

APPENDIX O

CGL Remediation Scheme Addendum



Clark Smith Partnership

Western Access, Southall

Remediation Scheme Addendum

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1. INTRODUCTION

Card Geotechnics Limited (CGL) has been instructed by Clark Smith Partnership, on behalf of FM Conway Limited (FMC), to provide geotechnical and geoenvironmental consultancy services on the Southall Western Access project. The project comprises a new section of road embankment, crossing two watercourses, which will provide access to the Southall Waterside development, an 88-acre mixed regeneration project being delivered by the Berkeley Group.

A site location plan is presented as Figure 1 and a development overview plan is presented as Figure 2.

1.1 Scope of works

As part of the wider Western Access scheme, CGL has been instructed to undertake ground investigation and design in order to produce the following deliverables and provide the associated support in terms of scheme construction and planning condition approvals;

- Geotechnical Design Report (GDR) (*Aconex ref: A720-E05-IW-CGL-EW-RP-0004*);
- GDR Addendum Report (*Aconex ref: A720-E05-IW-CGL-EW-RP-0005*);
- Earthworks Specification (*Aconex ref: A720-E05-IW-CGL-BR-EW-SPC-0001*);
- Materials Management Plan (MMP) (*Aconex ref: A720-E05-IW-CGL-RP-0003*);
- Piling Risk Assessment; and
- Permanent and temporary works support.

The above items incorporate both geotechnical and geoenvironmental aspects and are the subject of their own respective reports. The above deliverables have been produced under the detailed design phase of the scheme and build upon previous reports^{1,2} submitted by CGL under the Pre-Construction Services Agreement (PCSA) phase of works, completed in December 2016.

As a result of consultation throughout the detailed design phase, CGL has been instructed to complete a Remediation Scheme Addendum report in addition to the above

¹ CGL (2016). Southall Western Access – Materials Management Plan. (A720-E05-IW-BR-CGL-EW-TS-0002 P2)

² CGL (2016). Southall Western Access – Outline Geotechnical Design Report. (A720-E05-IW-BR-CGL-EW-TS-0001 P2)

deliverables. This addendum report builds upon the existing Arup Remediation Scheme document³ for the Western Access, which forms the remediation strategy for the project. The Arup Remediation Scheme document has been submitted to the London Borough of Hillingdon and approved through planning under the first phase of development of the Western Access project.

Remediation of the main Southall Waterside development site, located to the east of the Grand Union Canal and incorporating the eastern embankment of the Western Access scheme, is being undertaken by CA Blackwells Limited. A separate remediation strategy for the main Southall Waterside development has been produced by Atkins under London Borough of Ealing planning consents.

1.2 Scope of this report

This report is considered to act as an addendum to the Arup Remediation Scheme document, to incorporate recent aspects of the project development during the detailed design phase. In this respect, the report relates only to the area of the site located within the London Borough of Hillingdon.

The additional aspects, not previously covered by the Remediation Scheme, have been highlighted following ongoing engagement with the Environment Agency, in support of the Western Access development. These additional aspects comprise the following:

- Generation of chemical criteria for re-use of site won materials within the scheme;
- A methodology for managing temporary stockpiling of site-won materials for re-use within the scheme;
- Further information with regards to treatment of site won fill material for re-use within the scheme;
- Establishing a monitoring programme to be adopted pre-, during and post construction of the western access; and
- Confirmation of the supervision and verification to be undertaken during the works including how unexpected contamination will be assessed and addressed.

³ ARUP (2016). Proposed Bridge Works for Southall Gas Works Redevelopment – Remediation Scheme [Issue 6]. Dated 5th August 2016. (A720-E02-PA-ARU-EN-RP-0003 P6)

To provide context and address the above, this report includes the following sections:

- Section 2 – site setting and context including a summary of the proposed Western Access development;
- Section 3 – a summary of the contamination assessment works completed to date;
- Section 4 – confirmation of the scheme conceptual site model;
- Section 5 – a summary of the proposed earthworks strategy;
- Section 6 – a summary of detailed quantitative risk assessment (DQRA) undertaken to derive re-use criteria for the scheme and the DQRA outcomes;
- Section 7 – the proposed methodology for mitigation of new pathways during temporary stockpiling;
- Section 8 - a summary of proposals for elements of the permanent works relating to contaminant pathways and the application of the re-use criteria within the earthworks strategy;
- Section 9 – details of the monitoring programme to be adopted pre-, during- and post-construction;
- Section 10 – a proposed watching brief and discovery strategy in the event of unexpected contamination; and
- Section 11 – confirmation of verification requirements in conjunction with other scheme deliverables.

It is anticipated that this addendum report will be used to obtain agreement from the statutory authorities with regards to the proposed management of contamination risks throughout the temporary and permanent works. It is intended to provide supplementary information to the GDR, MMP and Earthworks Specification, which are referred to throughout this report.

2. SITE SETTING AND CONTEXT

2.1 General

The Western Access scheme will be undertaken by FM Conway Ltd (FM Conway), who will be providing 'design and build' services under contract to Berkeley West Thames (BWT). The above scheme, herein referred to as 'the Site', comprises the construction of two new access bridges, a footbridge foundation and associated carriageway and supporting embankments to link the main Southall Waterside development to the existing Pump Lane carriageway.

Extensive documentation has historically been compiled for this scheme, which contains detail of the site, the proposed development and site geology/hydrogeology. The following sections provided a concise summary of the information contained within previous reports. A summary of historical scheme documentation can be found within the CGL GDR, referenced in Section 1.1.

2.2 Site location

The Site area as a whole covers approximately 7.66Ha. The area encompassing all three permanent earthworks is centred approximately on National Grid Reference (NGR) 511254, 179810.

A site location plan is included as Figure 1.

2.3 Site description

The Site is located within the London Borough of Hillingdon and borders the London Borough of Ealing to the east.

The Site area is roughly rectangular in shape and is bound to the east by the Grand Union Canal with the main Southall Waterside development beyond, the Minet Country Park to the north and the Great Western Mainline to the south. The Site is bound to the west by the existing Pump Lane carriageway, onto which the new Western Access road will connect.

For the purposes of this report, and to align with preceding investigation reports, the Site has been delineated into four main areas lying between the three main watercourses cutting the site; the River Crane, Yeading Brook and the Grand Union Canal (Plate 1).

- Area 1 - The largest area follows the course of the River Crane, oriented roughly south to north east and located east of Pump Lane, towards the Flood Compensation Area. The southernmost portion of this area relates to the proposed western road embankment, located between the River Crane and the Yeading Brook. This also incorporates an area west of the River Crane previously referenced as 'Bridge Bund'.
- Area 2 - The second area of investigation was along the proposed route for the western access road alignment, orientated west to east along the southern area of the site between the Yeading Brook and Grand Union canal. This area relates to the location of the proposed central road embankment.
- Area 3 - The Lagoon Bund is located on the north-eastern boundary of the site, and is located just west of the Grand Union Canal (oriented south west to north east). The Lagoon Bund comprises a roughly circular area of some 83m², and is understood to have been used as a dumping area for dredged materials from the Grand Union Canal.
- Area 4 - The area of the proposed road alignment located to the east of the Grand Union Canal, comprising a small area that lies adjacent to the main Southall Waterside development site.

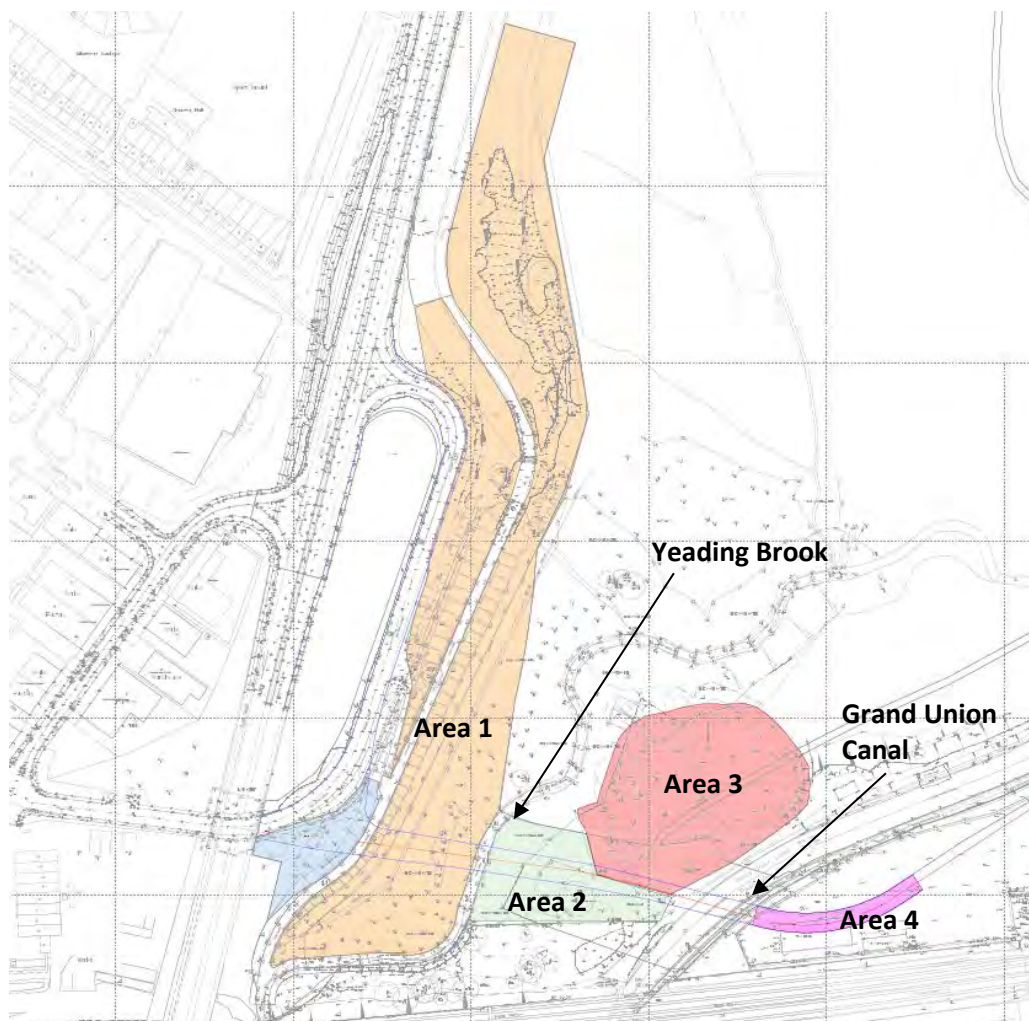


Plate 1 - Site overview

2.4 Proposed development

Planning permission has been granted for the construction of the new accesses to the main Southall Waterside development. The Site represents the construction of three new embankments and two new bridges, crossing the Yeading Brook and the Grand Union Canal. The work will also include the realignment of a flood channel to change where it enters the brook and provide flood compensation storage to offset the flood volume taken up by the road embankments.

The central embankment forming the Western Access will incorporate a section of land take within an area known as the Minet Tip, which will form the northern site boundary. The Minet Tip land is owned by the Canal and River Trust (CRT) and this area has been used for waste tipping of dredged materials from the Grand Union Canal. More recently, earthworks have been created to form lagoons used for canal dredgings. A portion of this land has been acquired by BWT under Compulsory Purchase Order to facilitate the construction of the central embankment.

Following construction of the Western Access embankment, the lagoon needs to be reconfigured in order to maintain the existing capacity for future CRT activities. Currently, the reconfiguration of the lagoon is not within FMC's scope of works for the Western Access scheme and will not be referred to in this report.

2.5 Summary of historical development

The key historical uses of the site and surrounding area are as follows:

- Prior to development the Site formed part of the flood plain and valley side of the Yeading Brook;
- The Grand Union Canal was constructed in the early 19th Century;
- The gasworks (within the main Southall Waterside development) was developed to the east of the canal between the mid 19th century and the end of the century; and
- Tipping started between the canal and the brook in the 1930s and continued until recently. Latterly only canal dredgings have been placed on the Minet Tip.

2.6 Ground conditions

2.6.1 Geology

According to the British Geological Survey (BGS) map of the area⁴, much of the Site is underlain by Made Ground. Along the course of the brook, Alluvium is shown with Lynch Hill Terrace Gravels also present. These are underlain by London Clay and Chalk at depth.

Beyond the immediate valley associated with the brook, the BGS records show the Langley Silt Member to be present.

2.6.2 Hydrogeology and hydrology

According to the Environment Agency website⁵ the site is underlain by a Principal Aquifer (Lynch Hill Gravel Member). These strata usually provide water storage and may also support water supply and/or river base flow.

The underlying London Clay is classified by the EA as an Unproductive Strata. The site is not located within a groundwater water protection zone. The Arup Detailed Quantitative

⁴ BGS (1998). 1:50,000 Series England and Wales Sheet 270, South London, Solid and Drift Geology.

⁵ <http://www.environment-agency.gov.uk/>

Risk Assessment report (DQRA)⁶ mentions that records from the EA indicate there is only one licenced abstraction within 1km of the site, which is located 700m southwest of the site boundary. The abstraction, which is from the Chalk Principal Aquifer, is used for industrial/commercial use.

Three main watercourses cut the site including the River Crane, Yeading Brook and the Grand Union Canal. Both the Grand Union Canal and the River Crane are lined which will afford protection to these water bodies. The Yeading Brook is unlined.

⁶ ARUP (2015). St James West London, Southall Gas Works. *Detailed Quantitative Risk Assessment*. Job number 228263.

3. SUMMARY OF CONTAMINATION ASSESSMENT

3.1 Previous ground investigation summary

Several phases of ground investigation have been undertaken at the Site dating back to 1977. A full summary of the available investigation information is contained within the CGL GDR. This section will introduce and summarise those investigations undertaken by CGL during the 'advanced works' and 'detailed design' phases of the scheme to support the determination of materials suitable for re-use within the earthworks.

A total of 54nr. trials pits were undertaken across three phases of investigation, completed between February and March 2017. The results of each phase of investigation were summarised within an Earthworks Material Acceptability and Waste Characterisation (EMAWC) report^{7,8,9}. The staged undertaking and issue of these individual investigation reports was to provide a continuous release of information and to suit specific design objectives during the separate advanced works and detailed design phases of the scheme.

A summary of the findings within each report is discussed below. A site layout & exploratory hole location plan is presented as Figure 3.

3.1.1 Pump Lane Bund (within Area 1)

Trial pits were undertaken within the soil bund offering the existing boundary between the Site and the Pump Lane carriageway, which exclusively comprised Made Ground. The bund was proposed to be removed as part of the initial enabling works to provide site access and offices.

Geotechnical and chemical testing was undertaken on selected soil samples to determine material suitability for re-use and, if required, disposal off-site. This phase of testing and assessment only comprised screening against criteria for risks to human health, as the potential re-use of the material was not yet determined. No concentrations recorded within the Made Ground exceeded the assessment criteria.

⁷ CGL (2017). *CGN/03732C Southall advanced works*. Earthworks material acceptability and waste characterisation - Pump Lane Bund. Rev1. May 2017

⁸ CGL (2017). *CGN/03732D Southall advanced works*. Earthworks material acceptability and waste characterisation – Bridge Bund and Lagoon Bund. Rev1. May 2017

⁹ CGL (2017). *CGN/03732E Southall Western Access*. Earthworks material acceptability and waste characterisation – Western Access Site. Rev0. May 2017

No assessment against criteria for risks to controlled waters was undertaken during this phase of investigation. Full details of the assessment and recorded exceedances are shown within the relevant EMAWC report contained within Appendix A (report ref: A720-E05-IW-BR-CGL-EW-TS-0003 P1).

3.1.2 Bridge Bund (Area 1) and Lagoon Bund (Area 3)

Trial pits were undertaken at two locations within the Site. The 'Bridge Bund' was an existing stockpile of material forming a further boundary between the Site and the Pump Lane carriageway. The stockpile, comprising exclusively Made Ground, was proposed to be excavated to permit the construction of a temporary bridge across the Yeading Brook.

The 'Lagoon Bund', which has been described earlier in the report, was primarily investigated to determine initial geotechnical parameters for the potential re-use of this material within the earthworks.

The results of the investigation showed that no concentrations within the Bridge Bund or Lagoon Bund exceeded the assessment criteria for risks to human health. However, waste acceptance criteria (WAC) assessment indicated the material would be deemed hazardous due to elevated TPH concentrations, with a single sample exceeding the hazardous waste landfill criteria.

No assessment against criteria for risks to controlled waters was undertaken during this phase of investigation. Full details of the assessment and recorded exceedances are shown with the relevant EMAWC report contained within Appendix A (report ref: A720-E05-IW-BR-CGL-EW-TS-0004 P1).

3.1.3 Western Access Site (incorporating Area 1-4)

This round of investigation was undertaken within the detailed design phase of the scheme. The number and location of trial pits was increased to obtain coverage of the likely source materials throughout the entire Site. Based on the results of the advanced works round of investigations, additional trial pits were focused on areas where contaminant concentrations were expected to be elevated i.e. the Lagoon Bund.

Samples taken from the River Crane (Area 1), the central embankment (Area 2) and the Lagoon Bund (Area 3), were tested against screening criteria for risks to controlled waters. The results of the investigation showed that all eight samples tested exceeded the Freshwater EQS screening criteria for certain contaminants including; sulfates, total

phenols, metals, PAH and pH. In addition, six metals and one PAH exceeded the DWV criteria, however this is considered to be a less preferential criteria than the EQS values. Full details of the assessment and recorded exceedances are shown with the relevant EMAWC report contained within Appendix A (report ref: A720-E05-IW-BR-CGL-EW-TS-0005 P1).

3.2 Soils

The results of soils analysis from the three phases of investigation completed between February and March 2017 were screened against UK generic assessment criteria (GAC) for a commercial land use, which were originally adopted as the 'limiting values' in accordance with Appendix 6/15 of the Preliminary Geotechnical Design Report. A commercial land use was considered a reasonably conservative initial assessment given the end use of the site as an access road with associated landscaping. The assessment did not identify any exceedances of commercial GAC within either Made Ground or natural strata though asbestos fibres were identified within six Made Ground samples, from laboratory analysis, at quantities, where recorded, below laboratory detection limits (<0.001% by volume).

Observations of contamination on site were recorded within a couple of Made Ground samples within Area 3, the lagoon bund. This included a layer of spent oxide ('Blue Billy') identified within TP29C at approximately 1.3m bgl and a number of hydrocarbon odours within the lagoon area. Whilst none of the results exceeded the GACs, the analysis from samples within the lagoon bund (Area 3) were found to contain the most elevated concentrations of contaminants.

3.3 Leachate

Leachate data was obtained from eight Made Ground / topsoil samples from the third phase of investigation in March 2017. These samples were obtained from the central embankment (Area 2), one from the River Crane (Area 1) and the remainder from the Lagoon Bund (Area 3). The results were compared with freshwater Environmental Quality Standards (EQS) and Drinking Water Values (DWV), as reasonably conservative screening values and based on the Yeading Brook forming the principal controlled waters receptor. These GAC were adopted as limiting values within Appendix 6/14 of the Preliminary Geotechnical Design Report.

Exceedances of the GAC were recorded within all eight samples with those samples from the Lagoon Bund found to have the highest concentrations. Exceedances in the Lagoon Bund included metals / metalloids, poly—cyclic aromatic hydrocarbons (PAHs), total

phenols, sulfate and pH. Generally, the highest concentrations were recorded within the leachate analysed from the spent oxide soil sample from TP29C.

Similar contaminants of concern were recorded within the three samples collected from the central embankment (Area 3) though concentrations were lower than in the samples from the Lagoon Bund. The leachate sample from the River Crane section (Area 1) was only found to exceed the GAC for a single contaminant; lead.

3.4 Groundwater

Two rounds of initial baseline monitoring and sampling of boreholes, installed to monitor the western access construction activities, was undertaken over the course of June 2017. Groundwater levels recorded during the monitoring rounds are summarised in Table 1. In-situ test results are presented in Appendix B. Samples were obtained from five monitoring locations, three from within the Lagoon (BH1A to BH3A) and two locations outside and nominally up-gradient of the Lagoon (BH3B and BH4B). A further two down-gradient monitoring locations, between the Lagoon and Yeading Brook (BH1B and BH2B), were installed between the 21st and 22nd June 2017 using restricted access drilling equipment. Pre-construction monitoring of these boreholes has not yet been undertaken, so as to enable the boreholes to settle following installation.

Table 1 Summary of groundwater levels

Borehole	Well response zone	Water strike (mbgl)	Water level 1 st Round 2 nd June 2017 (mbgl)	Water level 2 nd Round 27 th June 2017 (mbgl)
BH1A	Lynch Hill Gravel	Dry	2.45	2.55
BH2A	Made Ground	Dry	0.98	1.09
BH3A	Lynch Hill Gravel	Dry	1.16	1.55
BH1B	Lynch Hill Gravel	Dry	-	DRY
BH2B	Lynch Hill Gravel	Dry	-	DRY
BH3B	Lynch Hill Gravel	Dry	1.22	1.44
BH4B	Lynch Hill Gravel	Dry	0.45	0.57

Laboratory results were screened against freshwater EQS and DWV with exceedances recorded for certain metals (cadmium, boron and lead), free ammonia, PAHs (anthracene, fluoranthene and benzo(a)pyrene) and sulfate.

