments, Burns Close

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
914656	TP01	None Supplied	0.30	Brown loam and clay with gravel and vegetation.
914657	TP03	None Supplied	0.30	Brown loam and clay with vegetation.
914658	TP04	None Supplied	0.20	Brown loam and clay with vegetation.
914659	TP05	None Supplied	0.20	Brown loam and clay with vegetation.
914660	WS01	None Supplied	0.30	Brown clay and loam with vegetation.
914661	WS04	None Supplied	0.20	Brown clay and loam with vegetation.
914662	WS06	None Supplied	0.20	Brown clay and loam with vegetation.
914663	WS08	None Supplied	0.20	Brown clay and loam with vegetation.
914664	TP01	None Supplied	2.00	Brown clay and sand with gravel and vegetation.
914665	TP03	None Supplied	1.00	Brown clay and sand with vegetation.
914666	TP04	None Supplied	1.00	Brown clay and sand.
914667	WS01	None Supplied	1.50	Brown clay and sand.
914668	BH01	None Supplied	4.00	Brown clay.
914669	BH02	None Supplied	10.00	Brown clay.

Analytical Report Number : 18-77135

Project / Site name: Bellmore Allotments, Burns Close

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammonium as NH ₄ in soil	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests ^{***}	L009-PL	D	MCERTS

Iss No 18-77135-1 Bellmore Allotments, Burns Close 1712003.001

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

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Analytical Report Number : 18-77135

Project / Site name: Bellmore Allotments, Burns Close

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests"	L038	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038	W	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding.	L076-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L088/76-PL	W	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP01		S	18-77135	914656	c	Sulphide in soil	L010-PL	c
TP01		S	18-77135	914656	c	Total cyanide in soil	L080-PL	c
TP03		S	18-77135	914657	c	Sulphide in soil	L010-PL	c
TP03		S	18-77135	914657	c	Total cyanide in soil	L080-PL	c
TP04		S	18-77135	914658	c	Sulphide in soil	L010-PL	c
TP04		S	18-77135	914658	c	Total cyanide in soil	L080-PL	c
TP05		S	18-77135	914659	c	Sulphide in soil	L010-PL	c
TP05		S	18-77135	914659	c	Total cyanide in soil	L080-PL	c
WS01		S	18-77135	914660	c	Sulphide in soil	L010-PL	c
WS01		S	18-77135	914660	c	Total cyanide in soil	L080-PL	c
WS04		S	18-77135	914661	c	Sulphide in soil	L010-PL	c
WS04		S	18-77135	914661	c	Total cyanide in soil	L080-PL	c
WS06		S	18-77135	914662	c	Sulphide in soil	L010-PL	c
WS06		S	18-77135	914662	c	Total cyanide in soil	L080-PL	c
WS08		S	18-77135	914663	c	Sulphide in soil	L010-PL	c
WS08		S	18-77135	914663	c	Total cyanide in soil	L080-PL	c

APPENDIX E
Geotechnical Laboratory Report



LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

BH01

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

4.50

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

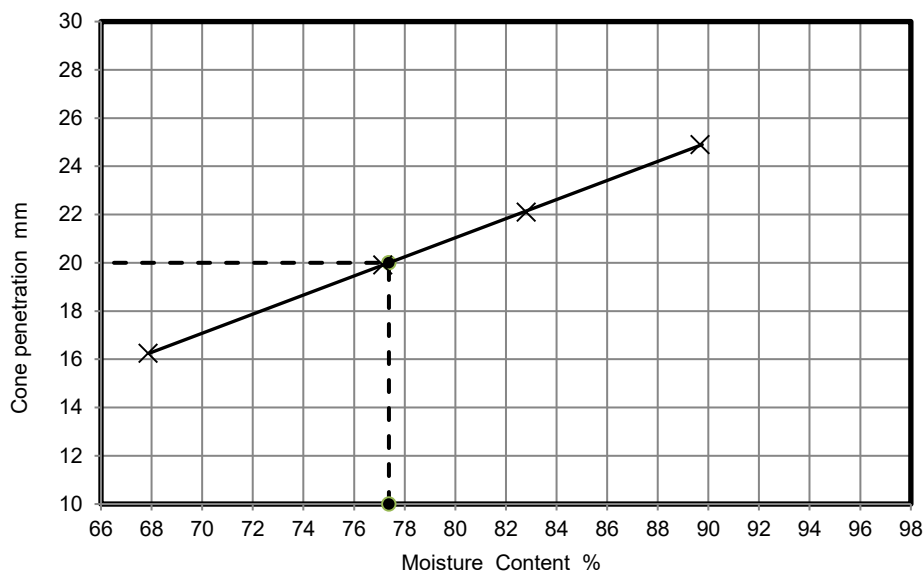
23/02/2018

Date Tested

07/03/2018

Soil Description

Brown silty CLAY



NATURAL MOISTURE CONTENT

30

%

% PASSING 425µm SIEVE

100

%

LIQUID LIMIT

77

%

PLASTIC LIMIT

26

%

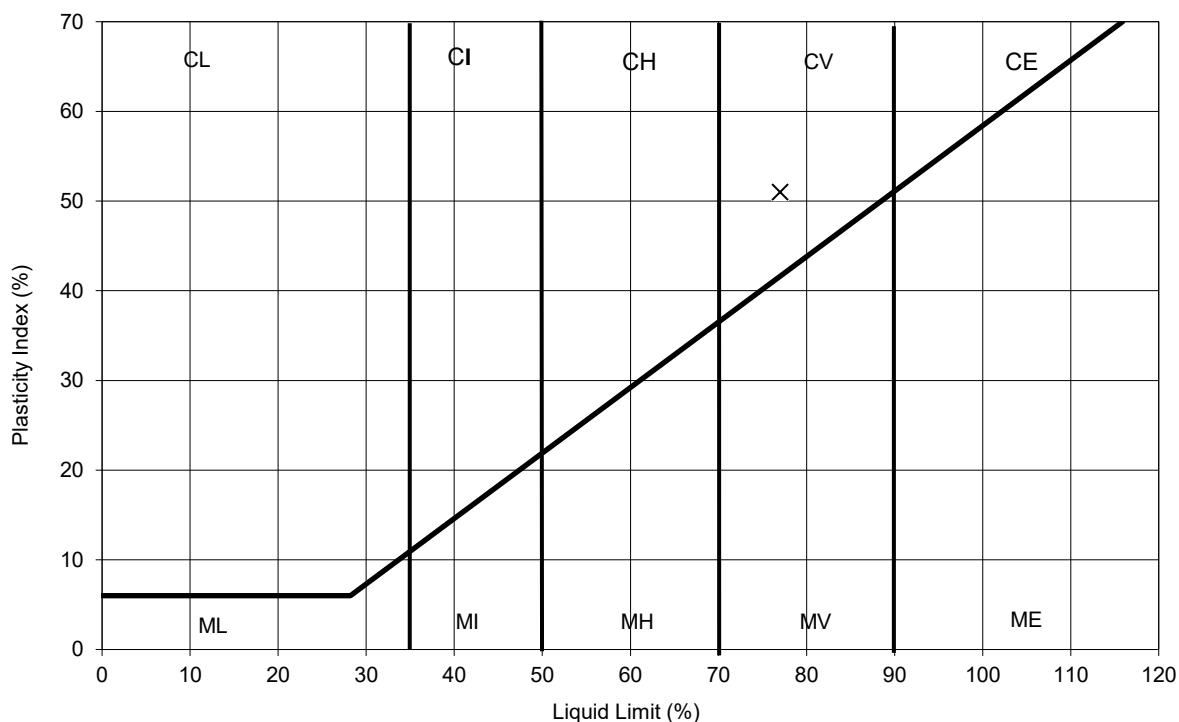
PLASTICITY INDEX

51

%

Remarks

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

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Checked and Approved

Initials: J.P

Date: 13/03/2018

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

BH01

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

8.00

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

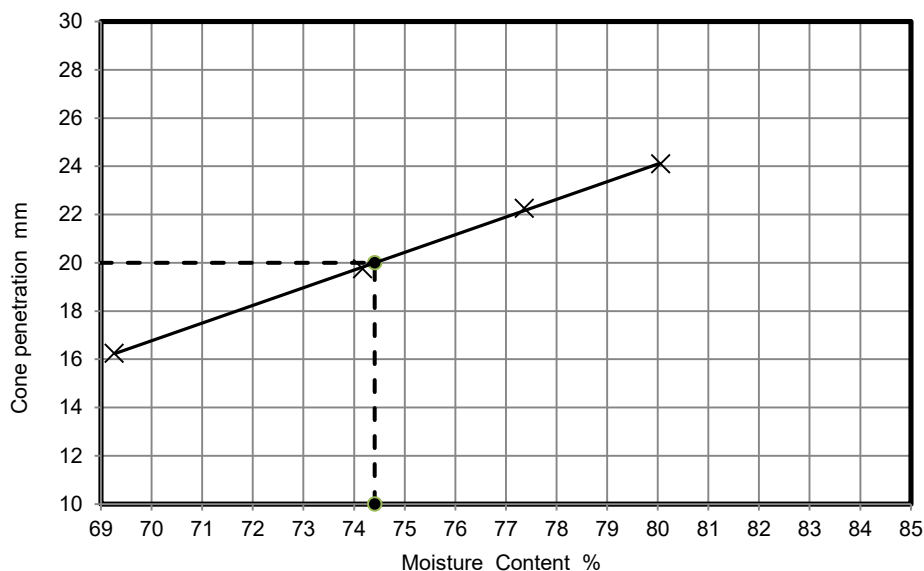
23/02/2018

Date Tested

07/03/2018

Soil Description

Dark brown slightly mottled orangish brown silty CLAY



NATURAL MOISTURE CONTENT

26

%

% PASSING 425µm SIEVE

100

%

LIQUID LIMIT

74

%

PLASTIC LIMIT

23

%

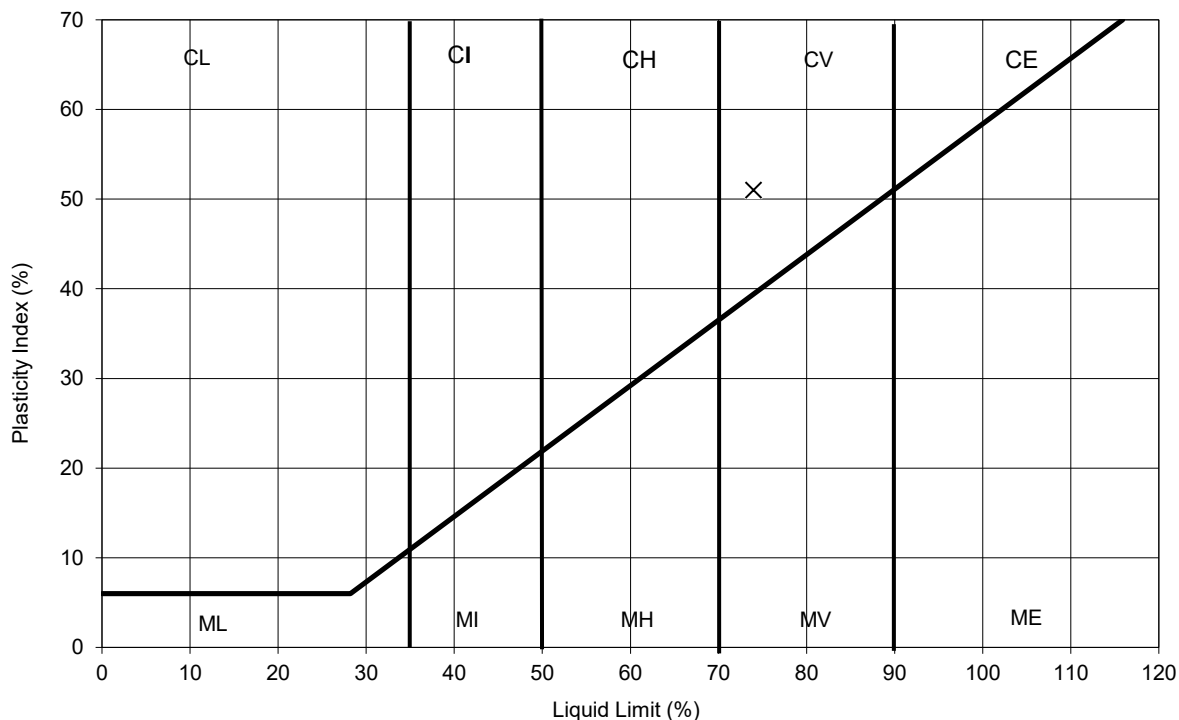
PLASTICITY INDEX

51

%

Remarks

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

BH02

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

6.00

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

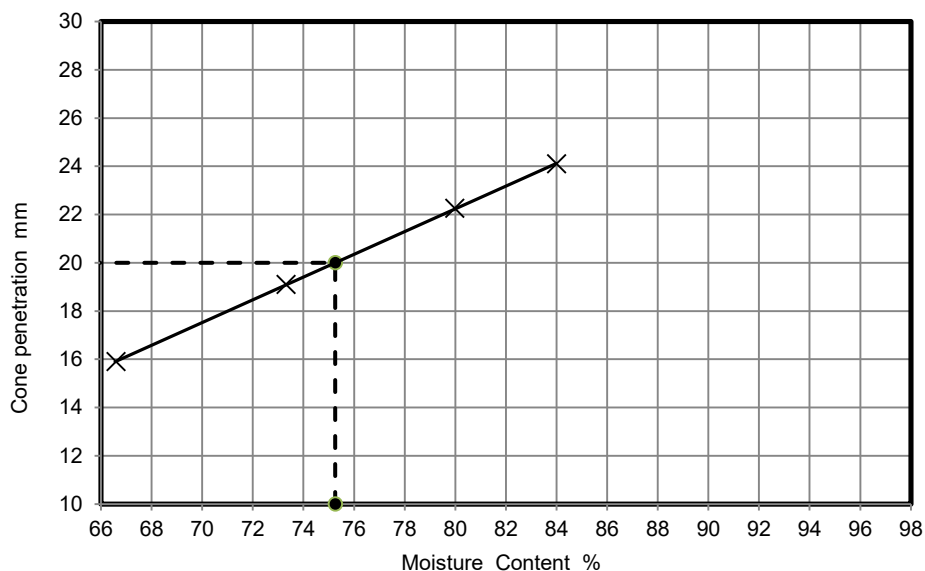
23/02/2018

Date Tested

07/03/2018

Soil Description

Dark brown slightly mottled orangish brown silty CLAY with rare fine gravel



NATURAL MOISTURE CONTENT

26

%

% PASSING 425µm SIEVE

99

%

LIQUID LIMIT

75

%

PLASTIC LIMIT

24

%

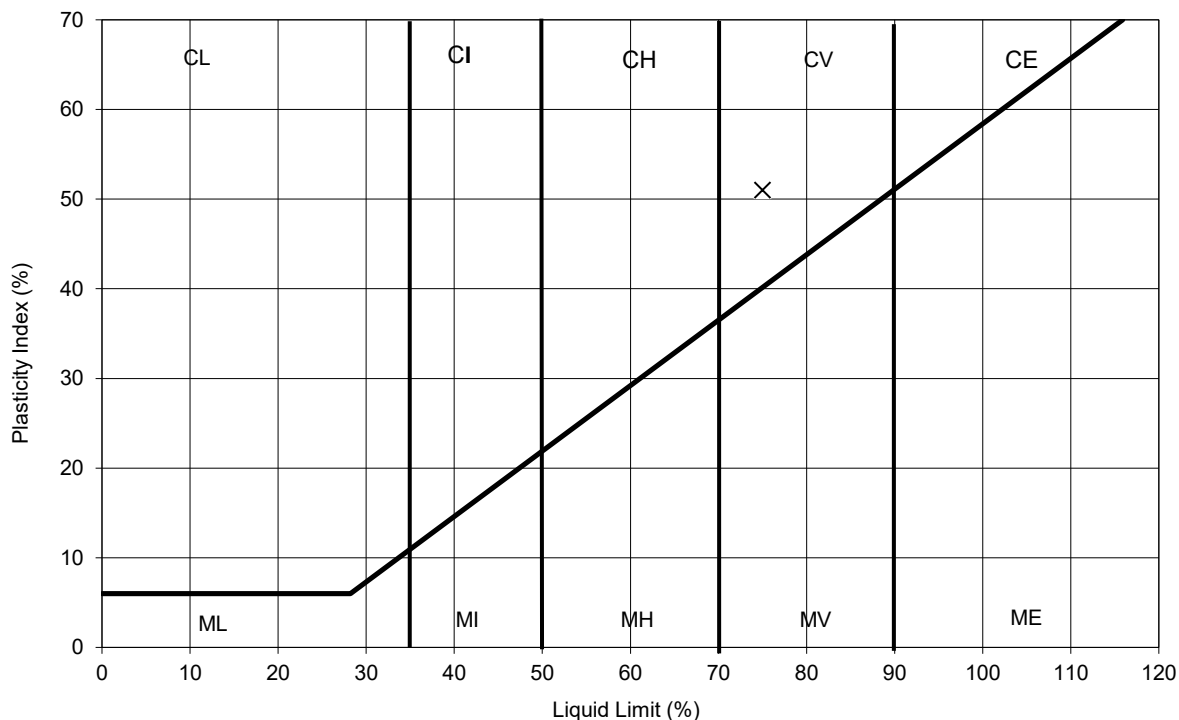
PLASTICITY INDEX

51

%

Remarks

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990: Determination of the moisture content by the oven drying