Further intrusive investigation, comprising borehole installation and monitoring was undertaken by Ramboll Environ, on behalf of FM Conway in April 2017. Three borehole locations were installed within the area of the western access to enable baseline, construction and post construction monitoring. The findings of the investigation including soils and initial groundwater monitoring results were presented in Ramboll Environ's Baseline Site Investigation Report (dated 19th May 2017) which concluded that the investigation did *'not identify field observations of significant contamination in soils or groundwater. Putrescible or unusual fill materials were not encountered. Ramboll Environ considers that the site investigation works have not identified significant or unexpected contamination.'*

3.5 Summary

The results of the investigation phase have identified some specific areas of the site where contamination is expected to be encountered. A contamination observation plan is presented as Figure 4, which highlights these areas and the contaminants of concern. Soil contaminants have been shown to be below the conservative screening criteria for risks to human health. Leachable contaminants have been shown to exceed initial screening criteria relevant to controlled waters. Groundwater contamination from pre-construction monitoring rounds has been shown to exceed conservative controlled waters screening criteria for some contaminants.

4. CONCEPTUAL SITE MODEL

4.1 Introduction

Previous phases of conceptual site model development and risk assessment have been completed for the Western Access site by Arup^{10, 11}. These concluded that no relevant pollutant linkages exist for the proposed Western Access Scheme and that risks can be managed through appropriate design and construction control measures. Based on these risk assessments, Arup concluded that remediation of the scheme was not required, as unacceptable risks to receptors were not identified.

Subsequent to these assessments the design of the Western Access has progressed and ongoing liaison with the regulators, principally the Environment Agency, has identified further aspects that require consideration, as noted above. As part of the design works additional ground investigation data has been obtained (and continues to be obtained) which has enabled refinement of the CSM and risk assessment. Based on these additional works and the previous Arup assessment a refined CSM and semi-quantitative risk assessment for the final, constructed scheme, is presented below.

The assessment has been undertaken in accordance with Contaminated Land Report (CLR) 11¹². The risks identified are in accordance with the DEFRA and Contaminated Land Report (CLR) 6¹³, site prioritisation and categorisation rating system which is summarised in Table 2 below.

Table 2 - Risk Rating Terminology

Risk Rating	Description
High Risk	Contaminants very likely to represent an unacceptable risk to identified targets Site probably not suitable for proposed use Enforcement action possible, Urgent action required
Medium Risk	Contaminants likely to represent an unacceptable risk to identified targets Site probably not suitable for proposed use

¹⁰ Ove Arup & Partners Ltd (18 February October 2015) St James West London Limited, Proposed Pump Lane Access, Works for Southall Gas Works, Redevelopment
Ground Investigation Report,

¹¹ Ove Arup & Partners Ltd (01 October 2015) St James West London, Proposed Bridge Works for Southall Gas Works Redevelopment, Ground Contamination: Detailed Quantitative Risk Assessment, Issue 2, Job No. 228263.

¹² The Environment Agency (2004) Model Procedures for the Management of Land Contamination, CLR 11

¹³ M.J. Carter Associates (1995) Prioritisation and Categorisation Procedure for Sites which may be Contaminated, Department of the Environment, CLR 6

	Action required in the medium term
Low Risk	Contaminants may be present but unlikely to create unacceptable risk to identified targets Site probably suitable for proposed use Action unlikely to be needed whilst site remains in current use
Negligible Risk	If contamination sources are present they are considered to be minor in nature and extent Site suitable for proposed use No further action required

The risk assessment is provided below in Table 3.

Table 3 - Semi-quantitative Risk Assessment

Source/Medium	Receptor	Potential Exposure Route	Risk Rating
Explosive / asphyxiating gases from within Made Ground and Lagoon deposits.	Future users	Migration of gases through the surface and via permeable soils, and subsequent inhalation in outdoor air.	Negligible <i>(Arup report Characteristic Situation 2 or low risk but no enclosed spaces proposed in development)</i>
	Embankment & bridge structures & services	Migration of gases through the surface and via permeable soils.	Negligible <i>(Risk of gas build-up and impact on structures is negligible as no enclosed spaces)</i>
	Construction workers	Migration of gases through the surface and via permeable soils, and subsequent inhalation.	Low <i>(Appropriate health and safety protocols and management during construction works)</i>
Contaminants in soils within flood compensation area and Lagoon Bund to be used in embankment construction	Future users, maintenance workers & trespassers	Direct contact & ingestion of soils, vapours and soil derived dust	Low <i>(Materials used will be effectively encapsulated within the embankment and under the road pavement construction minimising direct contact / dust pathways. GAC assessment does not indicate a risk to human health from vapours)</i>
	Buildings, structures & services	Direct contact	Low <i>(Elevated sulfate concentrations in soils and water to be mitigated through appropriate concrete / pile design)</i>
	Off-site occupants	Inhalation of vapours and soil derived dust	Negligible / low <i>(Post construction risk is considered negligible following placement and stabilisation of fill. Site control measures to be adopted to minimise risks during construction)</i>

Source/Medium	Receptor	Potential Exposure Route	Risk Rating
	Construction workers	Direct contact, ingestion, vapour inhalation and soil derived dust	Low to medium <i>(Appropriate health and safety protocols and personal/respiratory protective equipment required)</i>
	Plants and vegetation	Uptake via roots	Low to medium <i>(Capping layer and growth medium likely required where new vegetation proposed e.g. sides of the embankment)</i>
	Groundwater within the Lynch Hill Gravel	Leaching from soils to groundwater	Low to medium <i>(Potential ongoing impact to be mitigated by use of material meeting scheme re-use criteria and through appropriate design to mitigate risks associated with new pathways e.g. management of temporary stockpiles)</i>
	Groundwater within deep aquifer (Chalk)	Leaching and migration of contaminants	Negligible <i>(Groundwater in the deep Chalk aquifer protected by the overlying London Clay Formation ~30m thick)</i>
	Yeading Brook	Leaching and lateral migration of contaminants	Medium <i>(Design measures to minimise potential impact include lining the proposed temporary lagoon stockpiles, re-use of material to meet modelled criteria and treatment / stabilisation of certain materials which will reduce permeability)</i>
	Grand Union Canal	Leaching and lateral migration of contaminants	Negligible <i>(Canal is lined and not considered in hydraulic continuity with the site)</i>
Dissolved phase contamination within the Lynch Hill Gravel groundwater	Construction workers	Dermal contact and potential ingestion of contaminated shallow groundwater	Low <i>(Appropriate health and safety protocols required)</i>
	Yeading Brook	Lateral migration of contaminants in groundwater	Medium <i>(Design measures to minimise impact including lining temporary lagoon stockpile, re-use of suitable materials and stabilisation to treat residual dissolved phase metals contamination)</i>
	Grand Union Canal	Lateral migration of contaminants in groundwater	Negligible <i>(Canal is lined and not considered in hydraulic continuity with the site)</i>

Source/Medium	Receptor	Potential Exposure Route	Risk Rating
	Buildings, structures & services	Direct contact	Low <i>(Elevated sulfate concentrations in water to be mitigated through appropriate concrete / pile design)</i>

A simplified pictorial representation of the conceptual site model for the scheme is presented as Figure 5.

5. EARTHWORKS STRATEGY

5.1 General

The construction phase of the scheme will involve the excavation, movement, placement and compaction of fill to form three new embankments. Material excavated from source areas within the Site (e.g. Flood Compensation Area, Lagoon Bund) are proposed to be re-used within the earthwork. There is currently expected to be a net deficit of fill material, based upon the latest assessment of cut/fill volumes. Details of the proposed cut and fill areas are shown within Appendix C and summarised in Table 4 below.

An estimation of the proportion of directly re-useable cut material has been made based upon proposed formation levels, anticipated ground conditions and outline chemical soil results. Based on this estimate, an adjusted cut volume is calculated. This indicates a net fill of approximately 32,000m³, however this value may change depending on the variability of ground conditions encountered at excavation and presence of contamination and should be used as an estimation of anticipated fill volumes.

Table 4 Summary of cut/fill volumes

Zone	Location	Cut (m ³) ^a	Fill (m ³) ^b	Net (m ³) ^c	Estimated % re-use ^d	Adjusted cut (m ³) ^e	Adjusted Net (m ³)
1	Flood Compensation Area	20,527.0	6,770.7	-13,756.3	85%	17,448.0	-10,677.3
2	Diverted channel (River Crane)	3,010.0	1,200.3	-1,809.7	75%	2,257.5	-1,057.2
3	Pump Lane Junction	4,608.0	7,668.1	3,060.1	50%	2,304.0	5,364.1
3A	River Crane infilled channel (South)	0.0	892.0	892.0	0%	0.0	892.0
4	Central Embankment	9,963.6	16,465.0	6,501.4	25%	2,490.9	13,974.1
5	East of Grand Union Canal	1,347.7	10,755.3	9,407.6	75%	1,010.8	9,744.5
6	Detention Basin	912.4	1,036.5	124.1	50%	456.2	580.3
7	Western Embankment	1,622.4	6,199.2	4,576.8	75%	1,216.8	4,982.4
8	River Crane infilled channel (North)	1,025.1	2,896.1	1,871.0	50%	512.6	2,383.6
9	Pump Lane Bund	12,965.7	10,123.5	-2,842.2	40%	5,186.3	4,937.2
10	Pump Lane PRI	6,585.4	5,476.3	-1,109.1	75%	4,939.1	537.3
	Total (m³)	62,567.3	69,483.0	6,915.7		37,822.0	31,661.0

- a) Based upon gross cut from existing level to formation level (REF: A720-E05-IW-CCE-EW-DR-0610 P6)
- b) Based upon gross fill from existing level to formation level plus net fill from formation level to proposed design level (REF: A720-E05-IW-CCE-EW-DR-0600 P5) accounting for proposed pavement volumes.
- c) Positive (+ve) values indicate fill required. Negative (-ve) values indicate surplus cut. Values assume 100% reuse of cut material.
- d) Percentage based upon direct re-use without treatment.
- e) Cut volumes adjusted for estimated percentage of direct re-use.

The results of the recent rounds of investigation, discussed in Section 3, have shown that certain of the material, predominantly within the Lagoon Bund, has highly variable and unsuitable geotechnical properties. In order to render this source material suitable for re-use, improvement using lime was proposed during the design phase. Initial laboratory trials identified a combined lime and Ground Granulated Blast-furnace Slag (GGBS) treatment approach would obtain the necessary geotechnical parameters, when applied to a blended 'host' material. A source material comprised of approximately 40% Made Ground from the Lagoon Bund and 60% Made Ground/natural material from other areas within the Site was proposed. Following further design discussions and due to the programme constraints, the current proposal is not to undertake wholesale stabilisation of unsuitable site won material and to instead import material to make up the required balance. However, if the project requirements change, site won material may be stabilised as part of the works to meet the geotechnical and geoenvironmental parameters for material re-use. It should be noted that if site won material is stabilised the binding agents used may not be the same lime and GGBS mix used in the bench trials and further trials will be required, alongside consultation with the regulators, to agree suitability of materials and obtain the necessary treatment permits. Unsuitable materials encountered during the earthworks which are not stabilised for re-use will be tested and classified for either off-site re-use / treatment or disposal to a suitably licensed facility.

For those materials deemed suitable for re-use and for general storage of materials, it is proposed to utilise the Minet Tip lagoon area as a temporary stockpiling location, due to the limited working area within the Site. Further discussion on the temporary stockpiling is contained within Section 8.

A summary of the key construction activities include:

- Flood Compensation Area;
- River Crane diversion;
- the installation of CFA piles and pile caps to support the permanent bridges;
- the construction of bridge abutments and associated wing walls;
- material excavation, stockpiling and treatment;
- embankment filling and compaction; and

- final road construction.

5.2 Management of environmental aspects during construction

Development of the design beyond the PCSA phase has resulted in additional data becoming available, which has permitted those previously submitted reports to be updated as part of the detailed design phase. As outlined in Section 1, this report relates specifically to the environmental aspects of the construction, with risks to controlled waters representing the key assessment criteria.

Consultation with the Environment Agency during the detailed design phase meetings has revealed specific concerns with respect to the creation of contaminant pathways as a result of proposed construction activities. In summary, the concerns raised are:

- Definition of the upper limit criteria for re-use of material to prevent contamination to water courses;
- Clarification of the lining material proposed for the flood compensation area;
- Clarification of the lining material proposed for the highway drainage attenuation storage;
- Clarification of the outline 'clay tank' detail at the base of the earthworks;
- Consideration of seasonal groundwater levels;
- Clarification of measures to mitigate leachate from temporarily stockpiled materials;
- Confirmation of no adverse impact on pathways as result of surcharge from temporary stockpiling;
- Clarification of the protection measures proposed for the temporary stockpile;
- Definition of groundwater monitoring strategy throughout the construction activities and into service; and
- Definition of proposed discovery strategy in the event of unforeseen contamination;

The result of the investigations undertaken (Section 3) and the issues raised above, combined with the project objective to reduce material import, has led to the requirement to assess whether site specific re-use criteria may benefit the scheme whilst providing the necessary protection to controlled waters.

The following sections introduce the basis of a Detailed Quantitative Risk Assessment undertaken to determine re-use criteria based upon the site specific data gathered during the investigations. These sections then demonstrate screening of sampled source material against the derived re-use criteria and outlines the strategy by which material will be screened throughout the construction.

The derived re-use criteria are then presented alongside additional mitigation measures to minimise the risks from temporary stockpiling of materials and the long term risks associated with the stabilisation of materials for use within the embankment.

Generally, the process that has been adopted to manage the environmental risks, which is presented across the sections within this report, is as follows;

1. Determine extent and location of soils contamination through preliminary investigations.
2. Screen sampled materials against Generic Assessment Criteria.
3. Undertake DQRA to determine site-specific re-use criteria for risks to controlled waters.
4. Screen sampled materials against derived re-use criteria.
5. Install up- and down gradient groundwater monitoring installations.
6. Undertake baseline groundwater monitoring (pre-construction).
7. Install stockpile protection measures.
8. Excavate site won soils and stockpile and test materials within the temporary lagoon bund stockpile area.
9. Construct embankment in accordance with Earthworks Specification and associated testing.

10. Observe watching brief throughout construction to identify possible unforeseen contamination.
11. Undertake construction phase groundwater monitoring.
12. Submit verification report including all chemical testing of earthworks materials against derived re-use criteria and, if required, details of validation of unforeseen contamination.
13. Undertake post-construction monitoring.

6. CONTROLLED WATERS DQRA AND RE-USE CRITERIA

6.1 Introduction

A controlled water's detailed quantitative risk assessment (DQRA) has been undertaken for the Western Access site in order to derive site-specific reuse criteria with regard to the protection of controlled waters. It is proposed to reuse site-won material on site as engineered fill within the proposed embankments.

The principal controlled waters receptor is considered to be the Yeading Brook. The selected compliance point is the approximate distance between the soils placed within the embankment, behind the constructed bridge abutments, and the Yeading Brook which is considered to be approximately 15m distance.

6.1.1 Methodology

The risk assessment has been undertaken using the Environment Agency's Remedial Targets Methodology (RTM)¹⁴, in accordance with the Remedial Targets Worksheets¹⁵ and User Manual¹⁶. RTM is a Microsoft Excel based groundwater modelling package, which allows the assessment of the potential risks to controlled waters from contamination in soils and within the groundwater.

The assessment package is split into three Levels, each Level is progressive and the step to the next Level should only be undertaken if a potential risk is identified. The three levels within the model are:

- **Level 1:** Leaching: This level assesses the leaching potential of contamination within soils and its ability to be taken into solution. This assessment provides a measure of the contamination source; remedial targets in Level 1 are derived using the appropriate water quality standard. As a result, a Level 1 assessment is highly conservative as it does not consider retardation or degradation that may occur as the leachate moves through the soil profile.
- **Level 2:** Dilution: Level 2 looks at the effects of dilution and dispersion within groundwater, once contamination reaches the water table. The model does not

¹⁴ Environment Agency (2006). *Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination*.

¹⁵ Environment Agency (January 2013). *Hydrogeological Risk Assessment for Land Contamination; Remedial Targets Worksheets*. Release 3.2.

¹⁶ Environment Agency (October 2006). *Remedial Targets Worksheet v3.1: User Manual. Hydrogeological Risk Assessment for Land Contamination*.

account for an unsaturated zone and assumes that the contamination is located immediately above the groundwater table.

- **Level 3:** Dispersion: Level 3 models the movement of contamination through the aquifer to a compliance point; it takes into consideration the dispersion of contamination through the movement of groundwater and can accommodate factors such as biodegradation. As a contaminant disperses, so the overall concentration in groundwater will reduce, which will in turn reduce the risk to the wider down gradient receptor.

6.2 Input parameters

Site specific data has been used where possible. However, where this is not available, data from published sources have been used. A list of the parameters used in the modelling, and justifications for the parameters, is provided in Appendix D. The main sources of the input parameters (K_d , K , etc.) are summarised as follows:

- Arup (2015). St James West London, Southall Gas Works. *Detailed Quantitative Risk Assessment*. Job number 228263.
- Golders Associates (2003). *ConSim*. Version 2.5. Technical reference file. Environment Agency.
- Vorhees et al (1999). *Human health risk based evaluation of petroleum release sites: Implementing the working group approach*. Total Petroleum Hydrocarbon Working Group Series Volume 5.
- Barnes (2010). *Soil Mechanics, Principles and practice*. Third Edition.
- Berry and Reid (1987). *An Introduction to Soil Mechanics*. Department of Civil Engineering University of Salford.
- Howard et al (1991). *Handbook of Environmental Degradation Rates*. Lewis Publishers. London.
- McWhorter and Sunada (2010). *Groundwater Hydrology and Hydraulics*. Water Resources Publications, Colorado.
- CL:AIRE (2017). *Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies*.

The background concentrations within the aquifer have been set to zero. This enables the contribution from contamination on the site to be assessed without interference from the surrounding area.

Given the Yeading Brook is a freshwater body, the Freshwater Environmental Quality Standard (EQS) have been used in the assessment of the risk to the compliance point.

6.3 Models

6.3.1 Contaminants of concern

Comparison of the leachate results from the CGL investigation to the (EQS) values indicate that the following contaminants exceeded the assessment criteria:

- Metals including, cadmium, chromium VI, lead and mercury;
- Free cyanide and total ammonia;
- PAHs including benzo(a)pyrene and naphthalene;
- Benzene; and
- Phenol.

6.3.2 Source area

The site investigation data indicates that the elevated concentrations of contaminants in the Made Ground occur in a series of discrete source areas and hotspots. The assessment has assumed a source width and length of 10m x 10m for these discrete hotspots.

6.3.3 Hydraulic gradient and hydraulic conductivity

The hydraulic gradient for the aquifer beneath the site has been calculated using monitoring data collected from the site in June 2017.

The hydraulic gradient was calculated from the change in groundwater head between boreholes BH1A, BH3A, BH3B and BH4B.

The hydraulic conductivity for the coarse grained Lynch Hill Gravel Deposits has been based on particle size distribution (PSD) test data from site samples which is similar to published data for gravels.

6.3.4 Saturated aquifer thickness

The saturated aquifer thickness has been modelled as 3.8m, which is based on the potential thickness of the groundwater in the coarse grained Lynch Hill Gravel Deposits recorded during CGL monitoring works.

6.3.5 Degradation rates

The models have been constructed assuming that anaerobic biodegradation is occurring in the Lynch Hill Gravel aquifer. This has been based on recorded redox measurements by CGL ranging from 141V to -114mV in the Lynch Hill Gravel aquifer indicating that biodegradation is occurring under mildly reducing conditions (+50mV to -150mV).

6.3.6 Attenuation/retardation

The models have been constructed assuming that attenuation/retardation is occurring in the Lynch Hill Gravels.

6.3.7 Compliance point

An initial conservative 15m compliance point has been used based on the estimated distance from the soil fill within the embankment, to Yeading Brook, to assess potential risk from dissolved phase contaminants beneath the site. This is considered to be conservative given there are no identified active groundwater or surface water abstractions located close to the site and in consideration of the industrial history of the surrounding area.

6.4 Model outputs – soil re-use criteria

The results of the modelling are presented in Table 5, below. The models have been constructed to allow derivation of re-use criteria for site-won material with regard to the protection of controlled waters. The models are also included in Appendix E.

Table 5. Soil Re-use Criteria

Contaminant	Environmental Quality Standard Value (mg/l)	Level 3 Soil Re-use Criteria (mg/kg) [mg/l]
Total Ammonia	0.6	161 [120]
Benzene	0.01	2.22 [2.01]
Benzo(a)pyrene	0.00002	12.96 [0.004]

Contaminant	Environmental Quality Standard Value (mg/l)	Level 3 Soil Re-use Criteria (mg/kg) [mg/l]
Cadmium	0.00025	12.05 [0.050]
Chromium VI	0.0034	23.99 [0.683]
Free Cyanide	0.001	0.085 (0.5)* [0.212]
Lead	0.0012	1,050.5 [0.241]
Mercury	0.00007	7.03 [0.0141]
Naphthalene	0.002	13.03 [0.403]
Phenol	0.0077	1.32 [1.59]

Note: * Free cyanide re-use criteria limited by the limit of detection of commercially available laboratories and has been set at 0.5mg/kg

6.5 Sensitivity analysis

A sensitivity analysis was undertaken on selected parameters. These parameters included: bulk density, fraction of organic carbon (FOC), effective porosity, hydraulic gradient, hydraulic conductivity, partition coefficient and half-life.