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

BH02

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

10.00

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

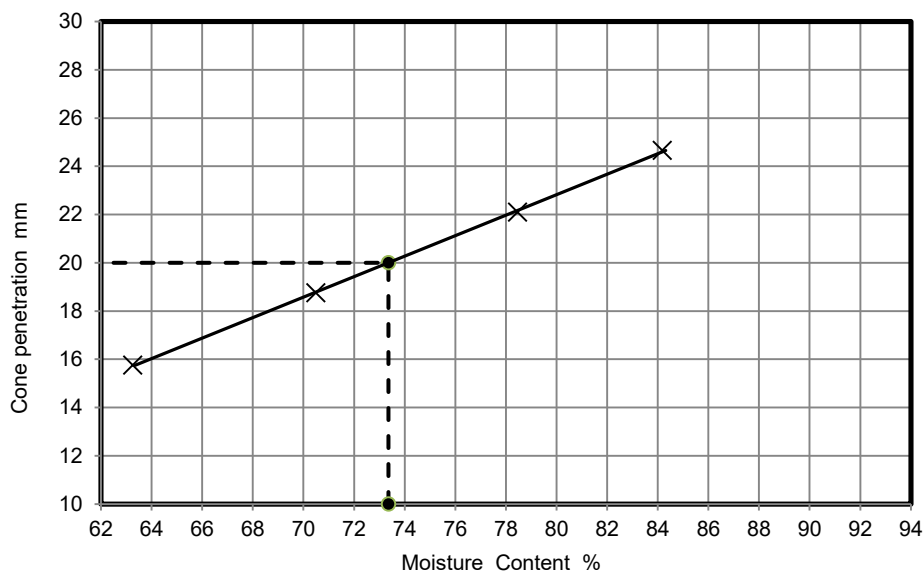
23/02/2018

Date Tested

07/03/2018

Soil Description

Dark brown silty CLAY



NATURAL MOISTURE CONTENT

27

%

% PASSING 425µm SIEVE

100

%

LIQUID LIMIT

73

%

PLASTIC LIMIT

22

%

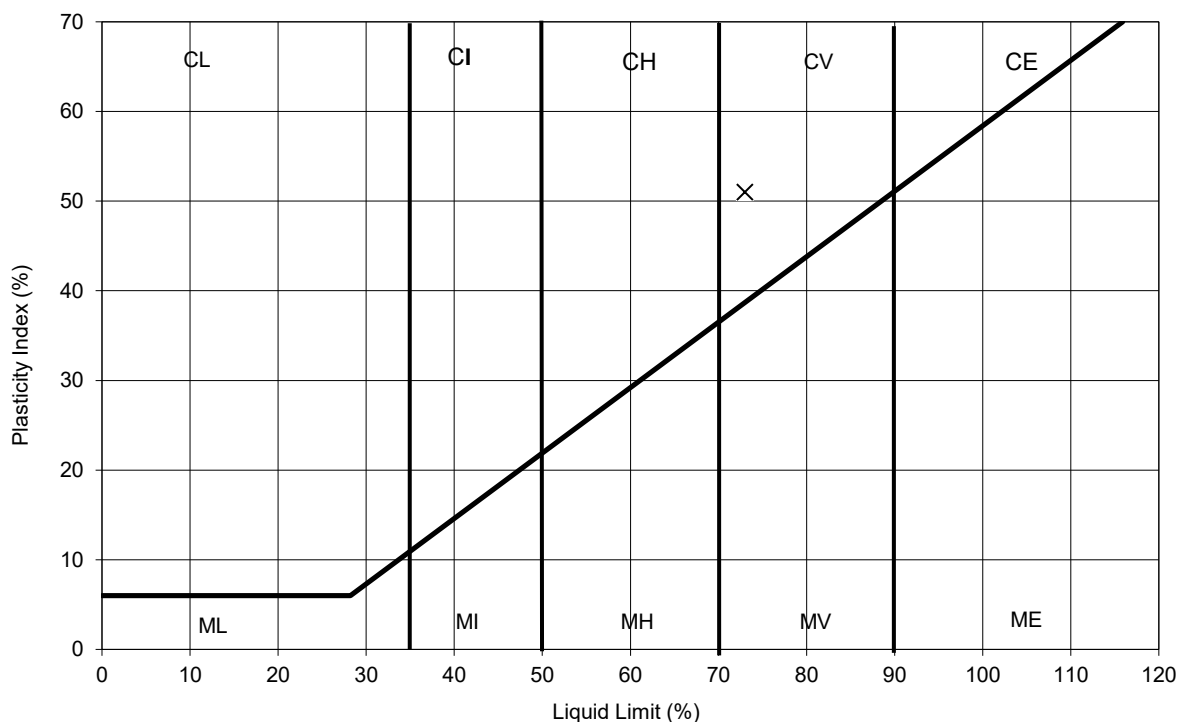
PLASTICITY INDEX

51

%

Remarks

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

WS01

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

1.50

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

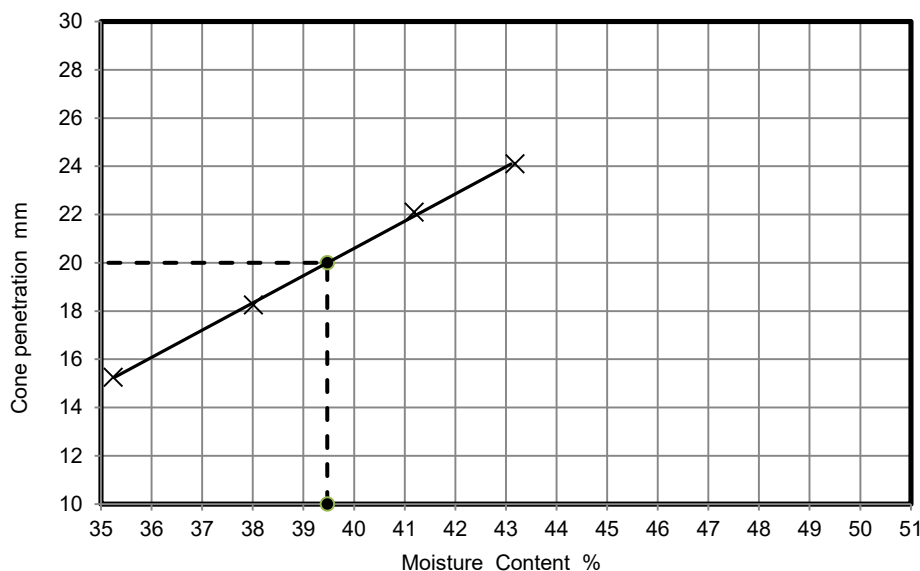
23/02/2018

Date Tested

07/03/2018

Soil Description

Light orangish brown slightly mottled grey slightly gravelly sandy silty CLAY with traces of fine rootlets (gravel is fm and sub-angular to angular)



NATURAL MOISTURE CONTENT

23

%

% PASSING 425µm SIEVE

98

%

LIQUID LIMIT

39

%

PLASTIC LIMIT

16

%

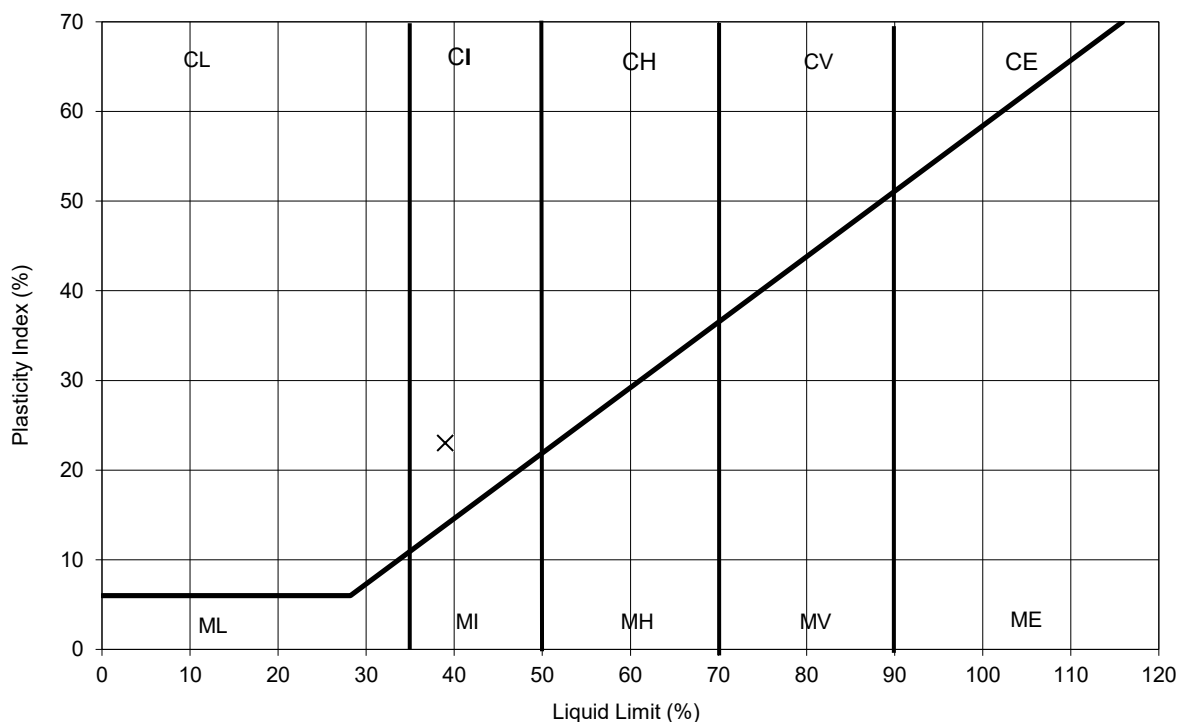
PLASTICITY INDEX

23

%

Remarks

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

WS02

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

0.90

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

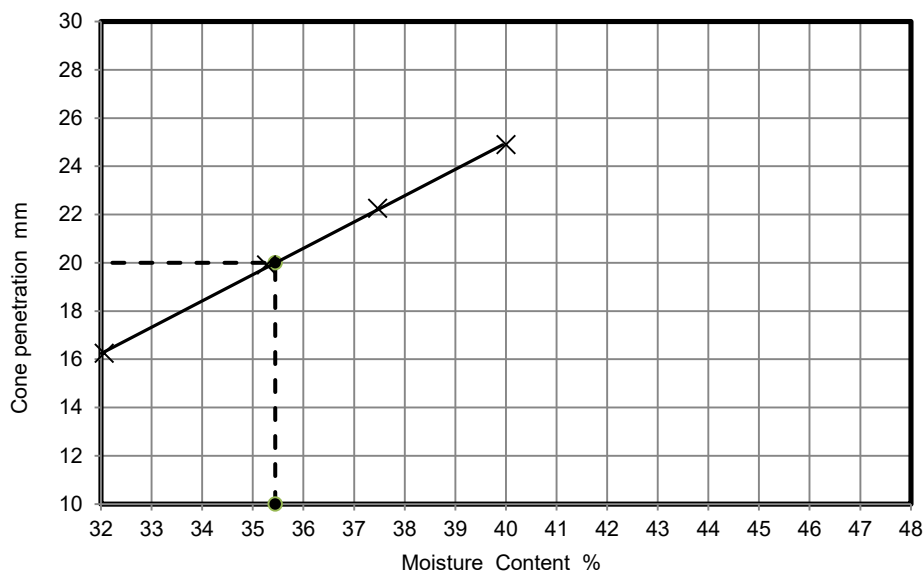
23/02/2018

Date Tested

07/03/2018

Soil Description

Orangish brown slightly mottled grey sandy silty CLAY with rare fine gravel



NATURAL MOISTURE CONTENT

21

%

% PASSING 425µm SIEVE

99

%

LIQUID LIMIT

35

%

PLASTIC LIMIT

16

%

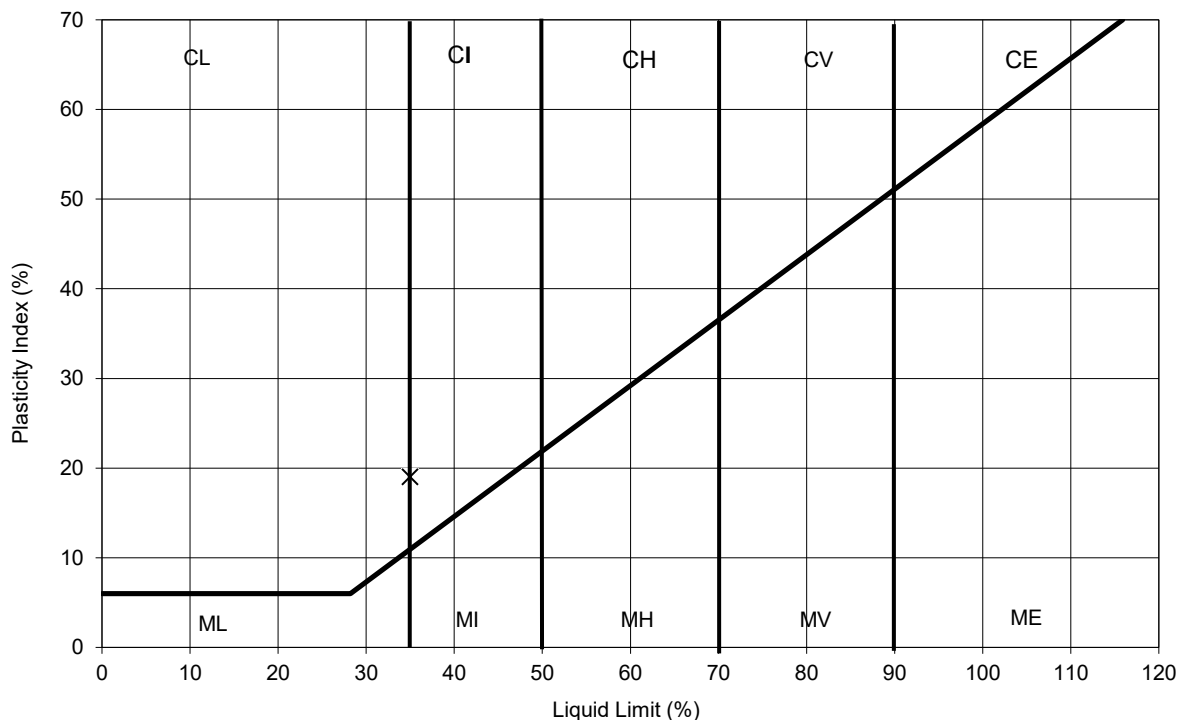
PLASTICITY INDEX

19

%

Remarks

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

WS05

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

2.40

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

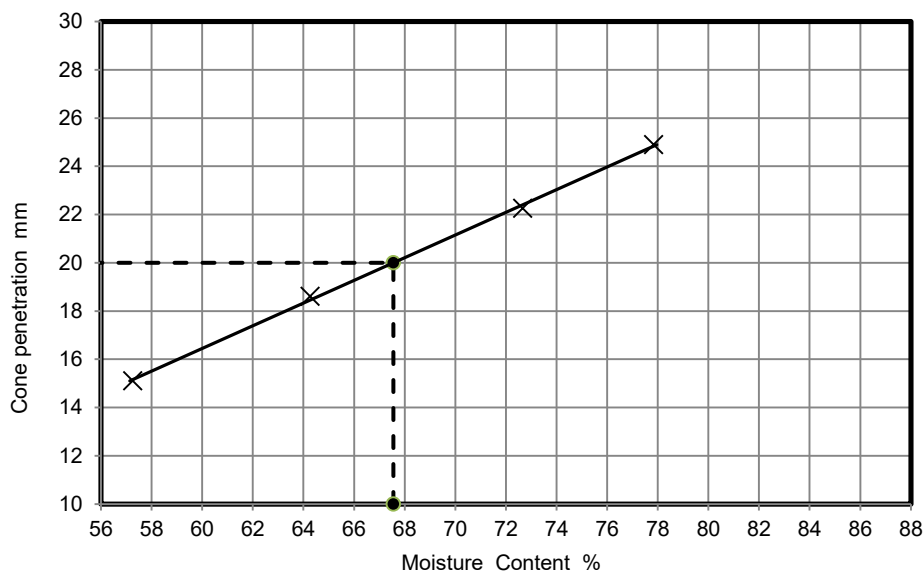
23/02/2018

Date Tested

07/03/2018

Soil Description

Orangish brown slightly mottled grey slightly gravelly silty CLAY
(gravel is fm and sub-angular to angular)