Although some fluctuations occurred by varying the bulk density, FOC and effective porosity, generally no significant change to the remedial target was seen when using the different values available and the most conservative, or average values were used as appropriate.

Using a lower hydraulic gradient and hydraulic conductivity value in the model generally resulted in lower remedial target concentrations, however the average value is considered to be more representative of the site.

A sensitivity analysis was also undertaken on the benzene and benzo(a)pyrene models by varying the partition coefficient and half-life parameters. The sensitivity analysis shows that the lower partition coefficient values, which were used in the assessment, gives more conservative remedial target values. The sensitivity analysis for half-life shows that the higher value used in the model gives more conservative targets.

Overall, it is considered that the model outputs to be sufficiently realistic based on the inputs used in the models.

7. TEMPORARY STOCKPILING

To facilitate the construction of the Western Access embankment it is proposed to temporarily stockpile materials won from source areas across the site within the Minet Tip lagoon, prior to their re-use in the permanent embankment. The following section relates to the proposed temporary stockpiling works and aims to summarise the outcomes of an earlier interim report, which was produced to address;

- *Clarification of measures to mitigate leachate from temporarily stockpiled materials;* (Section 7.1)
- *Confirmation of no adverse impact on pathways as result of surcharge from temporary stockpiling;* (Section 7.2)

The summary contained below repeats the outcomes of the previous interim report, but is presented within the context of the additional information provided as part of this wider remediation strategy addendum. The interim report, which is presented in Appendix F, was previously issued to obtain necessary statutory approvals throughout the design phase and should be read in conjunction with this report to provide additional detail.

7.1 Materials separation and protection

7.1.1 *Proposed stockpile material and potential risks*

The materials that are proposed to be stockpiled within the lagoon comprise Made Ground, fine-grained and coarse-grained Lynch Hill Gravels from source areas including the existing lagoon, the flood alleviation area and the proposed embankment alignment.

Made Ground within the lagoon is recorded to have elevated contaminant concentrations (including TPH and PAH), which are detailed further in Section 2 of this report. However, the majority of material to be stockpiled is anticipated to be sourced from the flood alleviation area, which is shown to have lower contaminant concentrations than those recorded at the lagoon.

The Yeading Brook presents a key receptor that could potentially be impacted by temporary stockpiling. The brook is located down gradient of groundwater flow from the lagoon area, which is understood to run in a southeast to northwest direction. Ground conditions beneath this area comprise fine-grained Lynch Hill Gravel with interrupted lenses of coarse-grained Lynch Hill Gravel.

The potential risk is for infiltration of rainwater through the stockpiled material creating contaminated leachate that could enter the groundwater regime beneath the stockpile.

7.1.2 Lagoon stockpile detail and design

An options appraisal was undertaken to determine possible mitigation solutions that incorporated combinations of impermeable liner, stabilised soils and granular platforms combined with a monitoring strategy.

Full detail of the proposals are presented in Appendix F, which incorporates the temporary stockpile liner schematic (Drawing: A720-E05-IW-CGL-EW-DR-0001). The proposed solution comprises the steps summarised below;

- Placement of a geotextile separation layer (permeable) on top the existing lagoon floor;
- Light compaction of site-won material from the Pump Lane bund or flood alleviation zone to raise levels and create cross-fall;
- Installation of impermeable basal liner geomembrane placed over sand bedding or protective fleece;
- Formation of perimeter swales to allow collection of water runoff across stockpile area;
- Infill of swales and liner area with a granular material to form a drainage blanket;
- Construction of leachate collection system with perimeter pipework and pumping points; and
- Groundwater monitoring at external well locations throughout the stockpiling period.

7.1.3 Post-stockpile conditions

As discussed in Section 2.4, following completion of the stockpiling activities, current proposals are for the lagoon to be permanently reconfigured. These proposals are outside the scope of this report, however the temporary stockpile solution has been developed to allow the lagoon to be easily reinstated to existing condition prior to any reconfiguration works.

7.2 Stockpile contaminant migration appraisal

An appraisal of the potential for mobilisation of contaminants as a result of surcharge load from the temporary stockpile has been undertaken within the above interim report and can be found within Appendix F.

The following is an extract from the report, which clarifies the risk from surcharge loading;

Interpretation of the ground and groundwater conditions at beneath the Lagoon Bund area indicates that, should new contamination pathways be created due to the loading of the existing ground, then the risk to downstream controlled waters from contaminants migrating within groundwater is considered to be low.

The relatively impermeable nature of the cohesive Made Ground, Alluvium and cohesive River Terrace Deposits restrict the migration of potential contaminants. In addition, the granular River Terrace Deposits, where migration of contaminants could readily occur, are not continuous beneath the site. Similarly, the groundwater encountered in the Alluvium is not considered to be laterally pervasive and it is considered unlikely that increased contaminant migration to downstream controlled waters receptors would occur.

8. PERMANENT WORKS

8.1 General

The following section is intended to provide a summary of key aspects, raised in consultation with statutory authorities, with respect to the risks posed to controlled waters from elements of the permanent works.

8.2 Highway embankment

As discussed within Section 5.1, the three permanent embankments will be constructed using site won materials as well as imported fill. The original scheme proposals included a 'clay stank' detail for the base of the embankment, comprising a layer of low permeability material. It is understood that this was specified due to the potential for the embankment to be constructed using granular fill materials that could provide a preferential pathway for contaminants to migrate towards surface water receptors. It can be shown, using the source-pathway-receptor principle, that the current scheme proposals do not pose a significant risk that would require this specific 'clay stank' detail to be retained.

Investigation of the materials found on the site during scheme development has shown a predominance of cohesive soils, with much of the anticipated fill material being classified as a Class 2A or 2C cohesive fill. In addition, treatment of the blended 'host' materials, where undertaken, would likely achieve a Class 9E cohesive stabilised fill. The proposed earthworks strategy will involve the placement and compaction of this fill material onto a predominantly cohesive formation comprised of Alluvium or River Terrace Deposits. As a result, it is considered unlikely that significant additional preferential pathways will be present along the length of the embankment formation and mobilisation of contaminants would be restricted.

8.2.1 Materials testing

The Earthworks Specification includes the requirement for fill materials to be tested against a suite of determinands relevant to pollution of controlled waters and human health. For site-won materials to be re-used within the scheme the principal risk driver has been established as the risk to the water courses on site, predominantly the Yeading Brook. The DQRA in Section 6 of this report sets out the agreed modelled re-use criteria for site-won fill which are protective of these controlled waters. Re-used materials within the scheme are, therefore, required to meet these criteria. Where material does not meet the criteria it will either be treated to render it suitable, for example via stabilisation or

removed from site either for recovery / treatment or for suitable disposal at a licensed facility.

Testing of materials against the re-use criteria will either be undertaken at the point of origin within the scheme (pre-classified), on material temporarily stockpiled within the lagoon area and/or on the treated fill. Testing frequencies will be as detailed within the Earthworks Specification, though will generally be undertaken on the basis of a minimum of one sample per 500m³ of material.

With reference to the conceptual site model and semi-quantitative risk assessment within Section 4, it is considered the combined screening and treatment of source materials reduces the risk to controlled waters through lateral migration of contaminants at the base of the embankment.

Robust site records, including site plans, will be kept to track materials testing and movements including the temporary stockpiling of fill within the lagoon area.

8.2.2 Imported general fill

Imported general fill to be used as embankment construction materials will be obtained from reputable, certified sources and accompanied by suitable test certificates. Recycled fill materials will ideally be WRAP (Waste Resource Action Programme) compliant or similar. Imported general fill will be tested on a frequency of 1 sample per 500m³ or a minimum of three tests per source and will be required to meet the maximum permissible concentrations for imported general fill soils within Appendix G. The criteria within Appendix G have been derived from CGL generic assessment criteria, except for phytotoxic metals; copper, nickel and zinc. For these contaminants, site specific criteria protective of controlled waters have been derived using the same approach adopted for the re-use criteria. The DQRA input parameters and model outputs for the phytotoxic metals are presented in Appendices D and E respectively.

8.2.3 Topsoil

Imported landscaping soils / topsoil will be obtained from certified, reputable sources and accompanied by suitable test data. A minimum of three tests per source and a frequency of one sample per 150m³ of imported landscaping soils / topsoil will be required. The test suite and resultant data will be required to meet the maximum permissible concentrations for imported capping soils, presented in Appendix H.

8.3 Drainage attenuation storage

The highway drainage from the embankments located west of the Grand Union Canal and the access roads around Pump Lane is proposed to be through an oil interceptor, attenuation storage and a flow control device. Current proposals for the attenuation storage is for it to be lined with impermeable membrane (Firestone Pondguard EPDM or equivalent), with a 300g/m² geotextile underlay. A concern regarding the potential mobilisation of contaminants due to infiltration of water through a ruptured liner and into the underlying soils, was raised during consultation with statutory authorities.

A plan location and cross section detail of the attenuation storage liner detail proposed by Create Consulting Engineers is shown in drawings A720-E05-IW-CCE-EW-DR-SK-0301 and A720-E05-IW-CCE-C-SK-0003 (Appendix I).

8.3.1 Ground conditions

The ground conditions in the immediate area of the attenuation storage are represented by trial pits (TP01C, TP02C & TP-5B) undertaken during the CGL investigation summarised within Sections 3.1.2 and 3.1.3 and trial pits (TP14, TP17 and TP36) undertaken during an earlier phase of investigation. The ground conditions generally comprise Made Ground between 0.50m to 0.90m thick, overlying Alluvium and a discontinuous layer of River Terrace Deposits. London Clay is encountered at depths of between 1.10m to 1.80m below ground level.

The Made Ground is shown to be a sandy gravelly clay. The Alluvium is shown to be a slightly sandy slightly gravelly clay. The River Terrace Deposits, where encountered, are shown to be a slightly silty sandy gravel. The intrusive investigation at this location has indicated that the granular River Terrace Deposits are not encountered as a continuous layer. This has also been observed at other areas of the site, in relation to the temporary lagoon stockpile, as discussed in Section 7.2.

The risk of contaminant leaching as a result of damage to the liner is considered to be **low** based upon the conceptual model presented in Figure 6. The proposed depth of the storage basin results in the base being founded within the London Clay, which limits migration of groundwater in the vertical direction. Lateral migration of groundwater is likely to be limited by the low permeability Alluvium. There is potential for discontinuous lenses of high permeability River Terrace Deposits to provide a pathway towards the Yeading Brook. Due to limited contamination testing within the immediate location, it is

not possible to identify the likely leachate concentrations that may pose a risk, therefore it is necessary to consider that contamination may be present within the Made Ground.

8.4 Materials Management Plan (MMP)

The MMP completed at PCSA stage has been updated to account for the material types and volumes defined as part of the detailed design phase. The finalised MMP¹⁷ has been subject to review by an independent Qualified Person, as required by the CL:AIRE Definition of Waste: Development Industry Code of Practice and the on-line declaration made on 28 July 2017. The MMP will be updated during the construction programme to account for variations in material volumes and type, with final details of material management to be captured within the scheme verification report.

8.5 Flood compensation area

The scheme includes for a new flood compensation area to provide sufficient flood alleviation for the Yeading Brook and diverted River Crane. At present, discussions are ongoing with the Environment Agency as to whether the flood compensation area requires a liner to be constructed. If a liner is required then the preferred option would be to construct it with site won Class 2A1 cohesive fill, if sufficient suitable material is available on site. If there is insufficient suitable site won material available then the material for the liner may be sourced from off-site or alternatively FM Conway may make use of an impermeable membrane, subject to agreement from the employer and Environment Agency.

Class 2A1 material is a derivation of Class 2A material, where certain selection criteria including material permeability is refined to keep such material within a define set of parameters for its end use. The specification for Class 2A1 fill is presented within the CGL Earthworks Specification (ref: A720-E05-IW-BR-CGL-EW-SPC-0001).

8.6 Piling risk assessment

A piling risk assessment for the permanent bridge abutment and retaining wall works was completed as part of the PCSA design phase, which has subsequently been updated and incorporated in the Geotechnical Design Report⁴ for the scheme. A copy of the risk assessment is attached as Appendix J. The assessment considered various potential pollution scenarios, in accordance with Environment Agency guidance¹⁸, and concluded

¹⁷ CGL, 2017, *Southall Western Access Materials Management Plan_rev2_CGN03732G_27 July 2017*

¹⁸ Environment Agency, 2001, *'Piling and penetrative Ground Improvement Methods on Land Affected by Contamination; Guidance on Pollution Prevention.'* NC/99/73 (2001).

that the proposed continuous flight auger (CFA) piling technique posed an overall very low risk to environmental receptors, though noted that contaminated arisings would need to be managed appropriately. Pile arising management will be dependent on the findings of initial ground investigation and data assessment from the previous phases of intrusive works but for the majority of materials will comprise stockpiling of arisings within the lagoon stockpile area followed by subsequent testing for potential re-use / treatment or disposal. Where previous contamination has been identified in an area of piling, arisings will be stored temporarily on plastic sheeting and covered over, prior to testing for potential re-use / treatment or disposal. Where necessary, a temporary sump will be constructed within the basal sheeting to allow for collection and disposal of impacted perched- / ground water within the arisings. Arisings from piling to the east of the GUC will be managed at source, as described above, and not moved to the lagoon stockpile area to the west of the canal to minimise unnecessary transportation of contaminated soils on the public highway. Where unexpected contamination is identified, this will be addressed in accordance with the discovery strategy set out in Section 10 and the process flow charts within Appendix L.

Temporary sheet piling, which is proposed adjacent to the Grand Union Canal, was not assessed as part of the PCSA phase piling risk assessment as details were unknown at that stage. A review has been undertaken for this addendum, which shows that the temporary sheet pile works are similarly considered to present a low risk to both environmental and human receptors. This is on the basis that the sheets are approximately 5 – 6m in length, will terminate within weathered London Clay and will therefore not create additional vertical migration pathways to the underlying aquifer. As with the earlier stockpiling risk assessments, the granular Lynch Hill Gravel deposits are indicated to be discontinuous. Therefore, temporary sheet piles driven through this unit pose only a low risk to receptors, based on limited pathway potential for contaminants. Furthermore, the sheet piles will be a temporary installation, during which groundwater and surface water monitoring will be undertaken to assess potential impact to key receptors and provide an early warning in the event of an increase in contaminant concentrations. In addition, as limited quantities of spoil will be generated during installation of the sheet piles they are also not considered to present a significant risk to human health in terms of potential exposure.

9. MONITORING STRATEGY

9.1 Introduction

A monitoring programme was identified as being required within the PCSA design phase in order to assess the potential risk to controlled waters during the material management element of the works.

This section presents the proposed groundwater and surface water monitoring programme and a contingency plan to be implemented in the event that groundwater/surface water monitoring indicates an unacceptable increase in contaminant concentrations.

9.2 Groundwater and surface water monitoring

In consideration of the proximity of the Yeading Brook to the site, groundwater and surface water monitoring is required to be undertaken to assess the potential risk to controlled waters, prior to, during and post all earthworks activities.

It is recommended that the monitoring network includes at least one up-gradient borehole to determine changes in background water quality and one down-gradient to provide early warning of deterioration of groundwater quality. It is also recommended that surface water samples are collected from the Yeading Brook from at least one point upstream and one point downstream.

The monitoring borehole installations are presented in Figure 3.

The proposed monitoring programme is presented in Table 6 below.

Table 6 - Monitoring Programme

Monitoring Location	Parameters to be Measured	Frequency of Monitoring Required ¹
One up-gradient (BH4B) and up to three down-gradient groundwater monitoring boreholes (BH1B, BH2B and BH3B) plus three lagoon source area boreholes (BH1A, BH2A and BH3A). Locations to be monitored by CGL.	Hardness; ammoniacal nitrogen; chloride, potassium, calcium and magnesium; Heavy metals including; arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc; Benzene, toluene, ethylbenzene, xylenes (BTEX) compounds; TPHCWG and PAHs; total monohydric phenols; total cyanide; free cyanide; sulfate; and pH determination. CGL surface water sampling to comprise ammoniacal nitrogen and un-ionised ammonia in addition to general suite by Ramboll Environ.	Two initial monitoring rounds prior to commencement of works, monthly during construction works, increased to weekly during key earthworks activities. Monthly post construction works up to three months and bi-monthly thereafter if no contamination is detected in the trigger locations up to one year following completion of the works. Water samples should be tested on a rapid laboratory turnaround where possible to ensure a prompt response.
One upstream, one mid-stream and one downstream surface water point. Surface water monitoring to be completed by FM Conway, Ramboll Environ and CGL.	In-situ parameters to be tested include: dissolved oxygen, redox potential, pH, temperature, electrical conductivity and total dissolved solids.	One initial monitoring round prior to commencement of works, weekly during earthworks activities and monthly post ground improvement works up to three months. Monitoring / sampling of ammonia to be undertaken concurrently with construction groundwater monitoring. Daily visual inspections of water quality including in-situ monitoring for the parameters noted.

Notes

1. The groundwater monitoring should be undertaken by a qualified geo-environmental engineer.

Following completion of the two baseline pre-construction groundwater monitoring rounds, undertaken by CGL in June and July 2017 (Appendix B), and three rounds of baseline monitoring by Ramboll Environ, the resultant data were reviewed to enable development of construction groundwater monitoring trigger levels. The groundwater trigger levels were derived for adoption during construction to act as indicators of deterioration in groundwater quality, which may be as a result of the influence of the scheme construction activities. The trigger levels presented (refer to Appendix K) are based on either laboratory limits of detection, where baseline monitoring data were less than these limits or have been set at 20% greater than the maximum concentration for those contaminants recorded above laboratory detection limits. Trigger levels are

presented for the individual boreholes to be monitored with the exception of the down-gradient boreholes BH1B and BH2B, both of which were dry during baseline monitoring. For these boreholes individual trigger levels have been provisionally determined, based upon the results obtained from baseline monitoring of borehole BH3B. These trigger values will be re-visited should boreholes BH1B and BH2B be found to contain groundwater during subsequent construction monitoring rounds.

For surface water monitoring, which is to be completed by FM Conway, Ramboll Environ and CGL, trigger levels have not been presented as it is not considered practicable to address breaches of a trigger concentration once that breach has already occurred within the receptor. It is proposed to track trends in surface water quality for the duration of construction and post construction, for the results to be reported and significant changes in water quality to be flagged to relevant parties.

Due to the concentrations of ammonia recorded in baseline groundwater monitoring it has been agreed with the Environment Agency that surface water sampling of Yeading Brook shall be undertaken, concurrently with the groundwater monitoring, to test for ammoniacal nitrogen and un-ionised ammonia concentrations. Baseline results are to be obtained for these parameters, within the brook, over three rounds and the data reviewed to establish suitable trigger levels, likely based on the approach outlined above.

9.3 Groundwater / surface water and mitigation contingency plan

The groundwater in the River Terrace Gravel aquifer will be monitored up and down gradient of the site during the earthworks activities and will be reviewed against the trigger levels presented herein. As noted above, monitoring is also to be undertaken for ammonia species within the Yeading Brook at the same time as the groundwater monitoring.

Where the groundwater or surface water monitoring data indicate unacceptable increases in contaminant concentrations above the agreed trigger levels then the following mitigation contingency plan will be implemented. This contingency plan is presented, within the context of the wider watching brief and discovery strategy (Section 10), as a process chart and is contained within Appendix L and outlined below:

1. Repeat sampling on an increased frequency (minimum weekly) to assess the data over three rounds and see if the trigger levels breach is sustained.

2. Where three rounds of sampling indicate a continuous breach of trigger levels, earthworks or other potentially causative activities are to cease on site.
3. Where three rounds of monitoring show continuous breach of trigger levels, notify the Client, Environment Agency and Contaminated Land Officer at London Borough of Hillingdon, as required.
4. The results from the groundwater monitoring will be used to determine the extent of groundwater impacts and to assess the feasibility of various mitigation options. The contingency plan will be triggered where there is a recorded breach of trigger levels over three successive monitoring rounds. It is noted that the implementation of the contingency measures will largely depend on the scope and extent of groundwater impacts. Therefore, a suitable solution is to be proposed to the Environment Agency for agreement before implementing specific contingency remediation works or recommencing development works.
5. Verification of the contingency measures will need to be undertaken by a qualified geo-environmental engineer.

9.3.1 Indicative contingency measures

It is not possible at this stage to identify the contingency measure that would be appropriate for a given exceedance of the trigger levels. Based on the assessments undertaken within this report, it is anticipated that construction activities are unlikely to increase contaminant concentrations or mobilise contaminants via preferential pathways within the groundwater. In the event this does occur, it is anticipated that a relatively simple contingency measure may be appropriate. Below is one such example, however, this would have to be reviewed once the scope and extent of groundwater impacts are known.

A permeable reactive barrier typically involves installation of a permeable trench across the width of a contaminant plume to intercept and treat shallow and/or perched contaminated groundwater. As groundwater passes through the reactive zone, the contaminants of concern are typically transformed into harmless by-products. The barrier would need to be keyed into the underlying London Clay Formation. Monitoring should be undertaken for a minimum of three months' post treatment. Samples should be taken fortnightly for the first month and monthly thereafter.

Notwithstanding the above, it is important for the contractor to implement good site drainage and surface water controls to mitigate run-off of surface water into the Yeading Brook.

10. WATCHING BRIEF AND DISCOVERY STRATEGY

A watching brief is to be maintained by FM Conway and their earthworks contractor during construction works. This will focus on the key excavation and materials handling works including the proposed material cut from the flood compensation area, stockpiling within the lagoon, stabilisation of fill within the lagoon (where undertaken) and placement and compaction within the embankment footprint. Areas of known contamination, based on observations from previous investigation and subsequent assessment, are presented on a Contamination Observation Plan (Figure 4). Material within these identified areas will not be excavated for re-use within the scheme without suitable further assessment and treatment, as necessary.

Where unexpected contamination such as material of an unusual colour or odour; in particular, suspected gasworks related material such as spent oxides (e.g. 'blue billy') or black/dark grey coal tars, is encountered during earthworks then the following discovery strategy is recommended. This strategy is presented, in the context of the watching brief and groundwater contingency plan (Section 9), as a process chart contained within Appendix L and outlined below:

1. Notify geoenvironmental engineer to attend site, assess the contamination and sample material for appropriate analysis.
2. Where gross contamination (e.g. free product, asbestos containing materials or gasworks related waste) is encountered, cease work in that area of the site, fence off the area and advise BWT and their Environmental Guardian (Ramboll Environ).
3. Geoenvironmental engineer will notify the Contaminated Land Officer at London Borough of Hillingdon or Ealing, as appropriate and / or the Environment Agency contacts and agree the appropriate mitigation, which is likely to comprise the following.
4. Geoenvironmental engineer to supervise the excavation of contaminated material, where required, which should be placed in a separate, bunded area within the lagoon stockpile and covered, where practicable, to prevent rainwater infiltration.
5. Where required, soil samples should be obtained by the geoenvironmental engineer from both the excavated material, and the soils in the sides and base of

the excavation to demonstrate that the full area of contamination has been excavated.

6. On receipt of chemical test results, the soils may be appropriately classified for recovery, treatment or disposal, where appropriate, and dealt with accordingly. Grossly contaminated material such as gasworks related waste will not be re-used within the scheme.
7. To facilitate waste disposal or potential re-use of materials excavated soils should be segregated and stockpiled depending on their soil classification.
8. Detailed records of the stockpile(s) size, source, location and fate should be kept and regularly updated to allow materials to be easily tracked from excavation until leaving the site or re-used, as appropriate.
9. Records of excavated areas and the results of chemical testing should be incorporated within the final verification report for the scheme.

11. VERIFICATION

To confirm that the measures and procedures detailed in this document have been implemented, a Verification Plan has been produced and is presented in Appendix M. The Verification Plan sets out the measures to be undertaken during construction to verify the works are being undertaken in accordance with this Remediation Strategy Addendum report and in order to support completion of a Verification Report for the scheme.

The Verification Plan has been compiled to be in accordance with London Borough of Hillingdon decision notice (ref: PDU/2310/06) planning condition 21, which states:

Following completion of each Part of site remediation, and prior to the commencement of any further development of this Part, a validation/verification report demonstrating completion of the works set out in the remediation scheme together with amendments and longer-term monitoring for the relevant Part shall be submitted to and approved in writing by the London Borough of Hillingdon as the local planning authority.

Each validation/verification report shall include:

- a) Detail of who carried out the work*
- b) Laboratory and in-situ test results to demonstrate that the site remediation criteria have been met*
- c) Monitoring of groundwater and gases during remediation and details of monitoring programme post completion of remedial works, where agreed*
- d) Summary data plots and tables relating to clean-up criteria*
- e) Plans showing treatment areas and details of any differences from the original remediation strategy*
- f) Waste management documentation*
- g) Confirmation that remediation objectives have been met, for example, by provision of a certification of completion*
- h) A long term monitoring and maintenance plan for longer term monitoring of pollutant linkages, maintenance and arrangement for contingency action and for*

the reporting of this to the London Borough of Hillingdon as the local planning authority.

Site inspections and compliance testing should be carried out during the works by a qualified geoenvironmental engineer for the various elements of the remediation works as follows:

- Inspect, sample and arrange laboratory analysis of site-won soils for re-use within the scheme;
- Inspect and sample blended and stabilised fill material prior to re-use within the embankment;
- Sample and test imported soils, where required, to confirm compliance with the re-use criteria, including review of source data prior to import of material to site;
- Construction monitoring of surface waters and groundwater, in line with the monitoring programme to assess trends in water quality and provide an early warning of issues with groundwater quality potentially associated with site activities;
- Site inspection records, photographs and testing where unexpected contamination is encountered.

Documentation will also be required to be provided by the Contractors including:

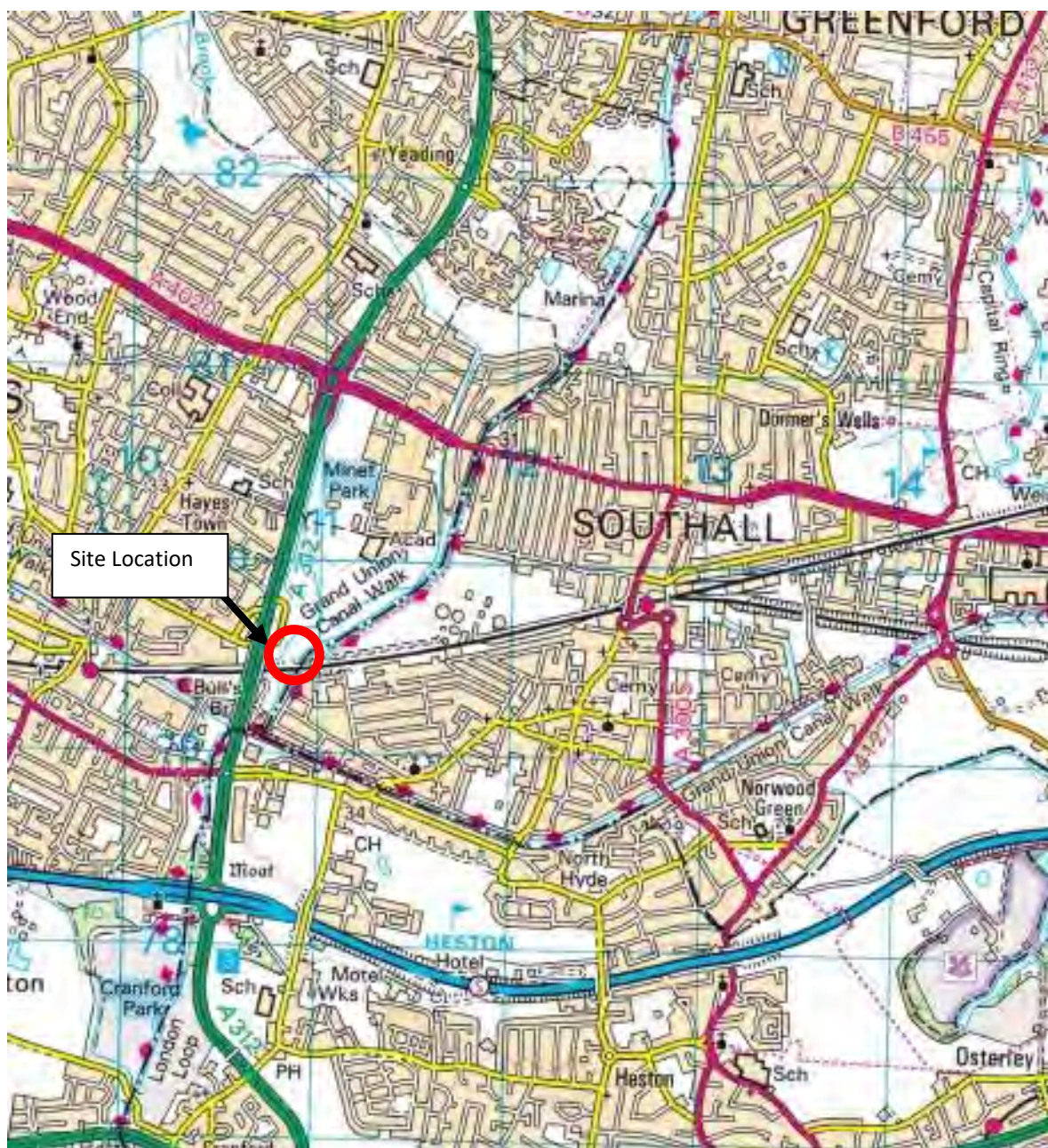
- Photographs of the earthworks undertaken;
- As built drawings;
- Duty of care records for the disposal of soils;
- Source data and pre-import laboratory data of imported topsoil/subsoil;
- Material management procedures (i.e. permits, exemption, MMP etc.) as appropriate;
- Confirmation of piling methodology and depth of piles; and
- Records of soils treated / stabilised for re-use.

- Validation laboratory test results for treated soils.
- Groundwater and surface water monitoring records.

On completion of the remediation works, a Verification Report should be prepared. This report should detail the works undertaken and should include copies of all relevant information listed above including waste transfer records, validation test results, inspection records, membrane material specifications and source certificates for imported materials.

This document should be made available to London Borough of Hillingdon and the Environment Agency, as evidence of the works carried out, and will ultimately form part of the health and safety file for the site.

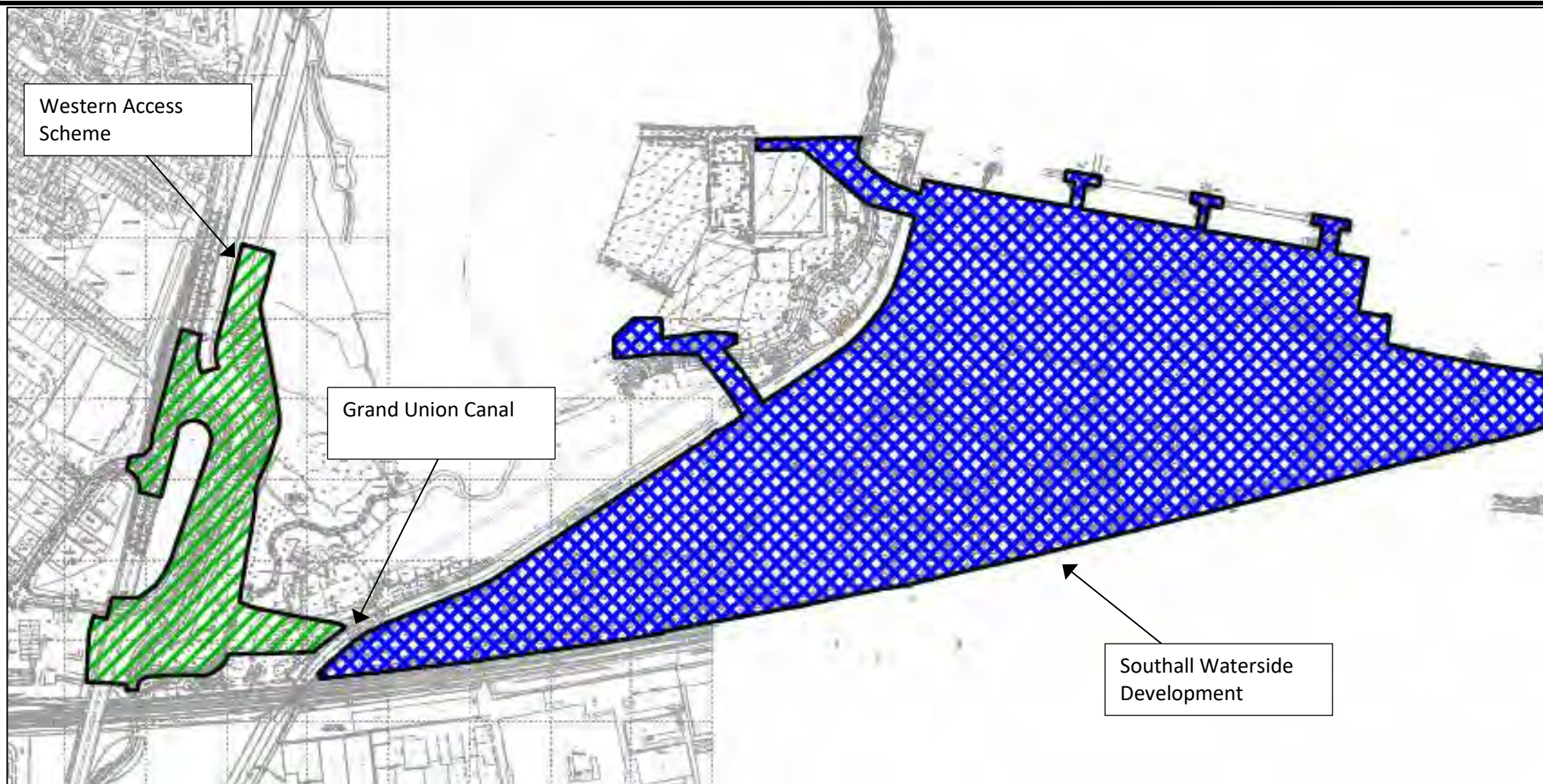
FIGURES



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Client Clark Smith Partnership	Project Western Access	Job No CGN/37321
	Title Site Location Plan	Figure 1



Client	Project	Job No
Clark Smith Partnership	Western Access	CGN/037321
	Title	Figure 2
	Development Overview Plan	



KEY

Completed trial pits (CGL 17th Feb 2017)

Completed trial pits (CGL 24th Feb 2017)

Completed trial pits (CGL 27th March 2017)

'Sentinel' groundwater monitoring well positions (CGL 2017)

Lagoon 'source' groundwater monitoring well positions (CGL 2017)

St James' groundwater monitoring well positions (Environ 2017)

Cone Penetrometer Test (CPT) locations (CGL 2017)

Western Access Site boundary

Western Access Road Alignment

Indicative highway extents

Extent of existing Lagoon Bund

'Bridge Bund' relating to investigation undertaken 24th February 2017

Area 1 - River Crane incorporating Western Embankment & Flood Alleviation Zone

Area 2 - Central Embankment

Area 3 - 'Lagoon Bund'

Area 4 - Eastern Embankment

1

06/07/17

Updated alignment east of GUC and added CPT locations

0

15/05/17

First issue

Rev

Date

Comments

CGL

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Project

Southall Western Access

Client

FM Conway Limited

Drawing title

Site Layout & Exploratory Hole Location Plan

Scale(s)

NTS

Job No.

CGN/03732I

Drawn

TSB

15/05/17

Checked

OEF

07/07/17

Approved

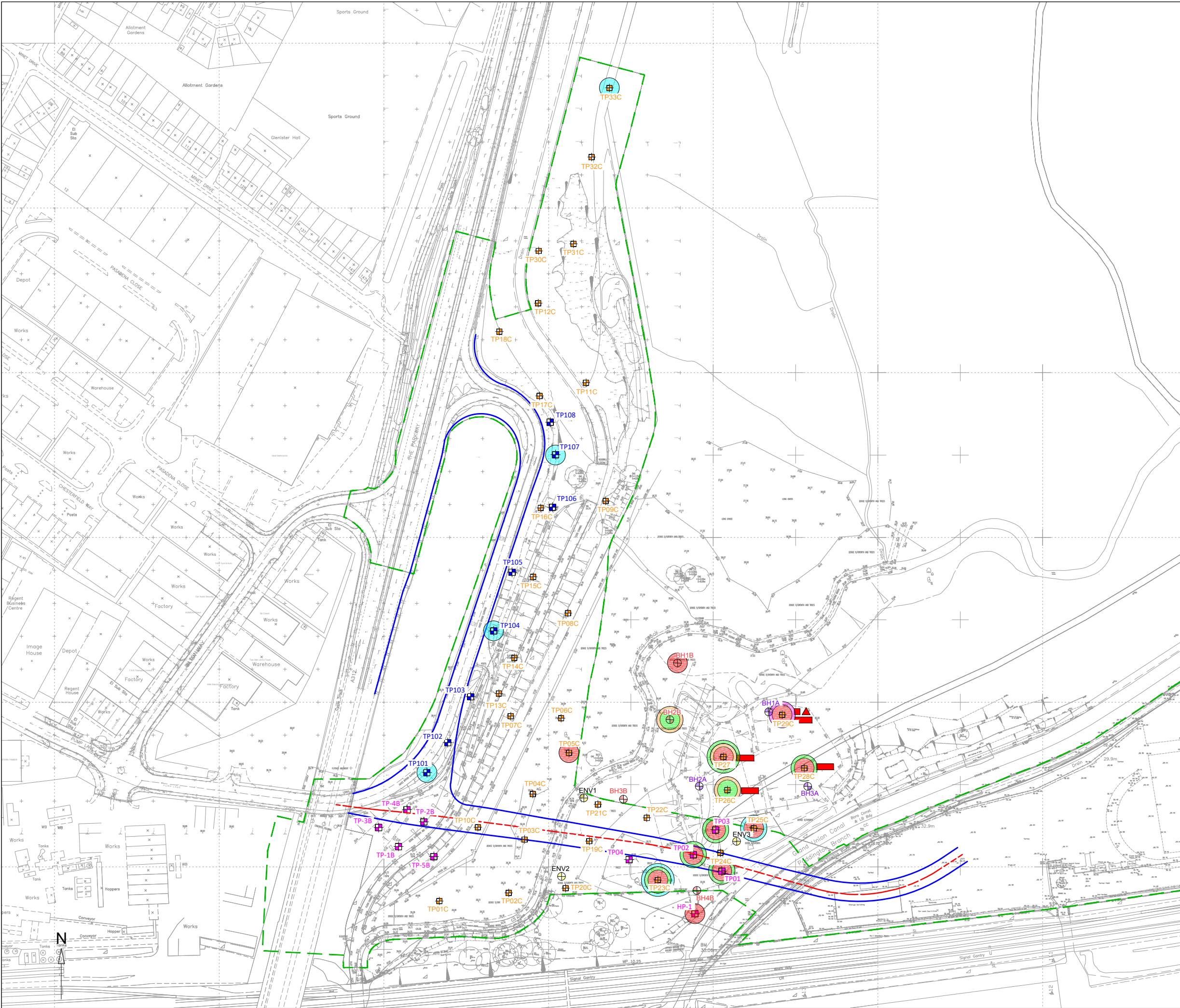
Dwg No.

A720-E05-IW-CGL-SIN-DR-0005

Rev.