NATURAL MOISTURE CONTENT

24

%

% PASSING 425µm SIEVE

97

%

LIQUID LIMIT

68

%

PLASTIC LIMIT

20

%

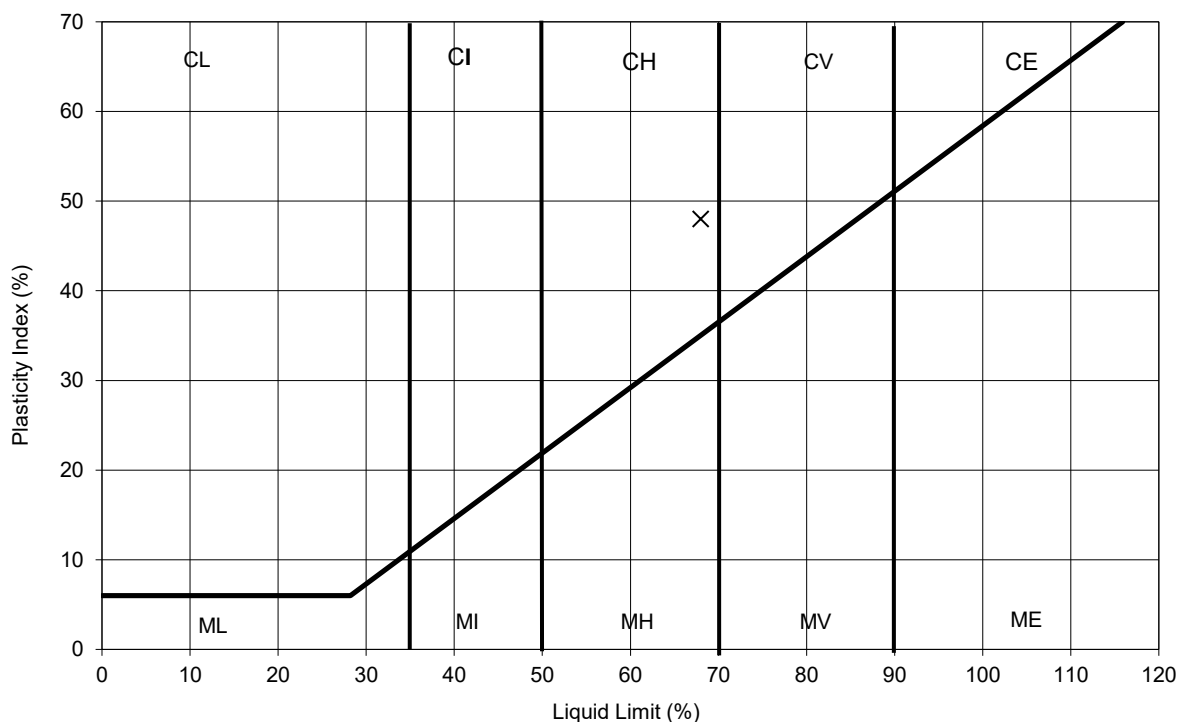
PLASTICITY INDEX

48

%

Remarks

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990:Determination of the moisture content by the oven drying

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

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MSF-5 R2





LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX

Job No.

24109

Borehole/Pit No.

WS08

Site Name

Bellmore Allotments, Burns Close

Sample No.

-

Project No.

1712003.001

Client

TEC

Depth Top

2.00

m

Depth Base

-

m

Sample Type

D

Samples received

21/02/2018

Schedules received

23/02/2018

Project Started

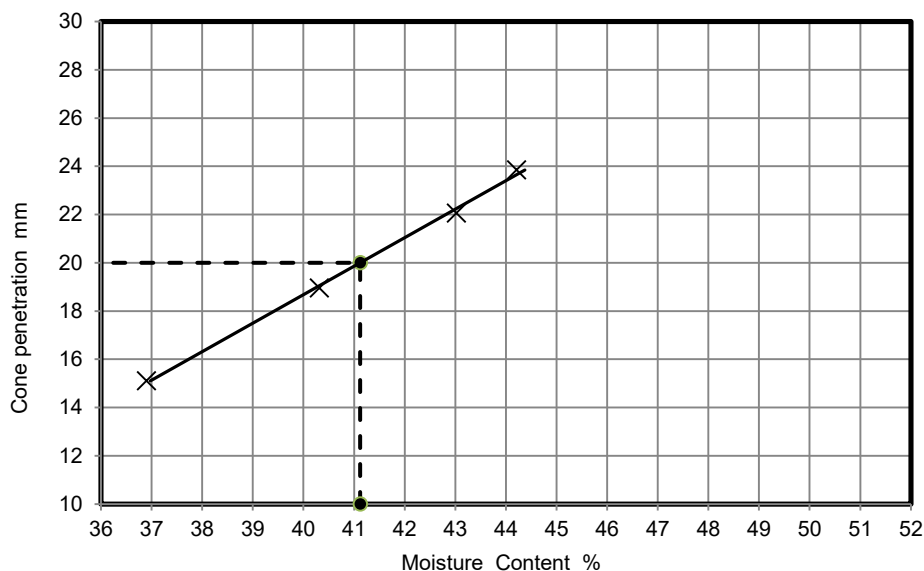
23/02/2018

Date Tested

07/03/2018

Soil Description

Orangish brown slightly mottled grey gravelly sandy silty CLAY
(gravel is fmc and sub-angular to sub-rounded)



NATURAL MOISTURE CONTENT

21

%

% PASSING 425µm SIEVE

35

%

LIQUID LIMIT

41

%

PLASTIC LIMIT

18

%

PLASTICITY INDEX

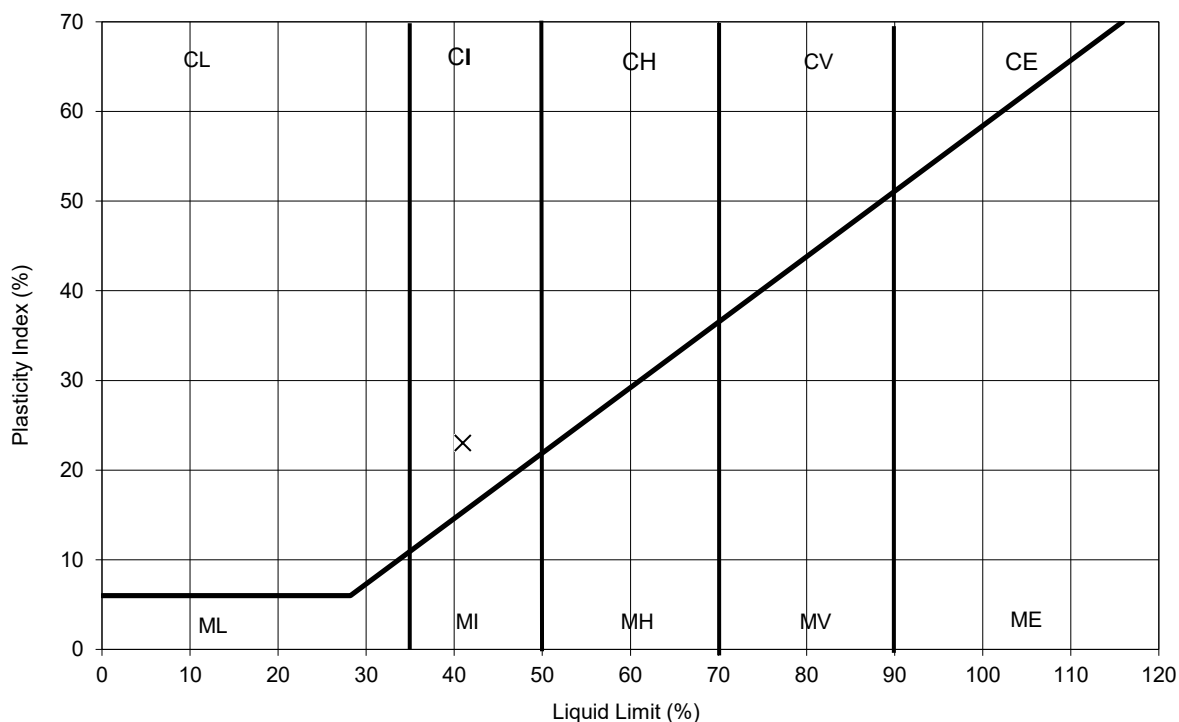
23

%

Remarks

Sample washed to obtain test fraction

PLASTICITY INDEX



TEST METHOD

BS1377: Part 2 :Clause 4.4 : 1990 Determination of the liquid limit by the cone penetrometer method

BS1377: Part 2 :Clause 5.0 : 1990: Determination of the plastic limit and plasticity index

BS1377: Part 2 :Clause 3.2 : 1990: Determination of the moisture content by the oven drying

Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU

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Checked and Approved

Initials: J.P

Date: 13/03/2018

2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5 R2



Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No. 24109	Project Name Bellmore Allotments, Burns Close	Programme	
		Samples received	21/02/2018
Project No. 1712003.001	Client TEC	Schedule received	23/02/2018
		Project started	23/02/2018
		Testing Started	07/03/2018