1

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- KEY**
- Completed trial pits (CGL 17th Feb 2017)
 - Completed trial pits (CGL 24th Feb 2017)
 - Completed trial pits (CGL 27th March 2017)
 - 'Sentinel' groundwater monitoring well positions (CGL 2017)
 - Lagoon 'source' groundwater monitoring well positions (CGL 2017)

- Western Access Site boundary
- Western Access Road Alignment
- Indicative highway extents
- Asbestos fibres present in Topsoil/Made Ground
- Cyanide (total) exceedance above re-use criteria
- Benzo(a)pyrene exceedance above re-use criteria
- Cadmium exceedance above re-use criteria
- Phenol exceedance above re-use criteria
- Strong hydrocarbon odour
- Marzipan odour
- Spent oxide 'Blue Billy' observed between 1.3mbgl and 1.5mbgl

1	07/07/17	Updated alignment east of GUC, contaminant exceedances	
0	21/06/17	First Issue	
Rev	Date	Comments	
		Card Geotechnics Ltd 4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW T: 01483 310600	
Project		Southall Western Access	
Client		FM Conway Limited	
Drawing title		Contamination Observation Plan	
Scale(s) NTS		Job No. CGN/03732I	
Drawn	TSB	21/06/17	Dwg No. A720-E05-IW-CGL-EW-DR-0002
Checked			Rev. 1
Approved			
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Sources

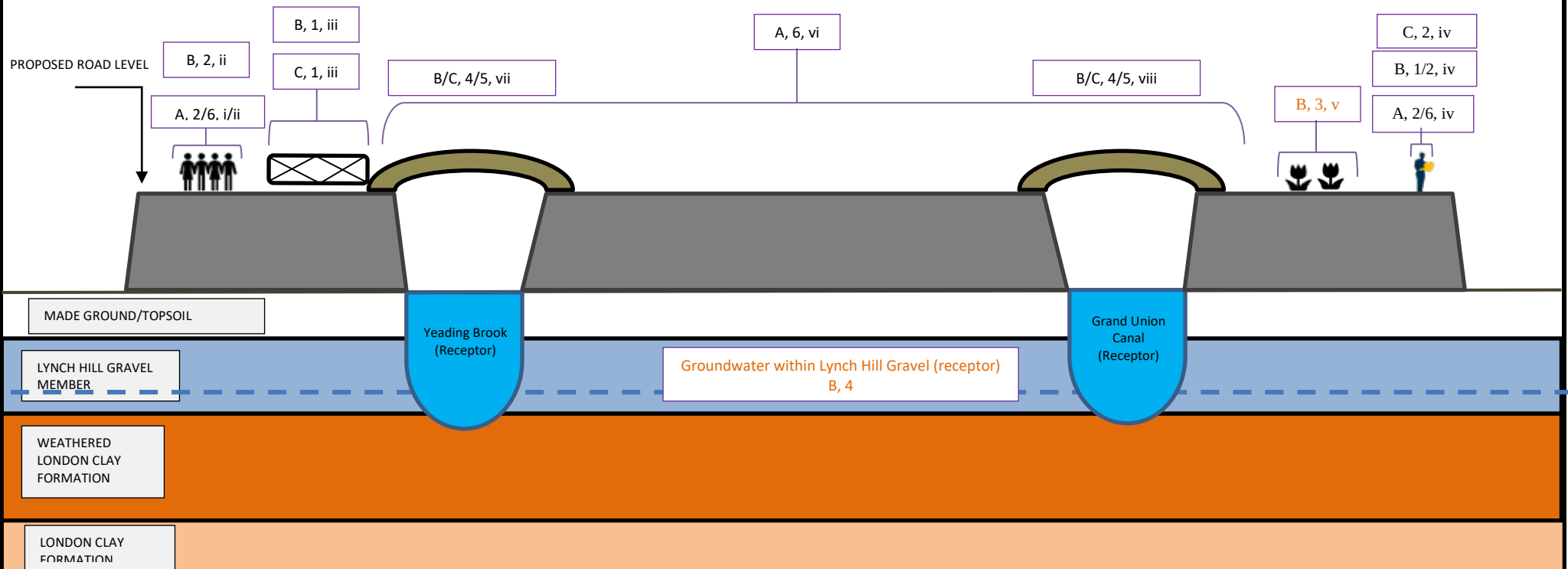
- A) Explosive/asphyxiating gases from Made Ground and Lagoon deposits
- B) Contaminants in soils within flood compensation area and Lagoon Bund to be used in embankment construction
- C) Dissolved phase contamination within the Lynch Hill Gravel groundwater

Potential Exposure Route

- 1) Direct contact
- 2) Ingestion and inhalation
- 3) Uptake via roots
- 4) Leaching from soils to groundwater
- 5) Lateral migration
- 6) Upward migration

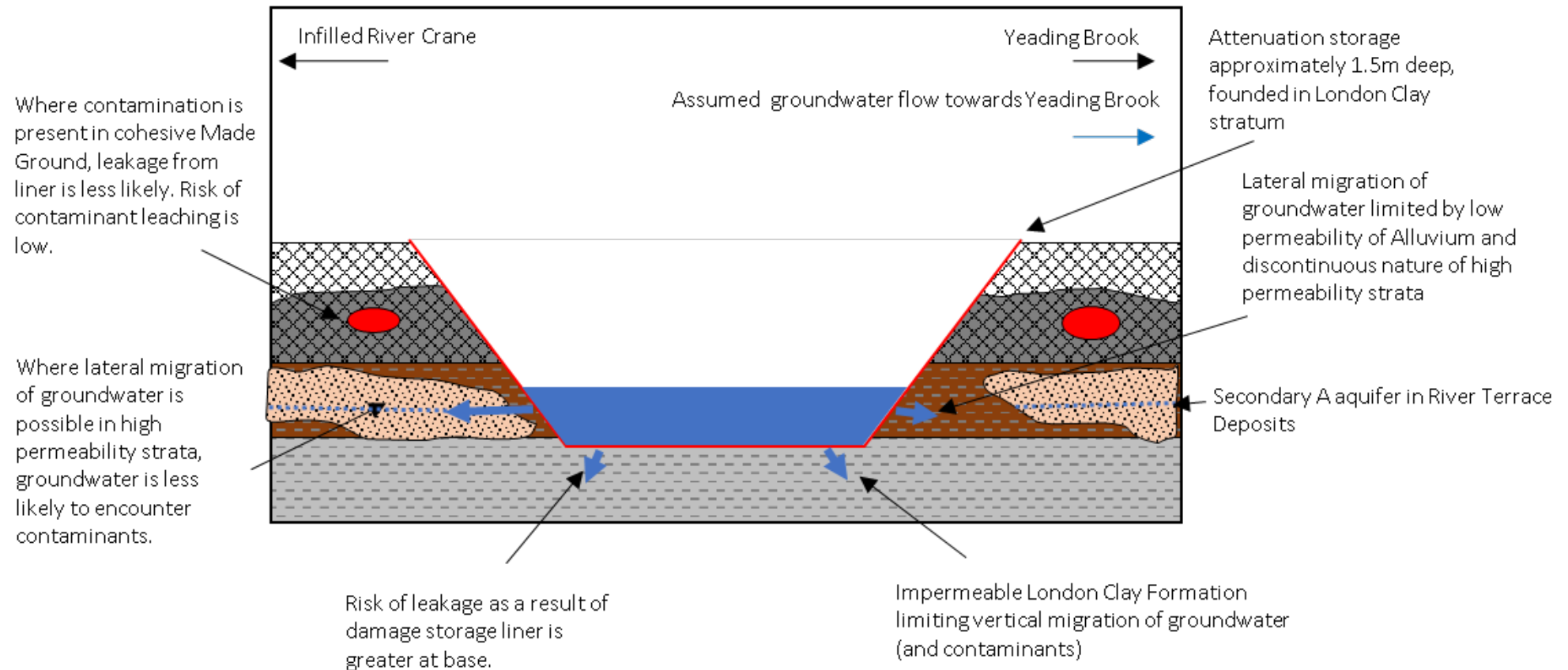
Receptors

- i) Future Users
- ii) off-site occupants
- iii) Buildings, Structures, and Services
- iv) Construction Workers
- v) Plants and Vegetation
- vi) Embankment & bridge structures and services
- vii) Yeading Brook
- viii) Grand Union Canal



Client Clark Smith Partnership	Project Western Access	Job No CGN/03732I
	Title Conceptual Site Model	Figure 5

Risk of contaminant migration as a result of attenuation storage leakage



Client	Project	Job No
Clark Smith Partnership	Western Access – Remediation Scheme Addendum	CGN/037321
	Title	
	Detention Basin Conceptual Model	Figure 6

APPENDIX A

Earthworks Material Acceptability and Waste Classification Reports

A720-E05-IW-BR-CGL-EW-TS-0003 P1

A720-E05-IW-BR-CGL-EW-TS-0004 P1

A720-E05-IW-BR-CGL-EW-TS-0005 P1



Clark Smith Partnership

Western Access, Southall
*Earthworks Material Acceptability
and Waste Characterisation (Pump
Lane Bund)*

May, 2017



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FIGURES

Figure 1 - Site Location Plan

Figure 2 – Trial Pit Location Plan

APPENDICES

Appendix A – Trial Pit Logs

Appendix B – Geotechnical Test Results

Appendix C – Chemical Test Results

1. INTRODUCTION

Card Geotechnics Limited (CGL) have been instructed by Clark Smith Partnership (CSP) to undertake initial trial pit and laboratory testing in order to provide a preliminary assessment of material suitability for direct transfer off-site or reuse on-site under a Materials Management Plan (MMP). Additionally, the testing has been scheduled to identify the suitability of these site won materials for lime or cement stabilisation.

This trial pitting at the Western Access in Southall was completed on the Friday 17th February 2017. This Letter Report specifically details the findings from the investigation undertaken at the location of an earth bund running parallel to the Pump Lane access road. The Preliminary Geotechnical Design Report (PGDR) detailing the ground conditions across the site was re-issued in December 2016¹.

¹ CGL (December 2016). *CGN03732 Southall, Pump Lane Western Access*. Preliminary Geotechnical Design Report. Rev1

2. SITE DESCRIPTION

The development area as a whole covers approximately 7.66Ha. The area encompassing all three permanent earthworks is centred approximately on National Grid Reference (NGR) 511254, 179810. An overall site location plan is presented as Figure 1 and a trial pit location plan showing the site areas relevant to this report is presented as Figure 2.

The earth bund considered within this investigation comprises a stockpile of material (herein referred to as *Pump Lane Bund*) located approximately immediate adjacent of the Pump Lane access road and west of the River Crane. The bund stretches runs approximately south-west to north-east along a length of approximately 500m. The Pump Lane Bund is proposed to be reduced in height by approximately 2-3m to facilitate the construction of temporary access and laydown areas. It is proposed that the excavated material be stockpiled for future use within the earthworks construction, subject to suitability.

3. INTRUSIVE INVESTIGATION

3.1 Summary of works

Eight trial pits were excavated in the Pump Lane Bund within Made Ground and natural strata during the investigation undertaken on the 17th February 2017. Representative samples were taken from each trial pit location for the purposes of geotechnical and chemical testing and are shown on the trial pits logs presented in Appendix A.

3.2 Ground conditions

3.2.1 Pump Lane Bund

The Pump Lane Bund is comprised of Made Ground recorded as brown slightly sandy slightly gravelly silty clay with fragments of brick, flint, concrete, wood, and rare plastic. Whilst the material was heterogeneous in nature, no distinct differences in the material were recorded between pit locations TP101 to TP108.

3.2.2 Visual and olfactory indicators of contamination

No visual and olfactory indicators of contamination were recorded within the material at either location.

3.3 Environmental laboratory testing

A total of six soils samples retrieved from the Pump Lane Bund were scheduled for testing for a range of contaminants including; heavy metals, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), BTEX and asbestos screening. A further five samples were scheduled for Asbestos Quantification based upon screening results.

3.4 Geotechnical laboratory testing

Eight samples from the Pump Lane Bund were scheduled for geotechnical testing including; Atterberg Limits, particle size distribution, moisture content, MCV, MCV/mc relationship, mc/MDD relationship, unconsolidated undrained triaxial and sulphates.

4. MATERIAL CHARACTERISATION

CGL have compared the results of the geotechnical and chemical tests to the limiting criteria detailed in the Earthworks Specification contained within the PDGR and have designated each of the locations under each of the three headings below:

- Material acceptability – compared against criteria within Appendix 6/1.

This indicates whether the material is acceptable for use in the earthworks based upon geotechnical properties. If the in-situ material is considered to be unacceptable, then the suitability for lime or cement stabilisation has been assessed;

- Contamination concentrations – compared against limiting values within Appendix 6/14

This indicates whether the material is acceptable for use in the earthworks based upon concentrations of contamination recorded within the in-situ materials. Where exceedances are noted, the material may be classified as Class U1B or U2 unacceptable material;

In order to assess the likely requirements for re-use and/or disposal off-site, CGL has reviewed the Morgan Tucker drawings (A720-E05-IW-MTU-EW-DR-0610 and A720-E05-IW-MTU-EW-DR-0600), which detail the proposed earthworks cut and fill volumes. Based upon a net cut of approximately 76,000m³ and a net fill of 80,400m³ across the development area, a deficit of approximately 4,300m³ of fill exists. The drawings indicate smaller zones of material balance across the site, however as these zones still generally cover larger areas than that sampled within this investigation, the volumes stated cannot be applied to these results.

4.1 Earthworks classification and acceptability testing

4.1.1 Sulfates

Testing was undertaken to TRL 477² methods 1, 2 & 4 to determine the Total Potential Sulfate (TPS) within six samples taken from the Pump Lane Bund. The mean value of the two highest results has been reported in accordance with MCHW 1. The results are presented below in Table 1.

² TRL Limited (2001). *Sulfate specification for structural backfills*. TRL Report TRL447.

Table 1 - Summary of sulfate test results

	Total Potential Sulfate (%SO ₄) ¹	Acid Soluble Sulfate (%SO ₄) ²
Pump Lane Bund	0.48	0.29
¹ Average of two highest recorded values		
² Maximum value across all samples		

The results indicate that Total Potential Sulfates (TPS) exceed the recommended limiting value of 0.25%³ for suitability for lime improvement and stabilisation. The risk of expansion will be related to the percentage addition of lime required to achieved the necessary properties and can be further assessed by undertaking trials on lime treated material.

4.1.2 Atterberg Limit & Moisture Content

Five samples from *Pump Lane Bund* were tested to determine the Plastic and Liquid Limits of the cohesive soils in accordance with BS 1377 (1990), Part 2, Clause 5.3. Full laboratory testing data is provided in Appendix B, and a summary of the Plastic and Liquid Limits for the site won materials is set out below in Table 2.

Table 2 - Summary of Atterberg Limit test results

Atterberg Limits						
Strata	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	% material <425µm	I _p ²	Volume change potential
<i>Pump Lane Bund</i>	15-32	55-74	22-25	50-97	17-49	Low – Medium

All samples have natural moisture contents exceeding a lower limit PL-4, therefore conform to a Class 2A material based upon Moisture Content (combined with below grading assessment). The Liquid Limit for all samples is greater than 50, which places additional limitations on the Compaction Method 1 for a Class 2A material.

4.1.3 Particle Size Distribution testing

Six samples from the *Pump Lane Bund* were tested for Particle Size Distribution (PSD) in accordance BS 1377:1990 Part 2:9.2. Full geotechnical laboratory testing data is provided in Appendix B.

The results indicate that two samples (TP106 & TP108) conform to the Class 2A specification. Four samples (66% of samples tested) conform to the Class 2C specification due to the lack of materials passing the 2mm sieve during testing. However, samples from TP102 & TP103 were only slightly below the criteria for a Class 2A material and it is

³ Britpave (2005). *Stabilisation of sulfate-bearing soils- Technical Guidelines*. Britpave: Camberley.

anticipated that mixing of soils may permit these materials to meet the criteria for a Class 2A material based upon grading.

Significant larger cobbles and concrete slabs exceeding 125mm were noted. These would require removal before the material could be incorporated into the earthworks.

4.1.4 Maximum dry density/moisture content relationship

Three samples from the *Pump Lane Bund* area were tested to determine the optimum moisture contents and maximum dry density of the soils in accordance with BS 1377 (1990), Part 4, Clause 3.6 using a 2.5kg CBR mould. Full laboratory testing data is provided in Appendix B, and a summary of the maximum dry densities for the site won materials is set out below in Table 3.

Table 3 - Summary of compaction test results (2.5kg hammer method)

Material	Number of tests	Maximum dry density for end-product verification (Mg/m ³)	Optimum moisture content range (%)
Pump Lane Bund	3	1.52-1.66	19.9-25.7

The results indicate that all samples tested from the *Pump Lane Bund* area were received as 'wet of optimum moisture content'. The results indicate a small range of optimum moisture content for these samples taken from the northern end of the Pump Lane Bund, suggesting that normal site controls may be adequate for the handling of this material.

4.1.5 Moisture Condition Value (MCV) and MCV/mc relationship

Two samples from the *Pump Lane Bund* were tested to determine a single point Moisture Condition Value in accordance with BS 1377 (1990), Part 4. Full laboratory testing data is provided in Appendix B, and a summary of the undrained shear strength for the tested materials is set out below in Table 4.

Table 4 - Summary of MCV test results

Material	Number of tests	Single point Moisture Condition Value (MCV)
Pump Lane Bund	2	8.7-9.2

The Moisture Condition Value can provide a simple controlling value for a given soil to obtain near-full compaction. The results indicate that both samples from the *Pump Lane Bund* fall outside of typical limiting values for a Class 2A soil (lower limit 12 and upper limit 16) but are within typical limiting values for a Class 2C material (lower limit 8 and upper limit 16).

Three samples from the *Pump Lane Bund* were also tested to determine the relationship between Moisture Condition Value and Moisture Content in accordance with BS 1377 (1990), Part 4, Clause 5.5. This provides a calibration line for the materials tested and allows a more specific assessment of limiting values of MCV. The results indicate that the samples from the *Pump Lane Bund* may warrant a MCV lower limit of 8 and an MCV upper limit of around 16, for use within the Earthworks Specification.

4.1.6 Undrained Shear Strength

Five samples from the *Pump Lane Bund* were tested to determine the undrained shear strength in accordance with BS 1377 (1990), Part 7. Full laboratory testing data is provided in Appendix B, and a summary of the undrained shear strength for the tested materials is set out below in Table 5.

Table 5 - Summary of unconsolidated undrained triaxial test results

Material	Number of tests	Undrained Shear Strength (kN/m ²)
Pump Lane Bund	5	40-55

The results indicate that all samples exceed the value of undrained shear strength that has been assumed within the PGDR of 40kN/m².

4.1.7 Summary of geotechnical results

The results of the geotechnical testing indicate the material from the southern and central areas of *Pump Lane Bund* would be generally acceptable as a Class 2C material based upon grading, with the material at the northern most area of the bund tending towards a Class 2A material. Natural moisture contents were recorded as at or around optimum, with samples at the northern end of the bund tending to be wetter and two samples at the far southern end recorded as being dry of optimum.

The majority of samples are close to the lower limit of undrained shear strength characteristics and may benefit from stabilisation to improve strength.

Sulfate concentrations recorded within bund exceed the recommended limits for lime treatment, should this be used for these materials. Lime treatment trials should be undertaken to determine the risk of expansion of the treated material based upon the percentage of lime expected to be required for improvement and/or stabilisation. It may

be necessary to stabilise the material using Ground Granulated Blastfurnace Slag (GGBS) in combination with lime, if the material is stabilised to improve its strength.

4.2 Contamination assessment - Risks to human health

The chemical results have been compared against the limiting values within Appendix 6/14 of the PDGR, derived from the Generic Assessment Criteria (GACs) derived in house by CGL for the “commercial” land-use category, considered to be conservative in this scenario. None of the concentrations recorded within the Made Ground exceeded the assessment criteria.

Asbestos in the form of loose fibres of Chrysotile was detected within three samples (TP101, TP104 & TP107). Subsequent Stage 2 Quantification undertaken on these samples recorded asbestos quantities below the limit of detection of 0.001%. For the purposes of waste disposal, these quantities are below the limit of 0.1%, above which material would be considered ‘Hazardous Waste’. Furthermore, these quantities are below the value considered to pose a risk to human health, however it would be prudent to prevent this material from drying out where fibres are more susceptible to transportation by wind.

4.3 Waste characterisation

The waste characterisation of the sampled material was undertaken in accordance with the waste classification guidance document, WM3⁴ to determine its characterisation and hazardous properties.

It should be noted that in May/June 2012, HMR&C issued Briefs 15/12 and 18/12 clarifying how construction spoil and excess soils will be assessed for landfill tax purposes. Detailed accurate descriptions of waste are required for all wastes to support the landfill tax assessment. Uncontaminated naturally occurring soils will remain inert by default and eligible for the lower rate of landfill tax. Similarly ‘reworked soils’ and demolition ‘stone’ comprising ONLY materials listed in the Schedule of the Landfill Tax (Qualifying Material) Order 2011 (SI 2011/1017) will also be eligible for the lower rate of landfill tax. However, Made Ground containing soil and foreign objects such as timber, plastic, rubber, metal, paper, plasterboard, asbestos etc., regardless of the results of chemical analysis for waste classification purposes, will be eligible for the standard (higher) rate of landfill tax.

Therefore, to maximise eligibility for lower rate landfill tax on waste construction spoil/

reworked ground, careful waste segregation and controls are necessary, and Made Ground recorded onsite will need sorting to remove foreign objects.

4.3.1 Pump Lane Bund

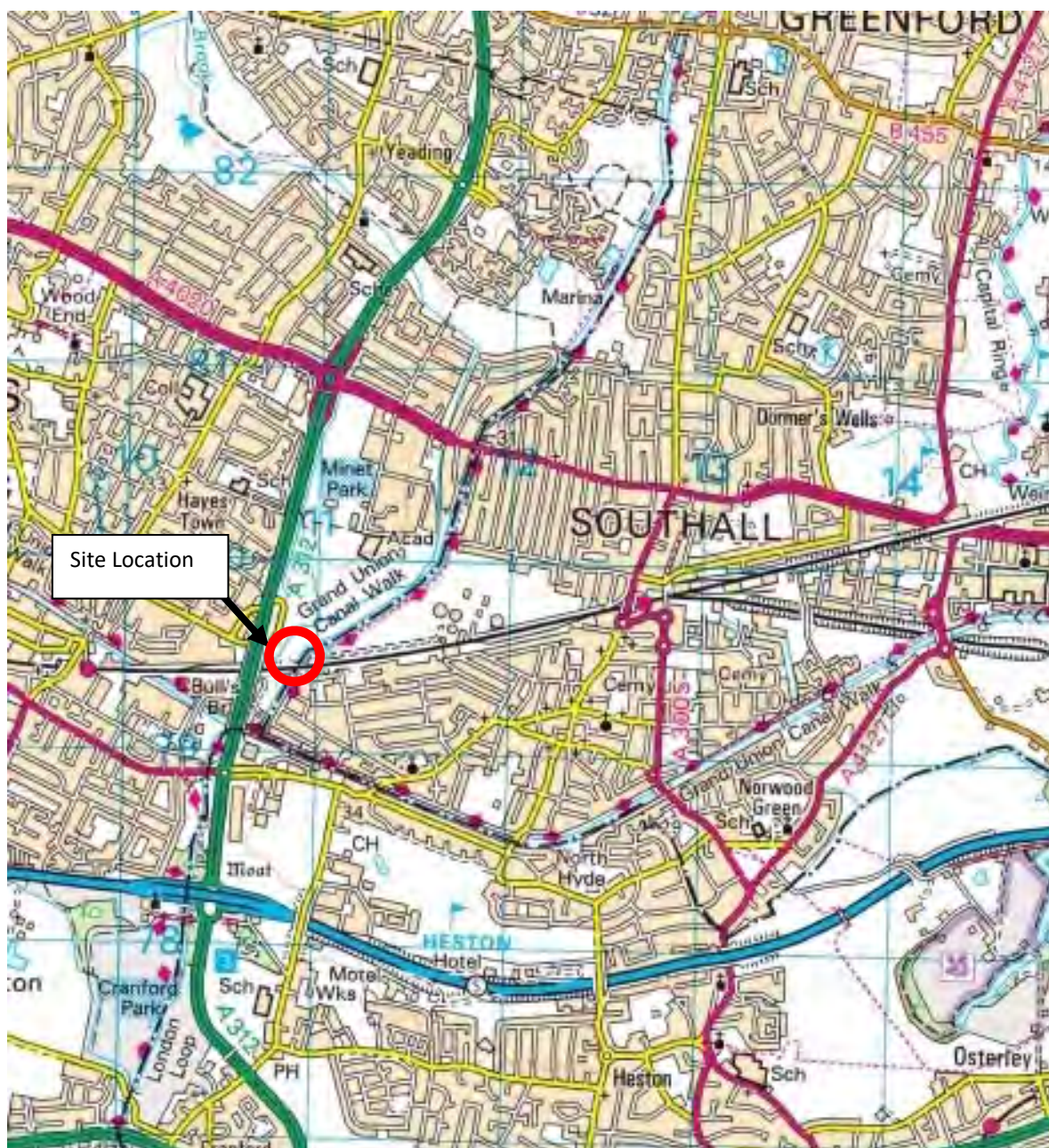
The results of the preliminary assessment using WM3 assessment criteria, indicate that the material associated with the samples from the *Pump Lane Bund* are deemed 'not-hazardous'. WAC testing has not been undertaken on these soils due to the low contaminant concentrations noted and the likely suitability for re-use as an earthworks material. However if the material was required to be disposed of off-site, based on the 'not-hazardous' WM3 classification, an Inert WAC test should be undertaken to determine whether the material was required to be taken to an Inert or Non-Hazardous waste disposal facility.

5. SUMMARY

This report provides the results of trial pitting undertaken and subsequent laboratory testing undertaken as part of the advanced works phase of the Western Access scheme.

The results show that the material from the Pump Lane Bund area demonstrates low variability and will likely be suitable for re-use providing good site controls are employed to manage the source materials on site.

FIGURES



Reproduced from the Ordnance Survey 1:50,000 map with permission of the Controller of Her Majesty's Stationary Office, Crown Copyright.

Licence No. 100012585

Client	Project	Job No
CSP Limited	Southall Advanced Works	CGN/3732C
	Title	
	Site location plan	Figure 1

APPENDIX A

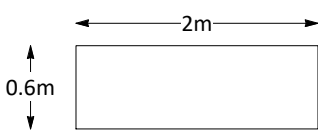
Trial Pit Logs

TRIAL PIT LOG



Project Southall access advanced works				TRIAL PIT No TP101
Job No CGN/03732C	Date 17-02-17	Ground Level (m)	Co-Ordinates (m)	
Client Conway				Sheet 1 of 1

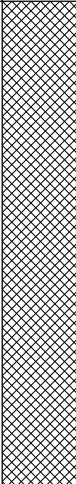
SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
1.00	ES/B					Grass over soft dark brown slightly clayey slightly sandy gravelly silt. Gravel is angular to subrounded fine to coarse of brick, concrete, flint and rare tarmac. Frequent inclusions of orange brown slightly gravelly clay. [MADE GROUND]
					(1.50)	
					1.50	(Pit terminated at 1.5m)

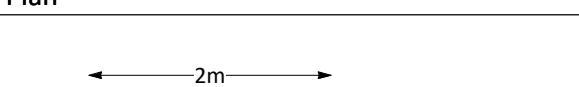
Plan  Stability:	General Remarks 1. Trial pit excavated on the eastern side of bund 2. Samples: B = bulk disturbed sample, ES = environmental sample 3. No groundwater seepage noted during excavation 4. Hole backfilled with arisings on completion
--	---

Method/ Plant Used	Field Crew	Logged By OJR	Checked By DRAFT
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CGL TP LOG CGN03732C.GPJ GINT STD AGS 3.1.GDT 17/2/17

Project Southall access advanced works				TRIAL PIT No TP102
Job No CGN/03732C	Date 17-02-17	Ground Level (m)	Co-Ordinates (m)	
Client Conway				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thickness)	DESCRIPTION
0.80	ES/B					(1.00)	Grass over soft dark brown and orange brown sandy gravelly silty clay. Gravel is angular to subrounded fine to coarse of brick, concrete and flint. Rare brick and concrete cobbles. [MADE GROUND]
						1.00	(Pit terminated at 1m)

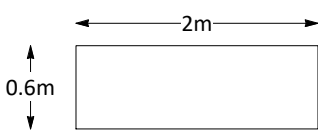
Plan  Stability:	General Remarks 1. Trial pit excavated on the eastern side of bund 2. Samples: B = bulk disturbed sample, ES = environmental sample 3. No groundwater seepage noted during excavation 4. Hole backfilled with arisings on completion		
Method/ Plant Used	Field Crew	Logged By OJR	Checked By DRAFT

TRIAL PIT LOG



Project Southall access advanced works				TRIAL PIT No TP103
Job No CGN/03732C	Date 17-02-17	Ground Level (m)	Co-Ordinates (m)	
Client Conway				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thickness)	DESCRIPTION
0.80	ES/B					(1.50)	Grass over soft dark orange brown silty slightly sandy gravelly clay. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of brick, flint and concrete. Occasional brick and concrete cobbles. One concrete boulder noted. Frequent rootlets. [MADE GROUND]
						1.50	(Pit terminated at 1.5m)

Plan  Stability:	General Remarks 1. Trial pit excavated on the eastern side of bund 2. Samples: B = bulk disturbed sample, ES = environmental sample 3. No groundwater seepage noted during excavation 4. Hole backfilled with arisings on completion
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Method/ Plant Used	Field Crew	Logged By OJR	Checked By DRAFT
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CGL TP LOG CGN03732C.GPJ GINT STD AGS 3.1.GDT 17/2/17

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thickness)	DESCRIPTION
0.60	ES/B					(1.50)	Grass over soft orange brown and occasional dark grey brown gravelly silty clay. Gravel is angular to subrounded fine to coarse of brick, concrete and occasional flint. Occasional brick cobbles. One curb stone noted. Frequent rootlets and twigs. [MADE GROUND]
						1.50	(Pit terminated at 1.5m)

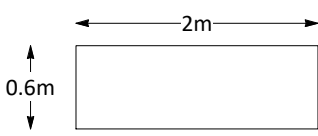
CGL TP LOG CGN03732C.GPJ GINT STD AGS 3 1.GDT 17/2/17

TRIAL PIT LOG



Project Southall access advanced works				TRIAL PIT No TP105
Job No CGN/03732C	Date 17-02-17	Ground Level (m)	Co-Ordinates (m)	
Client Conway				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
1.20	ES/B					Grass over soft dark orange brown sandy gravelly clay. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of flint, brick and concrete. Occasional concrete cobbles. Rare roots. [MADE GROUND]
						(1.50)
						1.50
						(Pit terminated at 1.5m)

Plan  Stability:	General Remarks 1. Trial pit excavated on the eastern side of bund 2. Samples: B = bulk disturbed sample, ES = environmental sample 3. No groundwater seepage noted during excavation 4. Hole backfilled with arisings on completion
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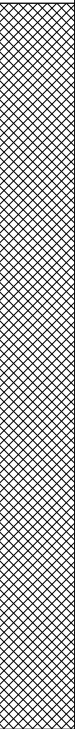
Method/ Plant Used	Field Crew	Logged By OJR	Checked By DRAFT
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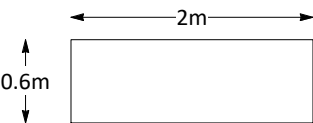
CGL TP LOG CGN03732C.GPJ GINT STD AGS 3.1.GDT 17/2/17

TRIAL PIT LOG



Project Southall access advanced works				TRIAL PIT No TP106
Job No CGN/03732C	Date 17-02-17	Ground Level (m)	Co-Ordinates (m)	
Client Conway				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
1.00	ES/B					Grass over soft dark brown grey slightly gravelly silty clay. Gravel is angular to subrounded fine to coarse of flint concrete. Occasional inclusions of red brown fine to coarse sand. [MADE GROUND]
					(1.50)	
					1.50	(Pit terminated at 1.5m)

Plan	General Remarks
 Stability:	1. Trial pit excavated on the eastern side of bund 2. Samples: B = bulk disturbed sample, ES = environmental sample 3. No groundwater seepage noted during excavation 4. Hole backfilled with arisings on completion

Method/ Plant Used	Field Crew	Logged By OJR	Checked By DRAFT
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CGI TP LOG CGN03732C.GPJ GINT STD AGS 3.1.GDT 17/2/17

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
1.50	ES/B				Depth (m) (Thickness)	Grass and vegetation stumps over gravelly organic silt with abundant roots. Gravel is angular to subrounded fine to coarse of flint and brick. [MADE GROUND]
					0.20	
					(1.80)	
					2.00	(Pit terminated at 2m)

CGL TP LOG CGN03732C.GPJ GINT STD AGS 3 1.GDT 17/2/17

TRIAL PIT LOG



Project Southall access advanced works				TRIAL PIT No TP108
Job No CGN/03732C	Date 17-02-17	Ground Level (m)	Co-Ordinates (m)	
Client Conway				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION
1.20	ES/B					(0.20) 0.20	Dark brown gravelly organic silt with abundant roots. Gravel is angular to subrounded fine to coarse of flint, concrete and brick. [MADE GROUND]
						(1.80)	Soft dark grey brown gravelly clay. Gravel is angular to subrounded fine to coarse of flint, brick and concrete. Occasional brick cobbles. Rare concrete boulders. [MADE GROUND]
						2.00	(Pit terminated at 2m)

Plan	General Remarks
Stability:	1. Trial pit excavated on the eastern side of bund 2. Samples: B = bulk disturbed sample, ES = environmental sample 3. No groundwater seepage noted during excavation 4. Hole backfilled with arisings on completion

Method/ Plant Used	Field Crew	Logged By OJR	Checked By DRAFT
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CGI TP LOG CGN03732C.GPJ GINT STD AGS 3.1 GDT 17/2/17

APPENDIX B

Geotechnical Test Results

INDEX PROPERTIES & TRIAXIAL COMPRESSION TESTS

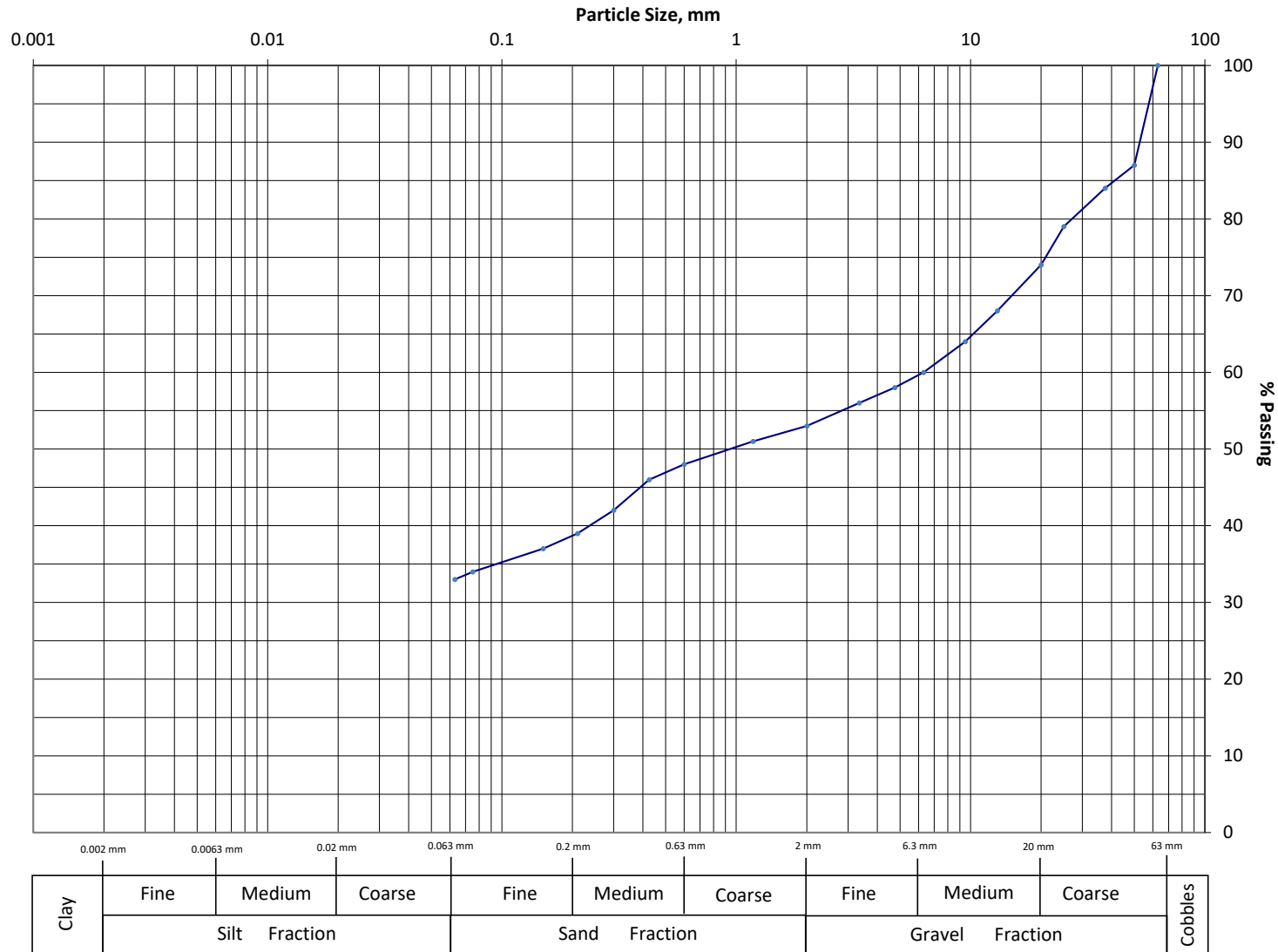
BS 1377 : Parts 2 & 7 : 1990

Report Ref	T17/1676	Contract	Southall Access Advanced Works
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TP No.	Sample		INDEX PROPERTIES						TRIAXIAL COMPRESSION							Remarks
	Depth m	Description	Liquid Limit %	Plastic Limit %	Plasticity Index %	% Passing 425micron Sieve	Corrected Plasticity Index IP %	Soil Plasticity	Code	Lateral Pressure kPa	Compressive Strength kPa	Cohesion kPa	Angle of Friction °	Bulk Density kg/cu.m	Water Content % dry wt	
101	1.00	Made ground (brown clayey sand, occasional pockets of sandy clay with gravel and cobbles including brick and concrete)													15.4	
102	0.80	Made ground (brown very sandy clay, occasional gravel including brick, ceramic tile and concrete fragments)													19.2	
103	0.80	Made ground (brown sandy clay, occasional gravel and cobbles including bricks and roots)	67	25	42	80	34	CH	U100	10 20 40	70 75 80	40		2095	30.3	
104	0.60	Made ground (brown sandy clay, occasional gravel including concrete and roots)	58	24	34	63	21	CH	U100	10 20 40	105 110 115	55		2205	25.8	
105	1.20	Made ground (brown sandy clay, occasional gravel and very occasional concrete)	55	22	33	50	17	CH	U100	10 20 40	90 105 110	50		2270	21.4	
106	1.00	Made ground (brown clay, very occasional gravel including concrete and brick fragments)	74	24	50	97	49	CV	U100	10 20 40	90 90 95	45		2105	32.2	
108	1.20	Made ground (brown clay, occasional gravel, very occasional concrete and brick fragments)	67	24	43	89	38	CH	U100	10 20 40	100 105 110	55		2130	31.1	
KEY: Code: Soil Type: Plasticity: 38 - 38mm nominal diameter specimen U - Undrained C - Clay L - Low 100 - 100mm nominal diameter specimen CD - Consolidated Drained M - Silt I - Intermediate R - Remoulded CU - Consolidated Undrained O - Organic H - High F - Functional M - Multi Stage NP - Non Plastic V - Very High LV - Laboratory Vane S - Single Stage E - Extremely High																

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	100
63	87
50	84
37.5	79
25	74
20	68
13	64
9.5	60
6.3	58
4.75	56
3.35	53
2	51
1.18	48
0.6	46
0.425	42
0.3	39
0.21	37
0.15	34
0.075	33
0.063	33

Particle Proportions (%)	
Cobbles	0
Gravel	47
Sand	20
Silt & Clay	33

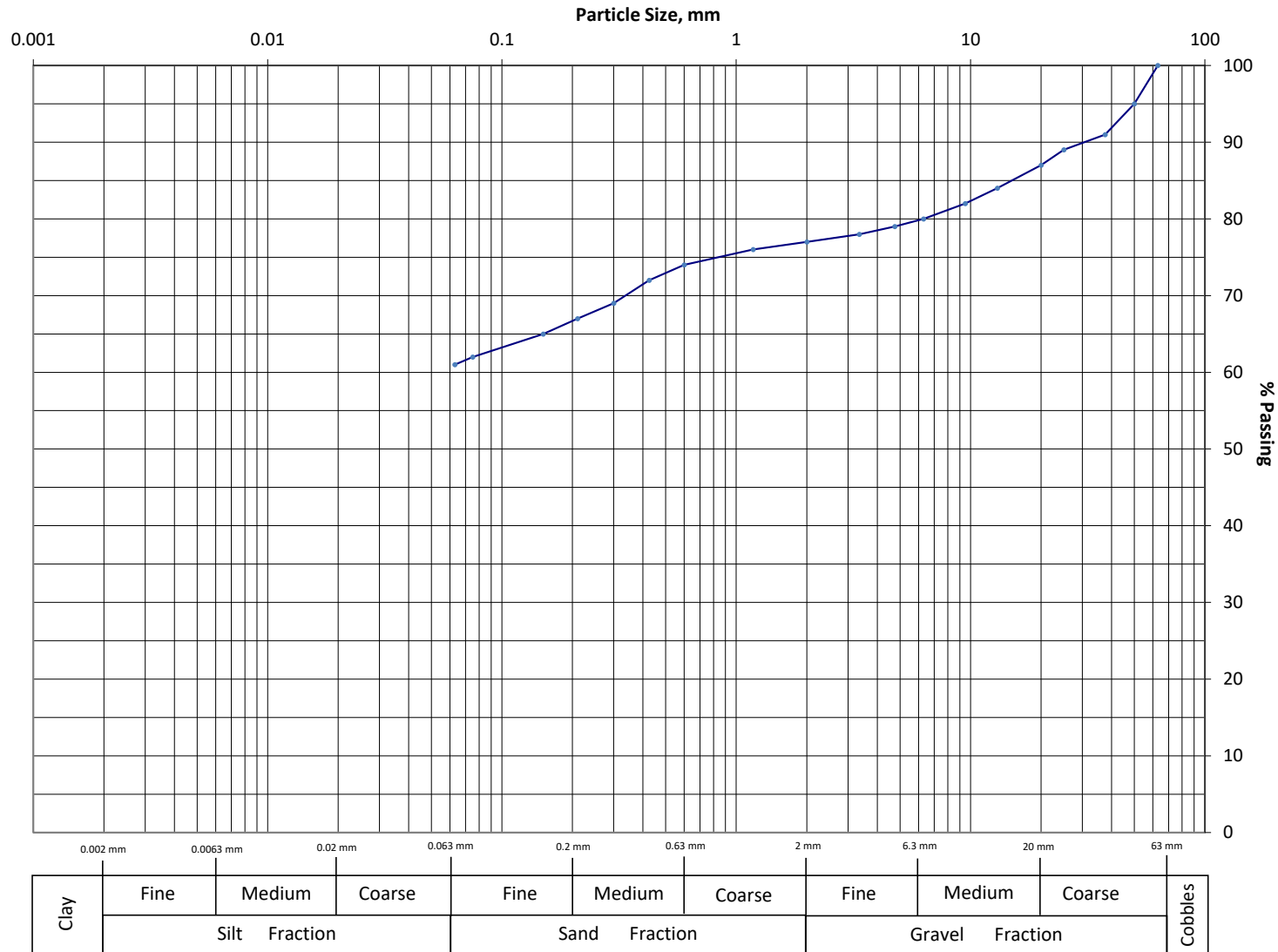
BH/TP No.	TP101	Depth, m	1.00	Report Ref	T17/1676
Visual Description	Made ground (brown clayey sand with occasional pockets of brown sandy clay with gravel including brick and concrete)			Contract	Southall Access Advanced Works



ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	100
63	95
50	91
37.5	89
25	87
20	84
13	82
9.5	80
6.3	79
4.75	78
3.35	77
2	76
1.18	74
0.6	72
0.425	69
0.3	67
0.21	65
0.15	62
0.075	61
0.063	61