Hole No.	Sample				Soil Description	NMC %	Passing 425µm %	LL %	PL %	PI %	Remarks
	Ref	Top m	Base m	Type							
BH01	-	4.50	-	D	Brown silty CLAY	30	100	77	26	51	
BH01	-	8.00	-	D	Dark brown slightly mottled orangish brown silty CLAY	26	100	74	23	51	
BH02	-	6.00	-	D	Dark brown slightly mottled orangish brown silty CLAY with rare fine gravel	26	99	75	24	51	
BH02	-	10.00	-	D	Dark brown silty CLAY	27	100	73	22	51	
WS01	-	1.50	-	D	Light orangish brown slightly mottled grey slightly gravelly sandy silty CLAY with traces of fine rootlets (gravel is fm and sub-angular to angular)	23	98	39	16	23	
WS02	-	0.90	-	D	Orangish brown slightly mottled grey sandy silty CLAY with rare fine gravel	21	99	35	16	19	
WS05	-	2.40	-	D	Orangish brown slightly mottled grey slightly gravelly silty CLAY (gravel is fm and sub-angular to angular)	24	97	68	20	48	
WS08	-	2.00	-	D	Orangish brown slightly mottled grey gravelly sandy silty CLAY (gravel is fmc and sub-angular to sub-rounded)	21	35	41	18	23	Sample washed to obtain test fraction

	Test Methods: BS1377: Part 2: 1990: Natural Moisture Content : clause 3.2 Atterberg Limits: clause 4.3, 4.4 and 5.0	Test Report by K4 SOILS LABORATORY Unit 8 Olds Close Olds Approach Watford Herts WD18 9RU Tel: 01923 711 288 Email: James@k4soils.com	Checked and Approved Initials J.P Date: 13/03/2018
	2519	Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)	MSF-5-R1



Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

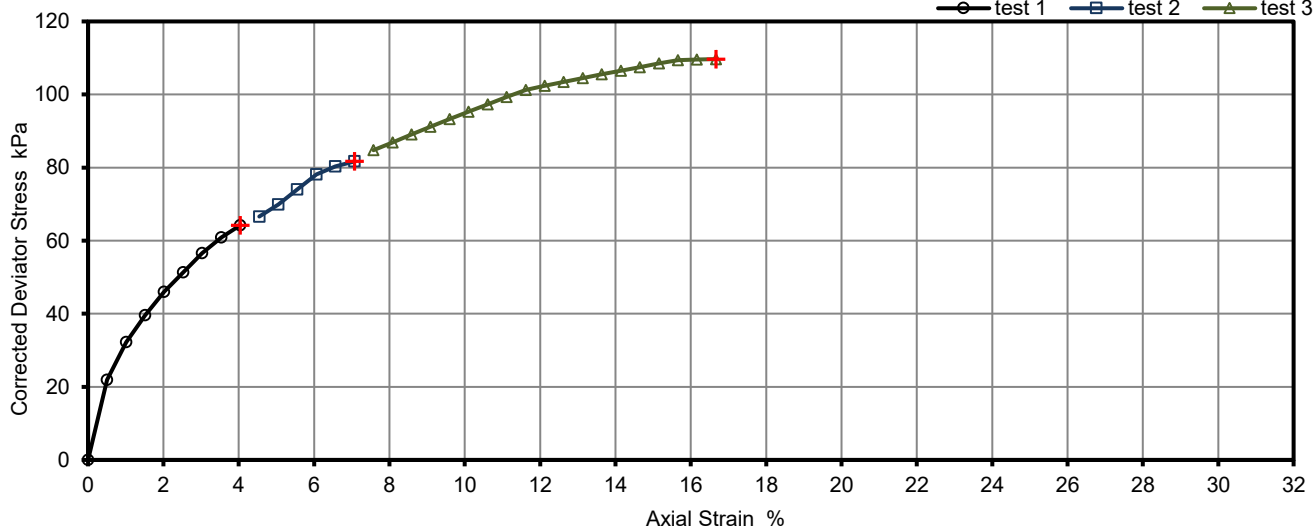
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test			Job Ref	24109
				Borehole/Pit No.	BH01
Site Name	Bellmore Allotments, Burns Close			Sample No.	-
Project No.	1712003.001	Client	TEC	Depth Top	2.00 m
Soil Description	Medium strength greyish brown slightly gravelly slightly sandy silty CLAY (gravel is fmc and sub-angular)			Depth Base	- m
				Sample Type	U
				Samples received	21/02/2018
				Schedules received	23/02/2018
Test Method	BS1377:Part 7:1990, clause 9, multistage test on a single specimen			Date of test	08/03/2018

Remarks

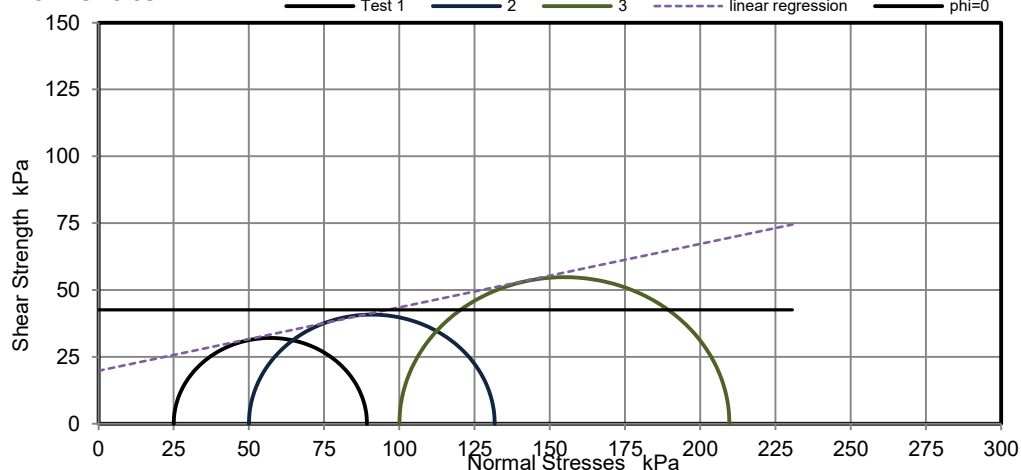
Position within sample

Length	mm	198.0			
Diameter	mm	102.0			
Bulk Density	Mg/m3	2.20			
Moisture Content	%	17			
Dry Density	Mg/m3	1.87			
Rate of Strain	%/min	2.00			
Stage Number		1	2	3	
Cell Pressure	kPa	25	50	100	
Axial Strain	%	4.0	7.1	16.7	
Deviator Stress, ($\sigma_1 - \sigma_3$)f	kPa	64.2	81.7	109.7	
Shear strength, cu	kPa	32.1	40.8	54.8	
Mode of failure		Compound			

Deviator Stress v Axial Strain



Mohr Circles



$\phi_u = 0$

Average cu 43 kPa

Linear Regression

ϕ_u 13.3 °

cu 20 kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.



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Initials: J.P

Date: 13/03/2018



Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

Job Ref	24109
Borehole/Pit No.	BH01
Sample No.	-
Depth Top	6.50 m
Depth Base	- m
Sample Type	U
Samples received	21/02/2018
Schedules received	23/02/2018
Date of test	08/03/2018

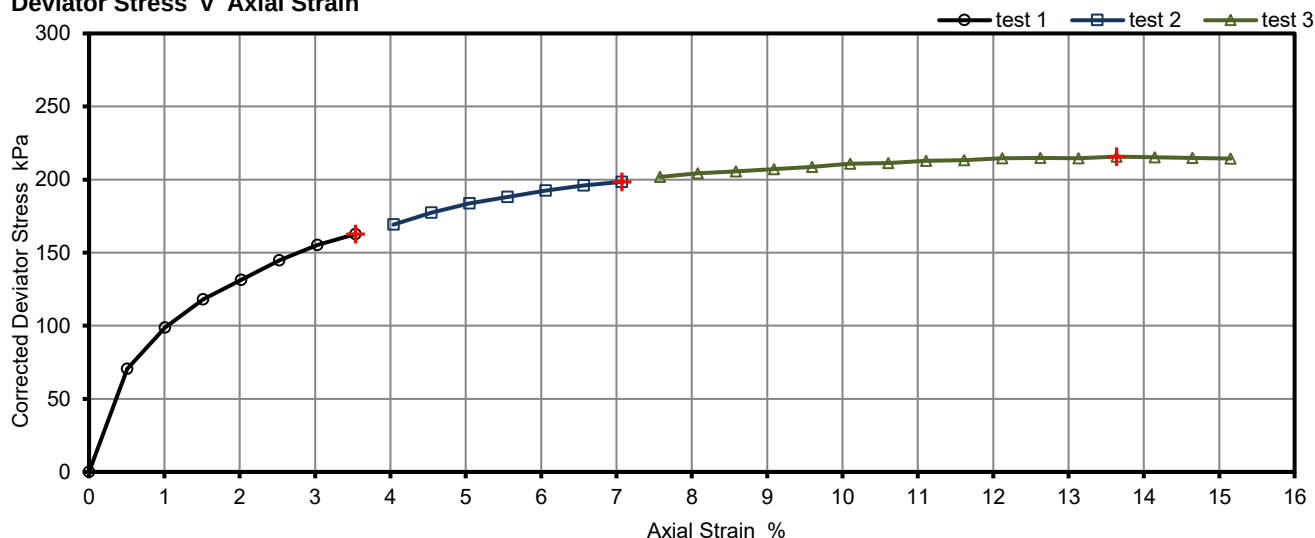
Site Name	Bellmore Allotments, Burns Close		
Project No.	1712003.001	Client	TEC
Soil Description	High strength dark grey silty CLAY		
Test Method	BS1377:Part 7:1990, clause 9, multistage test on a single specimen		

Remarks

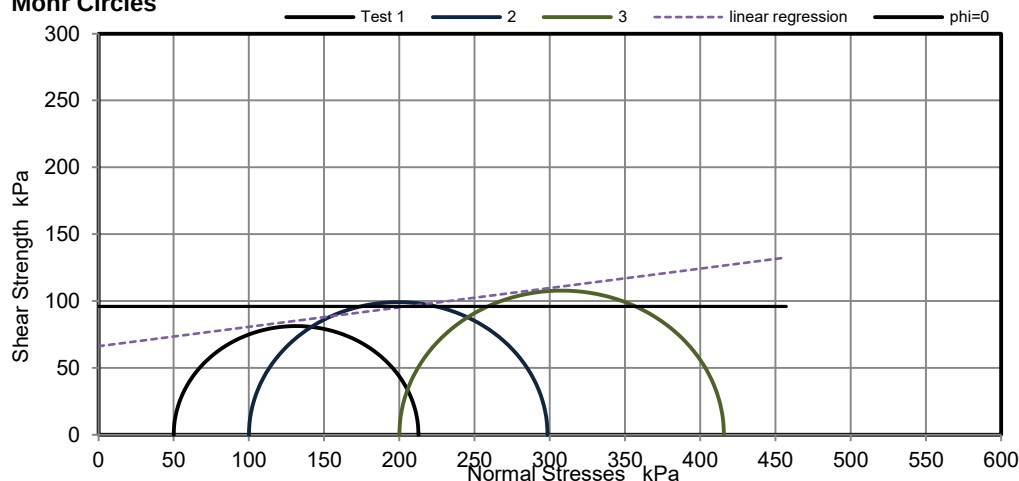
Position within sample

Length	mm	198.0		
Diameter	mm	102.0		
Bulk Density	Mg/m3	1.98		
Moisture Content	%	27		
Dry Density	Mg/m3	1.55		
Rate of Strain	%/min	2.00		
Stage Number		1	2	3
Cell Pressure	kPa	50	100	200
Axial Strain	%	3.5	7.1	13.6
Deviator Stress, ($\sigma_1 - \sigma_3$) f	kPa	162.7	198.5	215.7
Shear strength, cu	kPa	81.4	99.2	107.9
Mode of failure		Compound		

Deviator Stress v Axial Strain



Mohr Circles



$\phi_u = 0$
Average cu 96 kPa
Linear Regression
 ϕ_u 8.3 °
cu 66 kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.



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Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

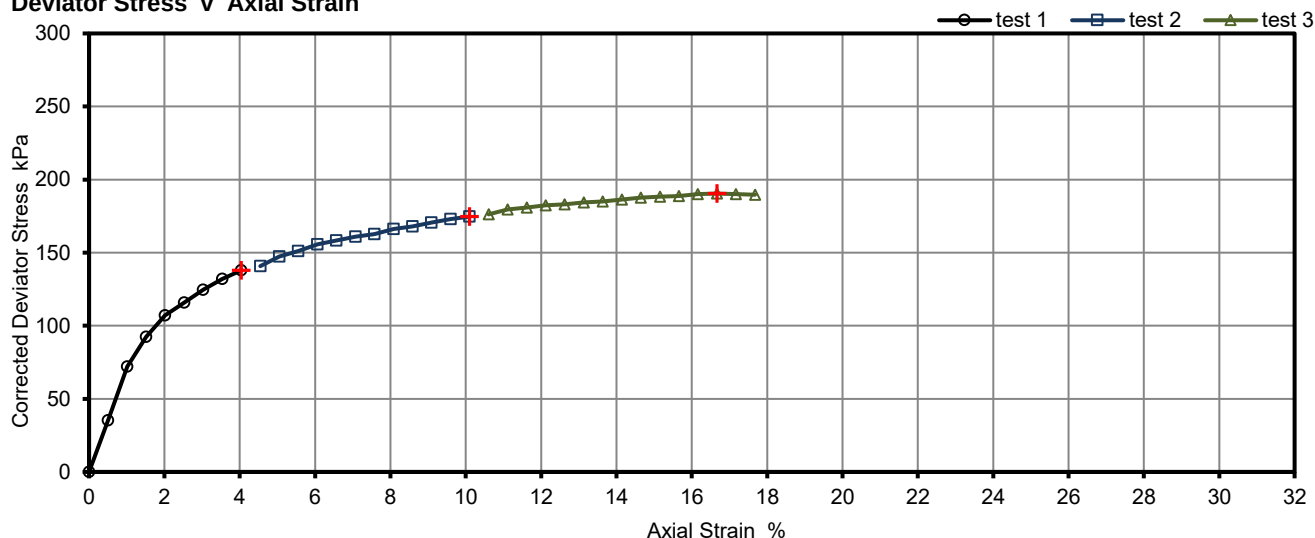
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test			Job Ref	24109
				Borehole/Pit No.	BH02
Site Name	Bellmore Allotments, Burns Close			Sample No.	-
Project No.	1712003.001	Client	TEC	Depth Top	3.00 m
Soil Description	High strength fissured brown and bluish grey mottled silty CLAY			Depth Base	- m
				Sample Type	U
				Samples received	21/02/2018
				Schedules received	23/02/2018
Test Method	BS1377:Part 7:1990, clause 9, multistage test on a single specimen			Date of test	08/03/2018

Remarks

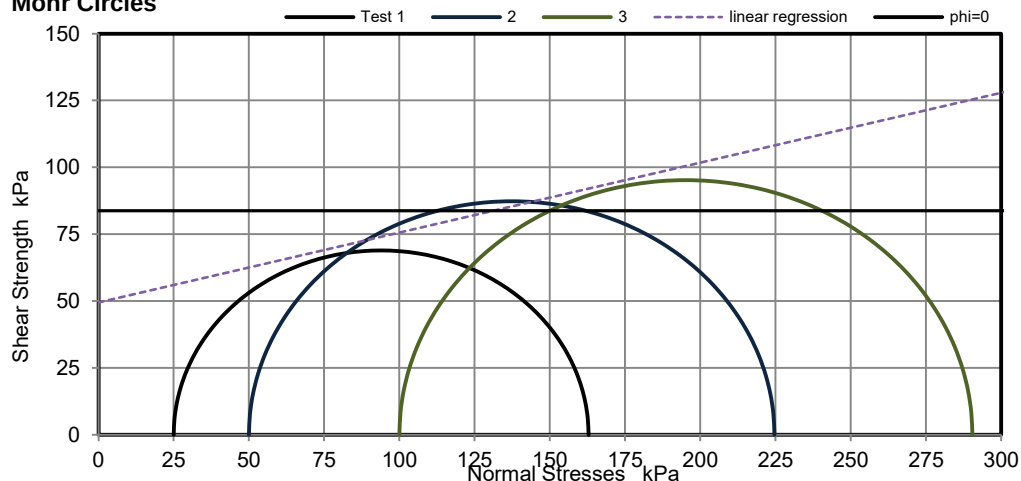
Position within sample

Length	mm	198.0		
Diameter	mm	102.0		
Bulk Density	Mg/m3	2.06		
Moisture Content	%	29		
Dry Density	Mg/m3	1.59		
Rate of Strain	%/min	2.00		
Stage Number		1	2	3
Cell Pressure	kPa	25	50	100
Axial Strain	%	4.0	10.1	16.7
Deviator Stress, ($\sigma_1 - \sigma_3$) f	kPa	137.9	174.7	190.4
Shear strength, cu	kPa	68.9	87.3	95.2
Mode of failure	Compound			

Deviator Stress v Axial Strain



Mohr Circles



$\phi_u = 0$

Average cu 84 kPa

Linear Regression

ϕ_u 14.6 °

cu 50 kPa

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Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

Job Ref	24109
Borehole/Pit No.	BH02
Sample No.	-
Depth Top	12.50 m
Depth Base	- m
Sample Type	U
Samples received	21/02/2018
Schedules received	23/02/2018
Date of test	08/03/2018

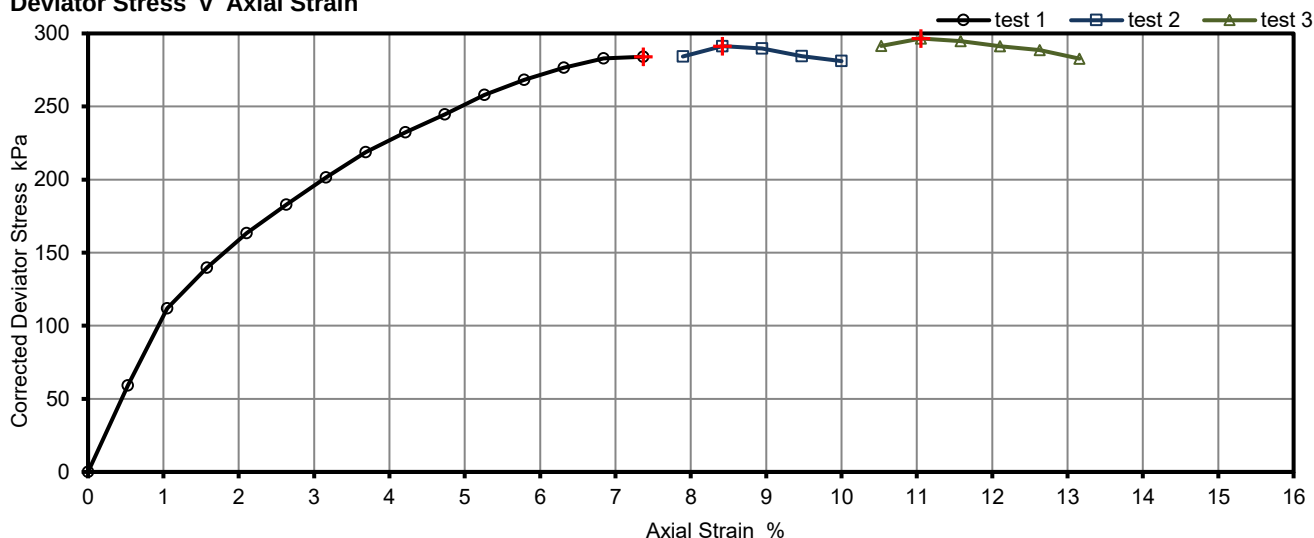
Site Name	Bellmore Allotments, Burns Close		
Project No.	1712003.001	Client	TEC
Soil Description	High strength fissured dark grey silty CLAY		
Test Method	BS1377:Part 7:1990, clause 9, multistage test on a single specimen		

Remarks

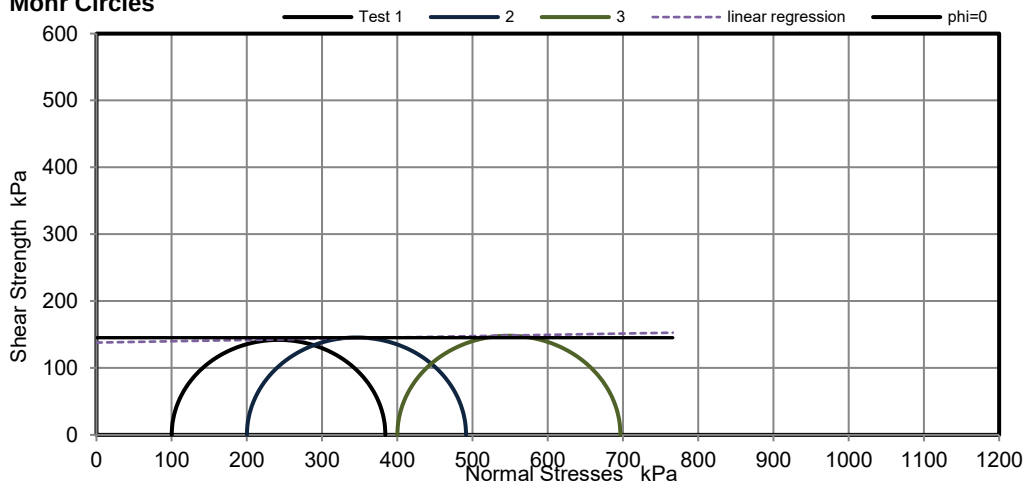
Position within sample

Length	mm	190.0		
Diameter	mm	102.0		
Bulk Density	Mg/m3	1.99		
Moisture Content	%	29		
Dry Density	Mg/m3	1.54		
Rate of Strain	%/min	2.00		
Stage Number		1	2	3
Cell Pressure	kPa	100	200	400
Axial Strain	%	7.4	8.4	11.1
Deviator Stress, ($\sigma_1 - \sigma_3$)f	kPa	284.1	291.3	296.5
Shear strength, cu	kPa	142.0	145.7	148.3
Mode of failure		Brittle		