Particle Proportions (%)	
Cobbles	0
Gravel	23
Sand	16
Silt & Clay	61

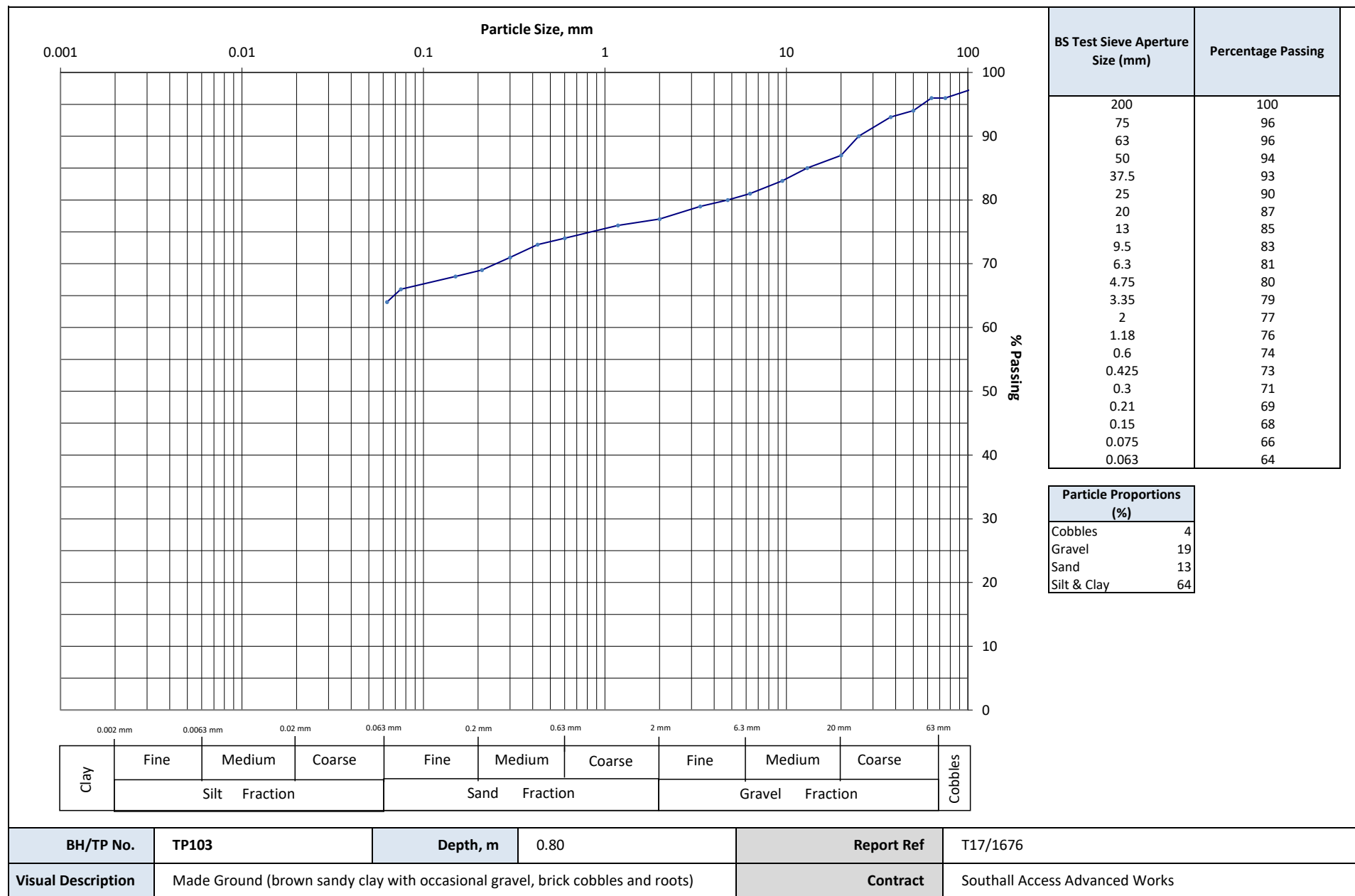
BH/TP No.	TP102	Depth, m	0.80	Report Ref	T17/1676
Visual Description	Made ground (brown very sandy clay, occasional gravel including brick, ceramic tile and concrete fragments)			Contract	Southall Access Advanced Works



ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH

PARTICLE SIZE DISTRIBUTION TEST

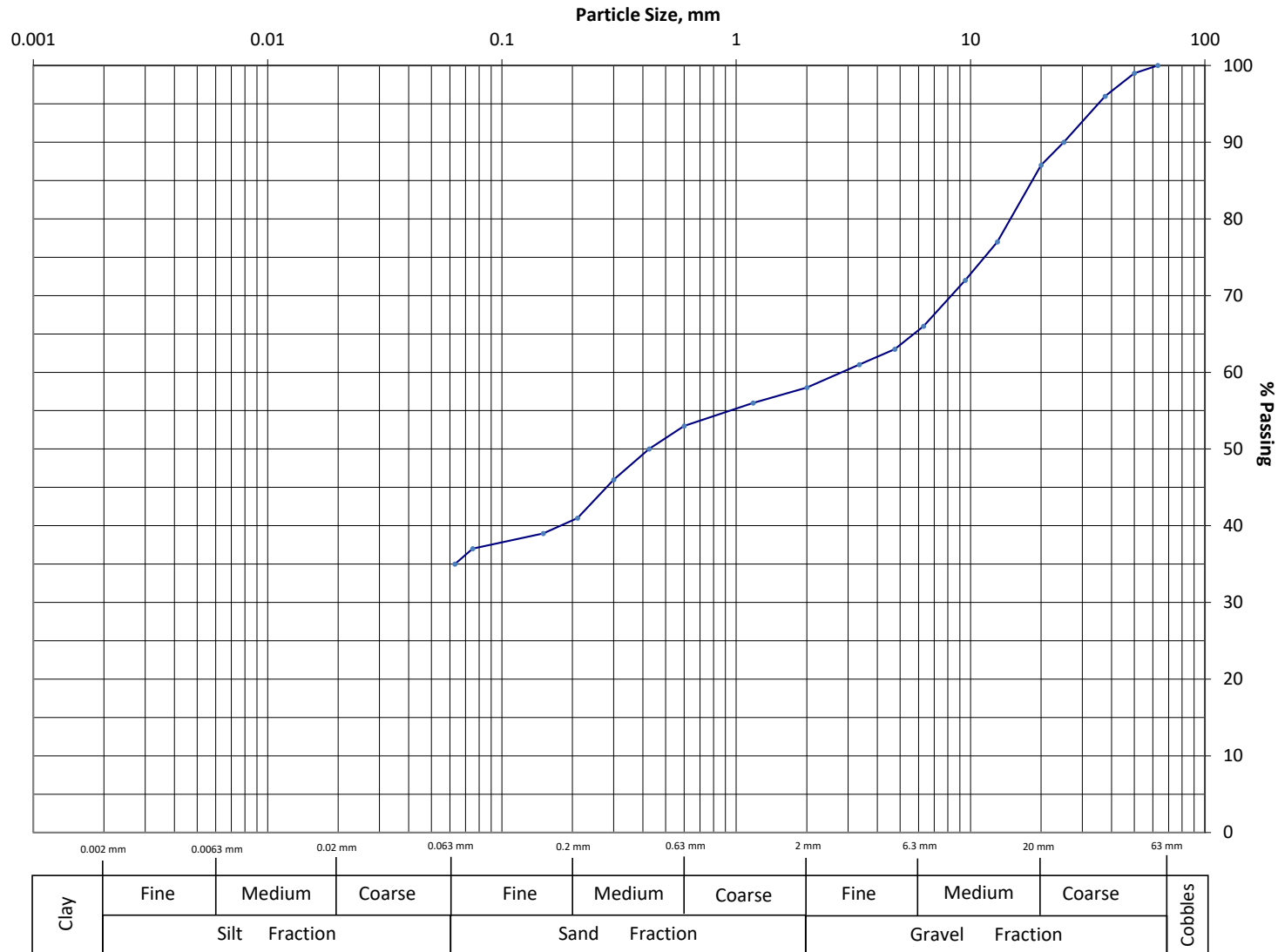
BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	
63	100
50	99
37.5	96
25	90
20	87
13	77
9.5	72
6.3	66
4.75	63
3.35	61
2	58
1.18	56
0.6	53
0.425	50
0.3	46
0.21	41
0.15	39
0.075	37
0.063	35

Particle Proportions (%)	
Cobbles	0
Gravel	42
Sand	23
Silt & Clay	35

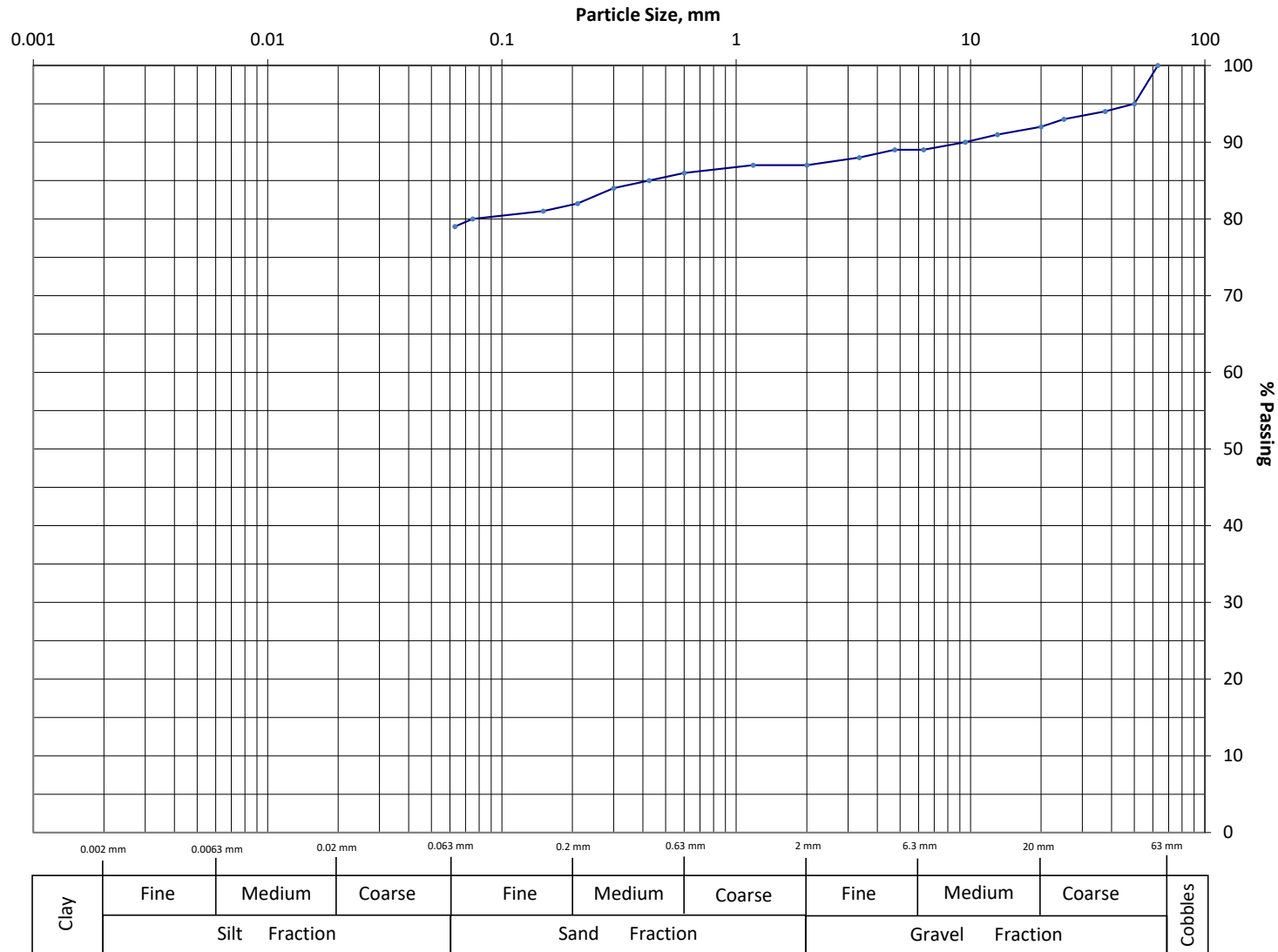
BH/TP No.	TP105	Depth, m	1.20	Report Ref	T17/1676
Visual Description	Made ground (brown sandy clay, occasional gravel and very occasional concrete)			Contract	Southall Access Advanced Works



ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	
63	100
50	95
37.5	94
25	93
20	92
13	91
9.5	90
6.3	89
4.75	89
3.35	88
2	87
1.18	87
0.6	86
0.425	85
0.3	84
0.21	82
0.15	81
0.075	80
0.063	79

Particle Proportions (%)	
Cobbles	0
Gravel	13
Sand	8
Silt & Clay	79

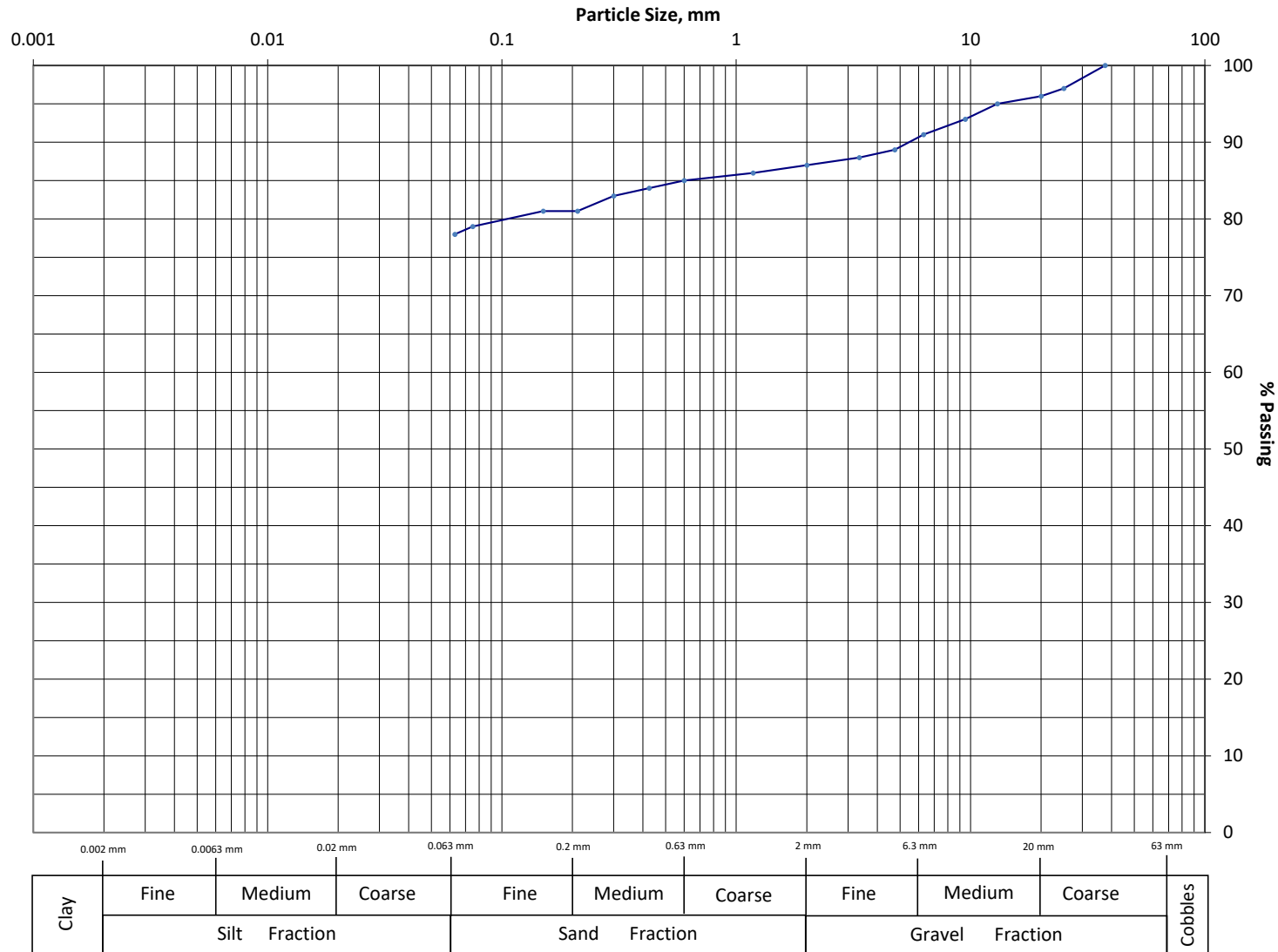
BH/TP No.	TP106	Depth, m	1.00	Report Ref	T17/1676
Visual Description	Made ground (brown clay, very occasional gravel including concrete and brick fragments)			Contract	Southall Access Advanced Works



ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	
63	
50	
37.5	100
25	97
20	96
13	95
9.5	93
6.3	91
4.75	89
3.35	88
2	87
1.18	86
0.6	85
0.425	84
0.3	83
0.21	81
0.15	81
0.075	79
0.063	78

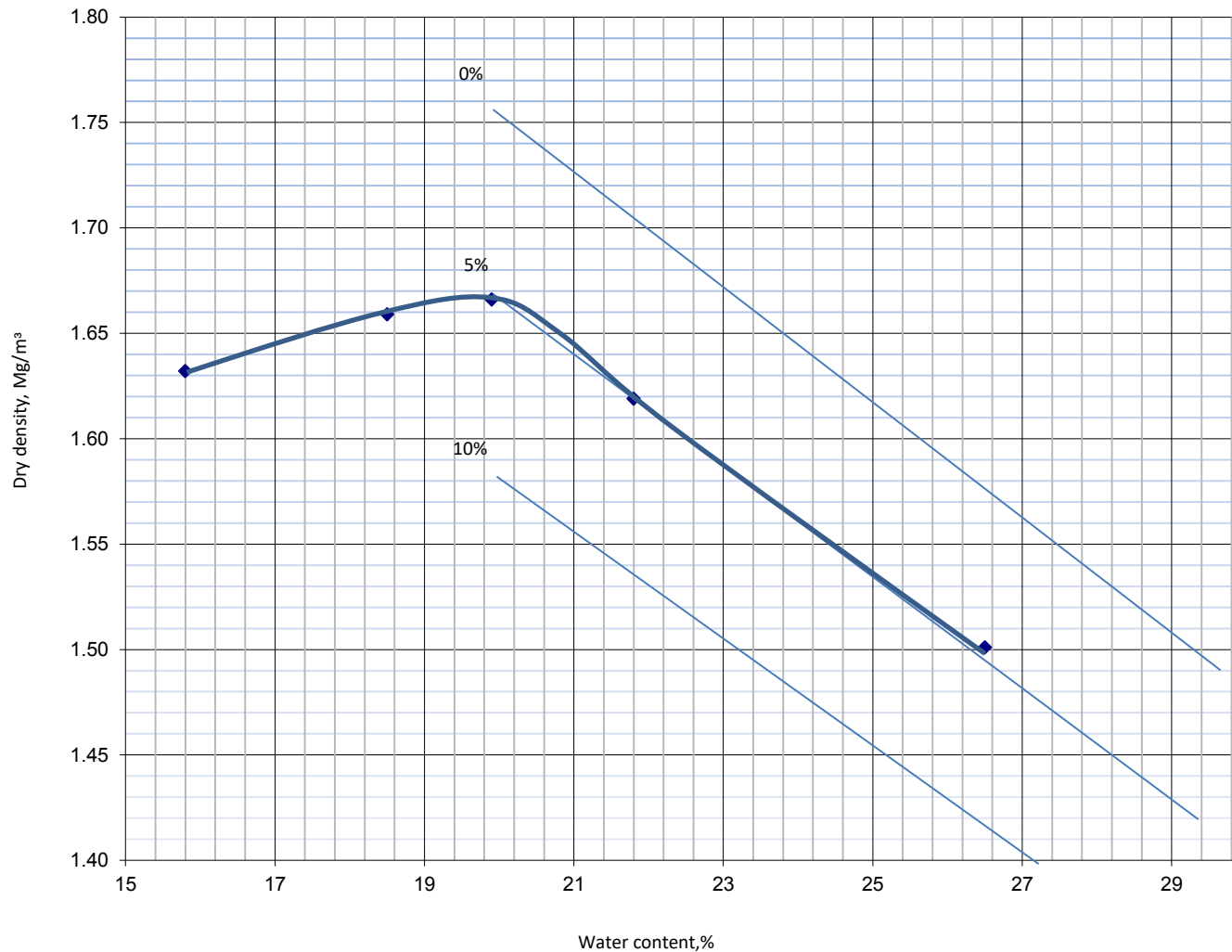
Particle Proportions (%)	
Cobbles	0
Gravel	13
Sand	9
Silt & Clay	78

BH/TP No.	TP108	Depth, m	1.20	Report Ref	T17/1676
Visual Description	Made ground (brown clay, occasional gravel, very occasional concrete and brick fragments)			Contract	Southall Access Advanced Works



ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH

Determination of dry density/moisture content relationship in accordance with BS1377 Part 4 Clause 3.6



Natural MC: 21.4%
Maximum dry density: 1.666Mg/m³
Optimum MC: 19.9%
Particle density(assumed): 2.70Mg/m³