Deviator Stress v Axial Strain



Mohr Circles



$\phi_u = 0$

Average c_u 145 kPa

Linear Regression

ϕ_u 1.1 °

c_u 138 kPa

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Unconsolidated Undrained Triaxial Compression tests without measurement of pore pressure Summary of Results

Tests carried out in accordance with BS1377:Part 7 : 1990 clause 8 or 9 as appropriate to test

Job No.	Project Name	Programme	
24109	Bellmore Allotments, Burns Close	Samples received	21/02/2018
		Schedule received	23/02/2018
Project No.	Client	Project started	23/02/2018
1712003.001	TEC	Testing Started	08/03/2018

Hole No.	Sample				Soil Description	Test Type	Density		w	Length	Diameter	σ_3	At failure				Remarks
	Ref	Top	Base	Type			bulk	dry					Axial strain	$\sigma_1 - \sigma_3$	cu	Mode	
		m	m				Mg/m ³		%	mm	mm	kPa	%	kPa	kPa		
BH01	-	2.00	-	U	Medium strength greyish brown slightly gravelly slightly sandy silty CLAY (gravel is fmc and sub-angular)	UUM	2.20	1.87	17	198	102	25 50 100	4.0 7.1 16.7	64 82 110	32 41 55	C	
BH01	-	6.50	-	U	High strength dark grey silty CLAY	UUM	1.98	1.55	27	198	102	50 100 200	3.5 7.1 13.6	163 198 216	81 99 108	C	
BH02	-	3.00	-	U	High strength fissured brown and bluish grey mottled silty CLAY	UUM	2.06	1.59	29	198	102	25 50 100	4.0 10.1 16.7	138 175 190	69 87 95	C	
BH02	-	12.50	-	U	High strength fissured dark grey silty CLAY	UUM	1.99	1.54	29	190	102	100 200 400	7.4 8.4 11.1	284 291 297	142 146 148	B	

Legend UU - single stage test (single and multiple specimens) σ_3 Cell pressure Mode of failure ; B - Brittle
UUM - Multistage test on a single specimen $\sigma_1 - \sigma_3$ Maximum corrected deviator stress P - Plastic
suffix R - remoulded or recompacted cu Undrained shear strength, $\frac{1}{2}(\sigma_1 - \sigma_3)$ C - Compound



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Date: 13/03/2018



ONE DIMENSIONAL CONSOLIDATION TEST

Job Ref 24109

Borehole/Pit No. BH02

Sample No. -

Site Name Bellmore Allotments, Burns Close

Depth Top 3.00 m

Project ID 1712003.001 Client TEC

Depth Base - m

Soil Description High strength fissured brown and bluish grey mottled silty CLAY

Sample Type U

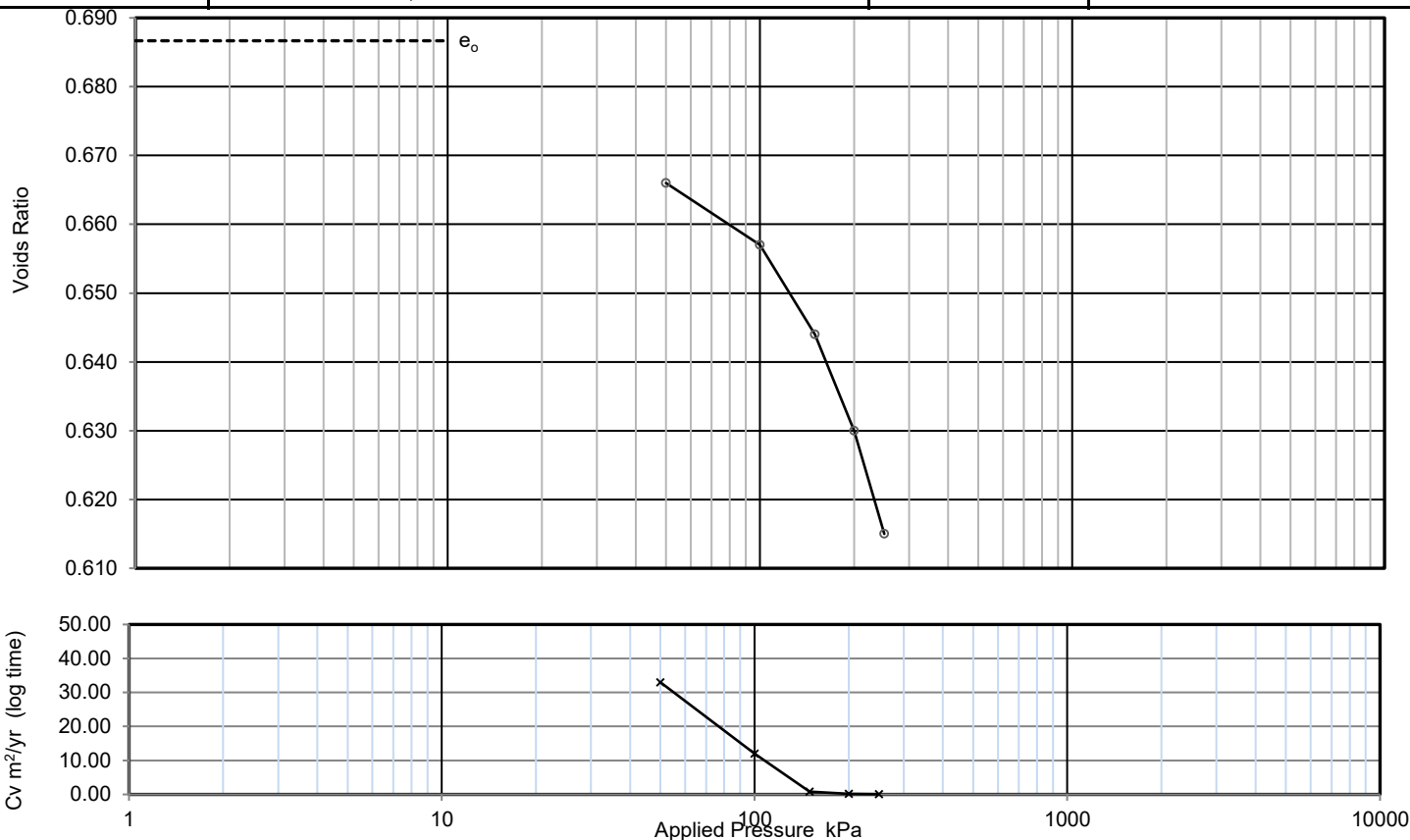
Sample Received 21/02/2018

Schedule received 23/02/2018

Project Started 23/02/2018

Test Method BS1377:Part 5: 1990, clause 3

Date Test started 27/02/2018



Applied Pressure kPa	Voids ratio	Mv m2/MN	Cv (t50, log) m2/yr	Cv (t90, root) m2/yr	Csec
2.0	0.687	-	-	-	-
50	0.666	0.26	33	33	0.00013
100	0.657	0.11	12	14	0.00037
150	0.644	0.15	0.8	1.7	0.0012
200	0.630	0.17	0.2	0.21	0.002
250	0.615	0.18	0.086	0.11	0.0036

Preparation

Orientation within sample

Vertical

Particle density assumed 2.70 Mg/m3

Specimen details

Diameter
Height
Moisture Content
Bulk density
Dry density
Voids Ratio
Saturation
Average temperature for test
Swelling Pressure
Settlement on saturation

Initial	Final	
75.05	-	mm
18.90	18.10	mm
26.2	26.7	%
2.02	2.12	Mg/m3
1.60	1.67	Mg/m3
0.687	0.615	
103	117	%
22.0		oC
		kPa
		%

Remarks

Test Report by K4 SOILS LABORATORY

Unit 8 Olds Close Olds Approach

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Initials K.P

Date: 13/03/2018

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

MSF-5-R6



APPENDIX F

CBR Results



In Situ California Bearing Ratio (CBR)

Job Ref 24013
CBR No. CBR1

Site Name Bellmore Allotments, Burns Close, Hayes, London, UB4 0EJ Depth m 0.50

Project No. - Client TEC Date of Test 15/02/2018

Soil Description Brown silty CLAY

Test Method BS1377 : Part 9 : 1990, clause 4.3 CBR Test Number 1

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

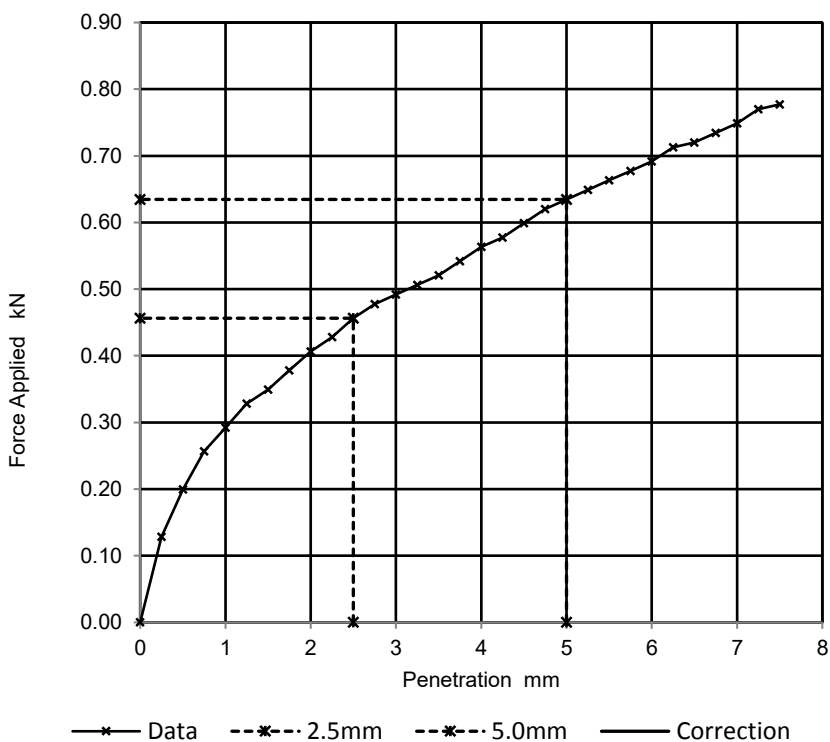
Rate of Strain 1.00 mm/min
Mass of Surcharge 4.6 kg
Proving Ring Factor 7.13 N/div

Temperature 8 °C
Environmental Conditions Clear

Readings

Penetration of Plunger mm	Force on Plunger	
	Dial Reading	Load kN
0.00	0	0.00
0.25	18	0.13
0.50	28	0.20
0.75	36	0.26
1.00	41	0.29
1.25	46	0.33
1.50	49	0.35
1.75	53	0.38
2.00	57	0.41
2.25	60	0.43
2.50	64	0.46
2.75	67	0.48
3.00	69	0.49
3.25	71	0.51
3.50	73	0.52
3.75	76	0.54
4.00	79	0.56
4.25	81	0.58
4.50	84	0.60
4.75	87	0.62
5.00	89	0.63
5.25	91	0.65
5.50	93	0.66
5.75	95	0.68
6.00	97	0.69
6.25	100	0.71
6.50	101	0.72
6.75	103	0.73
7.00	105	0.75
7.25	108	0.77
7.50	109	0.78

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
No	3.5	3.2	3.5	24



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Date: 16/02/2018



In Situ California Bearing Ratio (CBR)

Job Ref 24013
CBR No. CBR1

Site Name Bellmore Allotments, Burns Close, Hayes, London, UB4 0EJ Depth m 0.75

Project No. - Client TEC Date of Test 15/02/2018

Soil Description Brown silty CLAY

Test Method BS1377 : Part 9 : 1990, clause 4.3 CBR Test Number 2

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

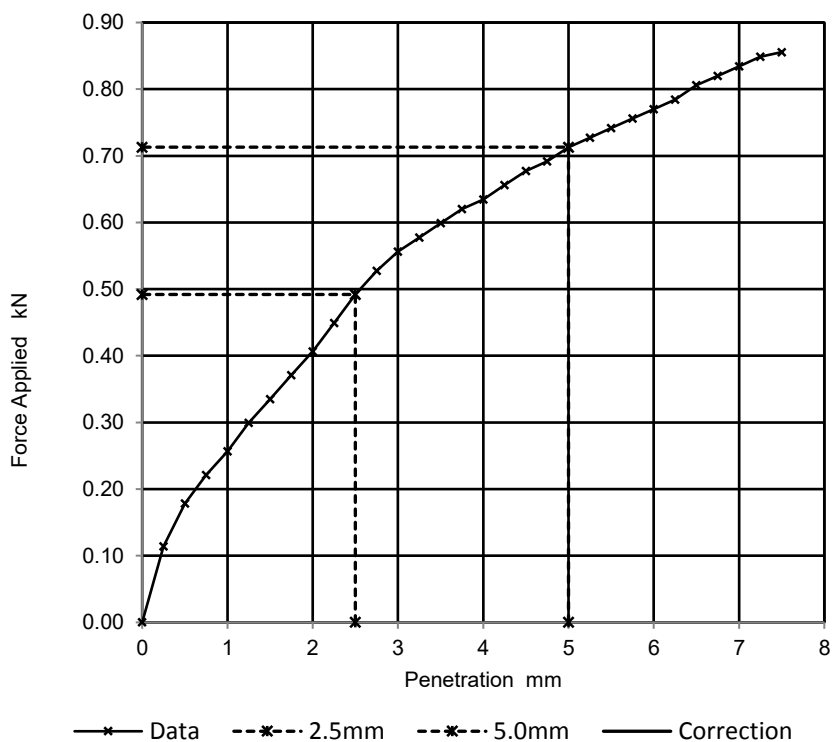
Rate of Strain 1.00 mm/min
Mass of Surcharge 4.6 kg
Proving Ring Factor 7.13 N/div

Temperature 8 °C
Environmental Conditions Clear

Readings

Penetration of Plunger mm	Force on Plunger	
	Dial Reading	Load kN
0.00	0	0.00
0.25	16	0.11
0.50	25	0.18
0.75	31	0.22
1.00	36	0.26
1.25	42	0.30
1.50	47	0.34
1.75	52	0.37
2.00	57	0.41
2.25	63	0.45
2.50	69	0.49
2.75	74	0.53
3.00	78	0.56
3.25	81	0.58
3.50	84	0.60
3.75	87	0.62
4.00	89	0.63
4.25	92	0.66
4.50	95	0.68
4.75	97	0.69
5.00	100	0.71
5.25	102	0.73
5.50	104	0.74
5.75	106	0.76
6.00	108	0.77
6.25	110	0.78
6.50	113	0.81
6.75	115	0.82
7.00	117	0.83
7.25	119	0.85
7.50	120	0.86

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
No	3.7	3.6	3.7	24



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Date: 16/02/2018



In Situ California Bearing Ratio (CBR)

Job Ref 24013
CBR No. CBR2

Site Name Bellmore Allotments, Burns Close, Hayes, London, UB4 0EJ Depth m 0.50

Project No. - Client TEC Date of Test 15/02/2018

Soil Description Brown silty CLAY

Test Method BS1377 : Part 9 : 1990, clause 4.3 CBR Test Number 3

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

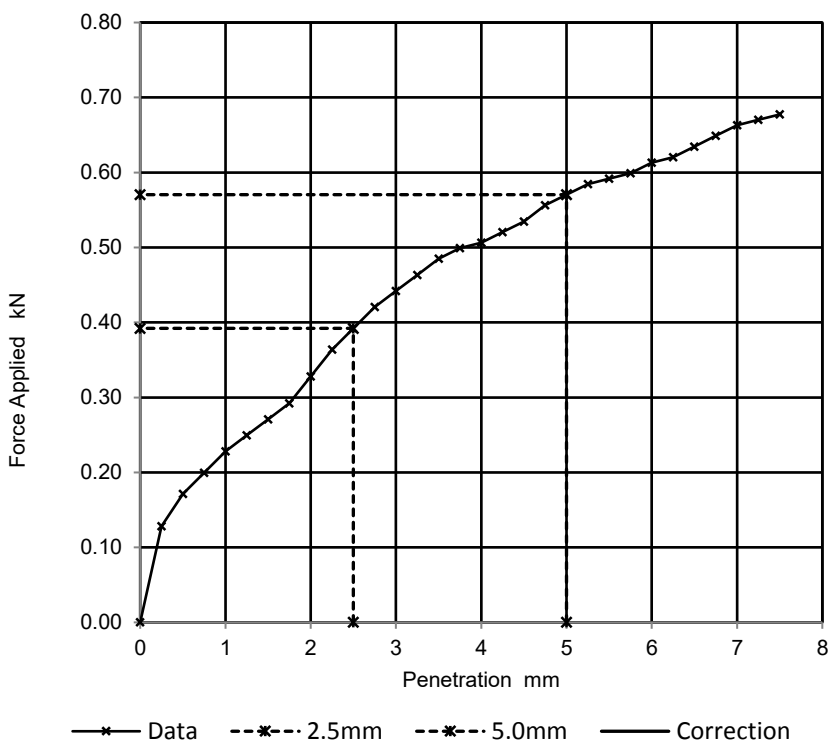
Rate of Strain 1.00 mm/min
Mass of Surcharge 4.6 kg
Proving Ring Factor 7.13 N/div

Temperature 8 °C
Environmental Conditions Clear

Readings

Penetration of Plunger mm	Force on Plunger	
	Dial Reading	Load kN
0.00	0	0.00
0.25	18	0.13
0.50	24	0.17
0.75	28	0.20
1.00	32	0.23
1.25	35	0.25
1.50	38	0.27
1.75	41	0.29
2.00	46	0.33
2.25	51	0.36
2.50	55	0.39
2.75	59	0.42
3.00	62	0.44
3.25	65	0.46
3.50	68	0.48
3.75	70	0.50
4.00	71	0.51
4.25	73	0.52
4.50	75	0.53
4.75	78	0.56
5.00	80	0.57
5.25	82	0.58
5.50	83	0.59
5.75	84	0.60
6.00	86	0.61
6.25	87	0.62
6.50	89	0.63
6.75	91	0.65
7.00	93	0.66
7.25	94	0.67
7.50	95	0.68

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
No	3.0	2.9	3.0	24



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In Situ California Bearing Ratio (CBR)

Job Ref 24013
CBR No. CBR2

Site Name Bellmore Allotments, Burns Close, Hayes, London, UB4 0EJ Depth m 0.75

Project No. - Client TEC Date of Test 15/02/2018

Soil Description Brown silty CLAY

Test Method BS1377 : Part 9 : 1990, clause 4.3 CBR Test Number 4

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

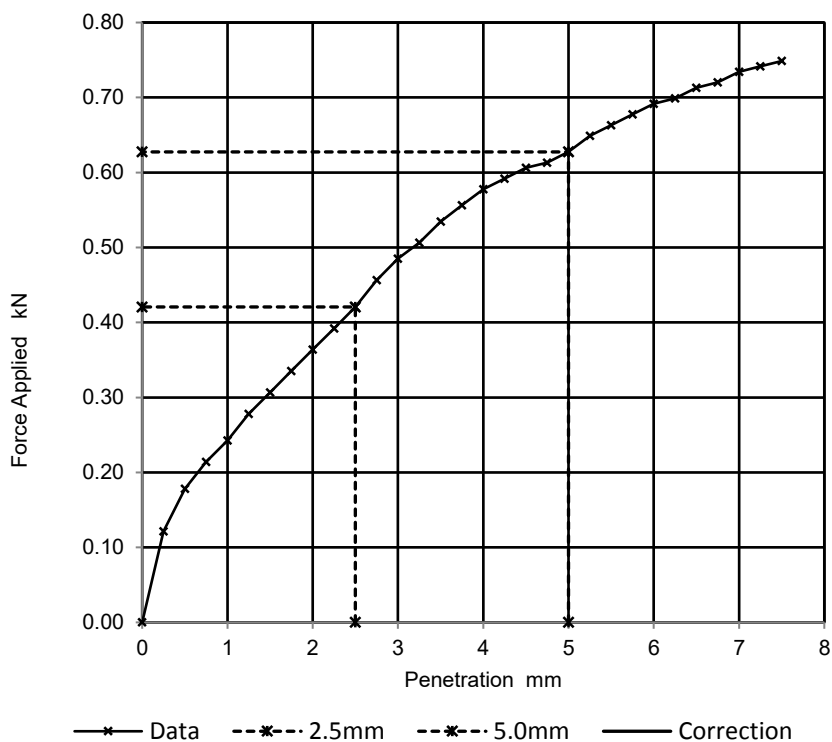
Rate of Strain 1.00 mm/min
Mass of Surcharge 4.6 kg
Proving Ring Factor 7.13 N/div

Temperature 8 °C
Environmental Conditions Clear

Readings

Penetration of Plunger mm	Force on Plunger	
	Dial Reading	Load kN
0.00	0	0.00
0.25	17	0.12
0.50	25	0.18
0.75	30	0.21
1.00	34	0.24
1.25	39	0.28
1.50	43	0.31
1.75	47	0.34
2.00	51	0.36
2.25	55	0.39
2.50	59	0.42
2.75	64	0.46
3.00	68	0.48
3.25	71	0.51
3.50	75	0.53
3.75	78	0.56
4.00	81	0.58
4.25	83	0.59
4.50	85	0.61
4.75	86	0.61
5.00	88	0.63
5.25	91	0.65
5.50	93	0.66
5.75	95	0.68
6.00	97	0.69
6.25	98	0.70
6.50	100	0.71
6.75	101	0.72
7.00	103	0.73
7.25	104	0.74
7.50	105	0.75

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
No	3.2	3.1	3.2	23



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Date: 16/02/2018