Initial wet mass sieved: 45879g
% retained on 37.5mm:4.1
% retained on 20mm: 13.2%

Sample type: disturbed

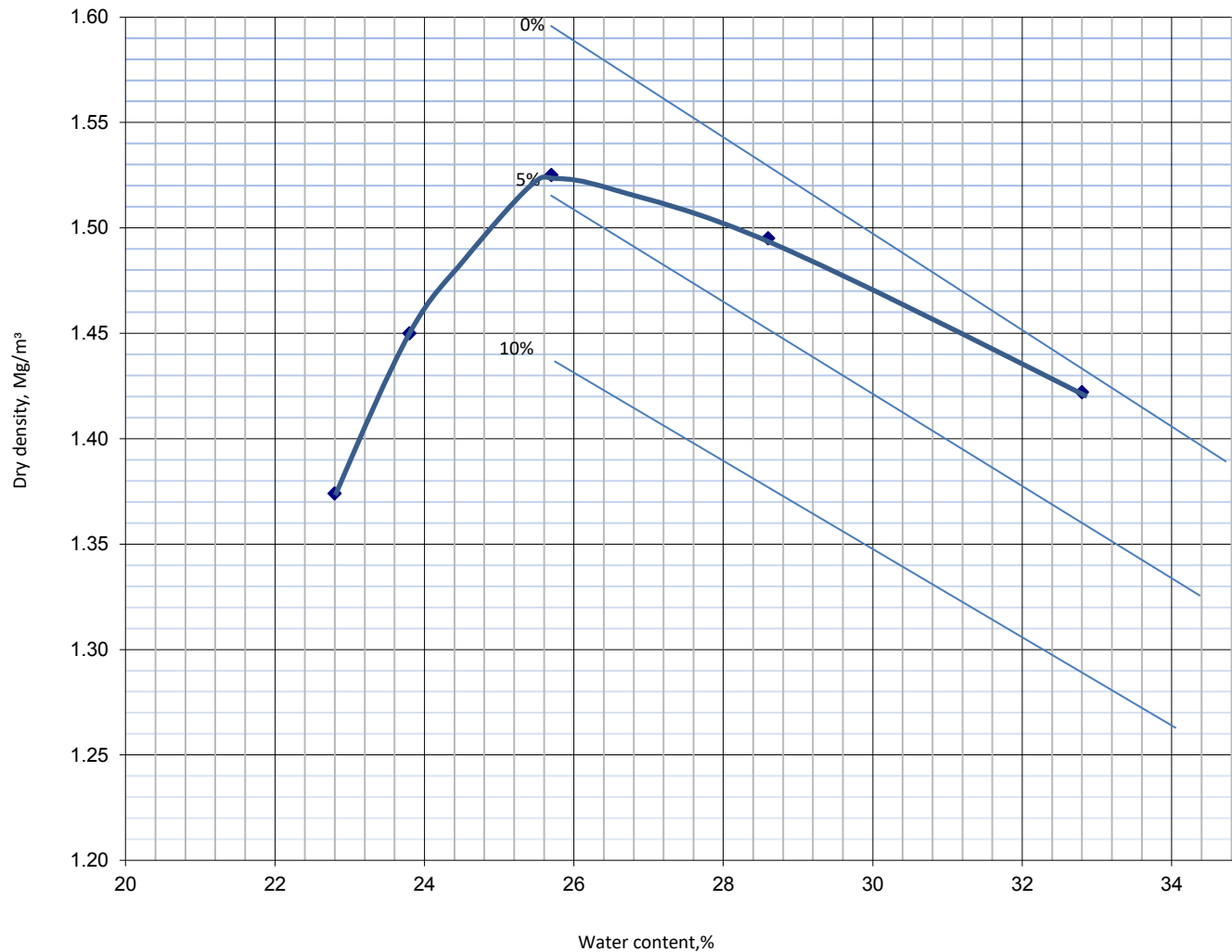
Method:
Sample prepared by passing 20mm
and 37.5mm sieve
Single sample
CBR Mould
2.5kg hammer
Drop height: 300mm
62 blows/layer
3 layers

Sample description: Made ground
(brown sandy clay with occasional
gravel and very occasional concrete)

Southall access advanced works

Sample: TP105 1.20m

Determination of dry density/moisture content relationship in accordance with BS1377 Part 4 Clause 3.6



Natural MC: 32.2%
Maximum dry density: 1.525Mg/m³
Optimum MC: 25.7%
Particle density(assumed): 2.70Mg/m³

Initial wet mass sieved: 40463g
% retained on 37.5mm:5.8%
% retained on 20mm: 7.7%

Sample type: disturbed

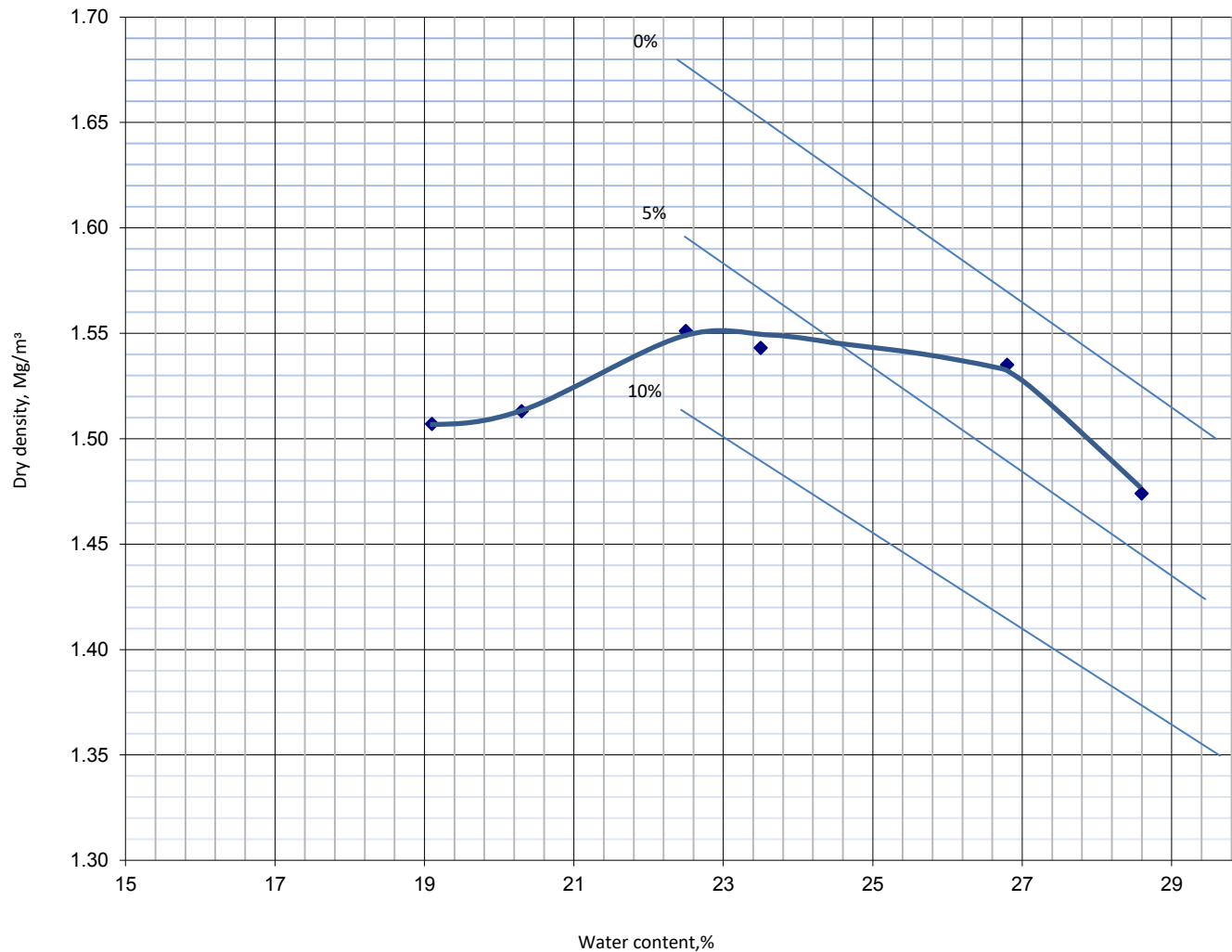
Method:
Sample prepared by passing 20mm
and 37.5mm sieve
Single sample
CBR Mould
2.5kg hammer
Drop height: 300mm
62 blows/layer
3 layers

Sample description: Made ground
(brown sandy clay with occasional
gravel and very occasional concrete
and brick)

Southall access advanced works

Sample: TP106 1.00m

Determination of dry density/moisture content relationship in accordance with BS1377 Part 4 Clause 3.6



Natural MC: 31.1%
Maximum dry density: 1.551Mg/m³
Optimum MC: 22.5%
Particle density(assumed): 2.70Mg/m³

Initial wet mass sieved: 46530g
% retained on 37.5mm:0%
% retained on 20mm: 3.8%

Sample type: disturbed

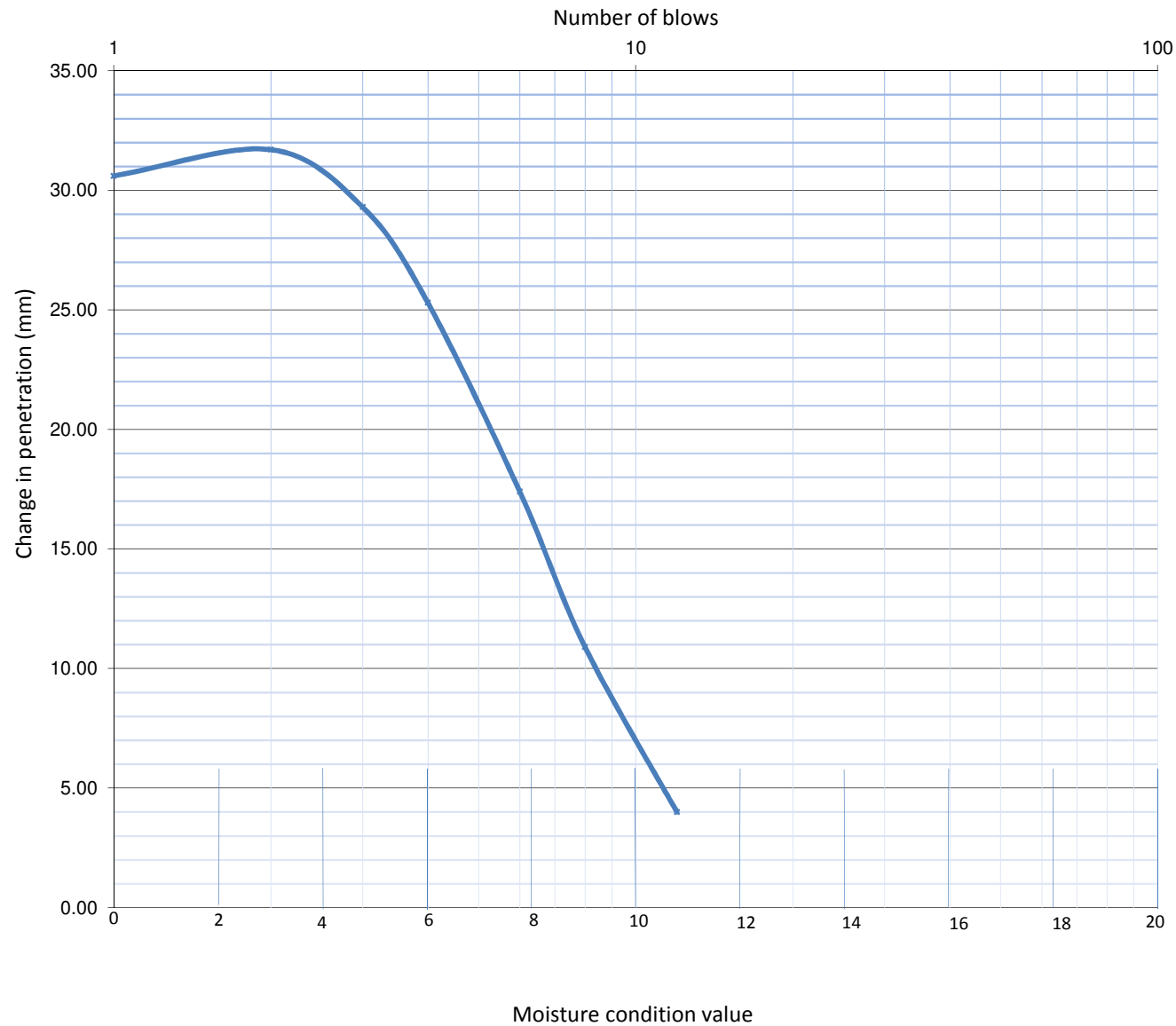
Method:
Sample prepared by passing 20mm
and 37.5mm sieve
Single sample
Proctor Mould
2.5kg hammer
Drop height: 300mm
27 blows/layer
3 layers

Sample description: Made ground
(brown sandy clay with occasional
gravel and very occasional concrete
and brick)

Southall access advanced works

Sample: TP108 1.20m

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 19.9

MCV: 10.6

Initial wet mass sieved: 45879g

% retained on 20mm: 13.2

% retained on 37.5mm: 4.1

Sample type: disturbed

Method:

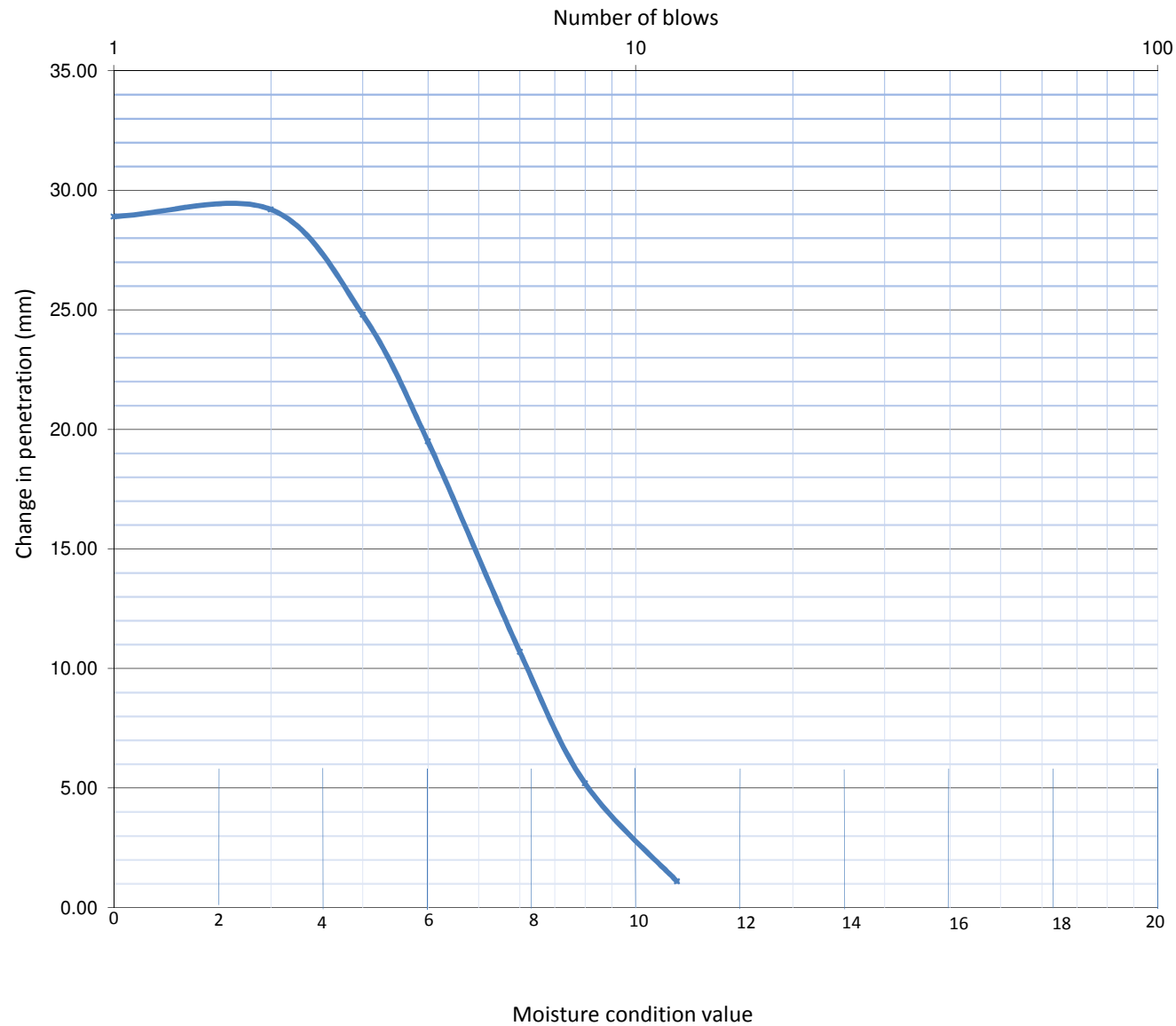
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 21.4%
MCV: 9.1

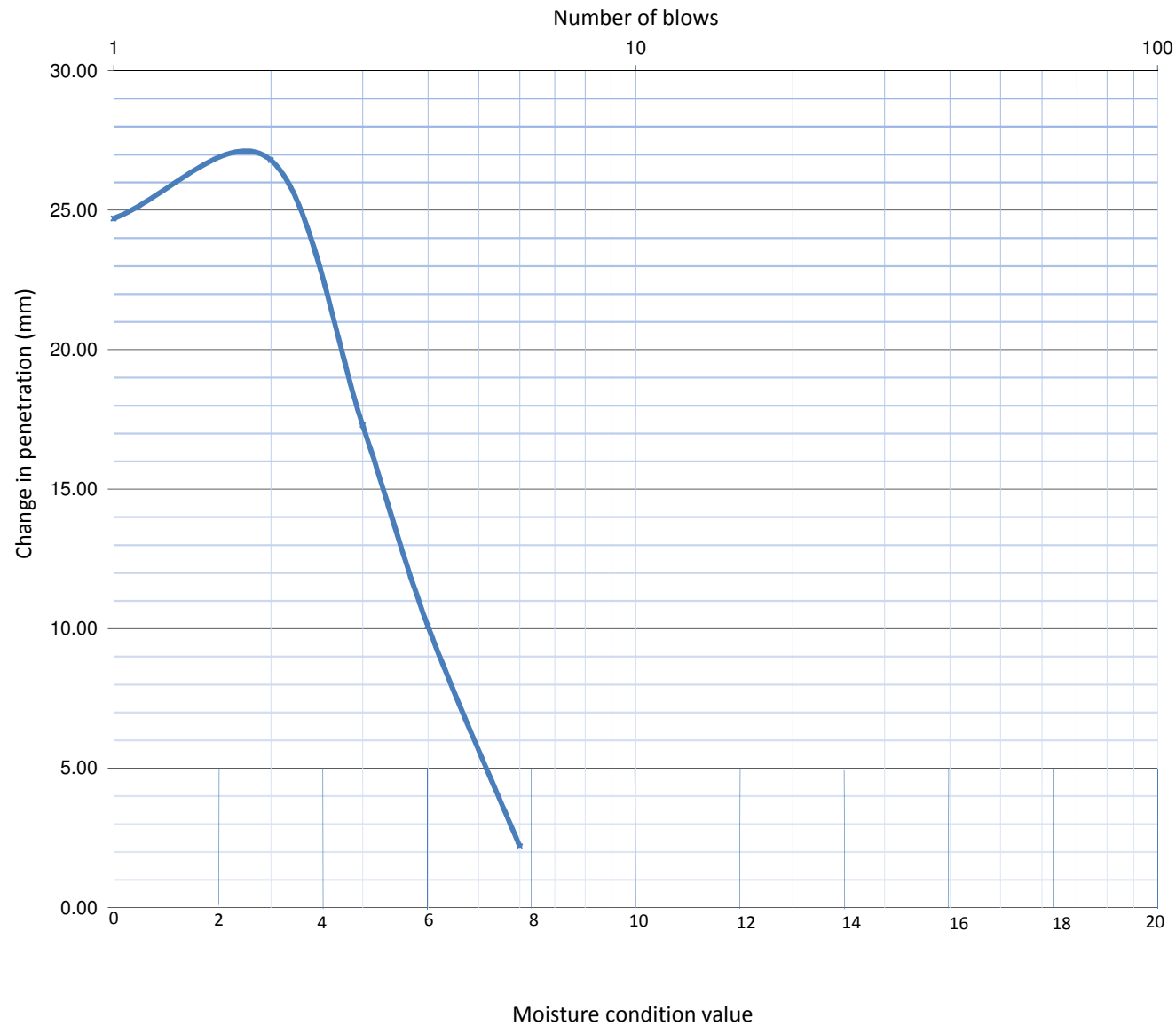
Initial wet mass sieved: 45879g
% retained on 20mm: 13.2
% retained on 37.5mm: 4.1

Sample type: disturbed

Method:
Sample prepared by passing 20mm
sieve
Batch prepared
Graph interpretation: steepest line
through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional
gravel and very occasional concrete

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 23.0

MCV: 7.2

Initial wet mass sieved: 45879g

% retained on 20mm: 13.2

% retained on 37.5mm: 4.1

Sample type: disturbed

Method:

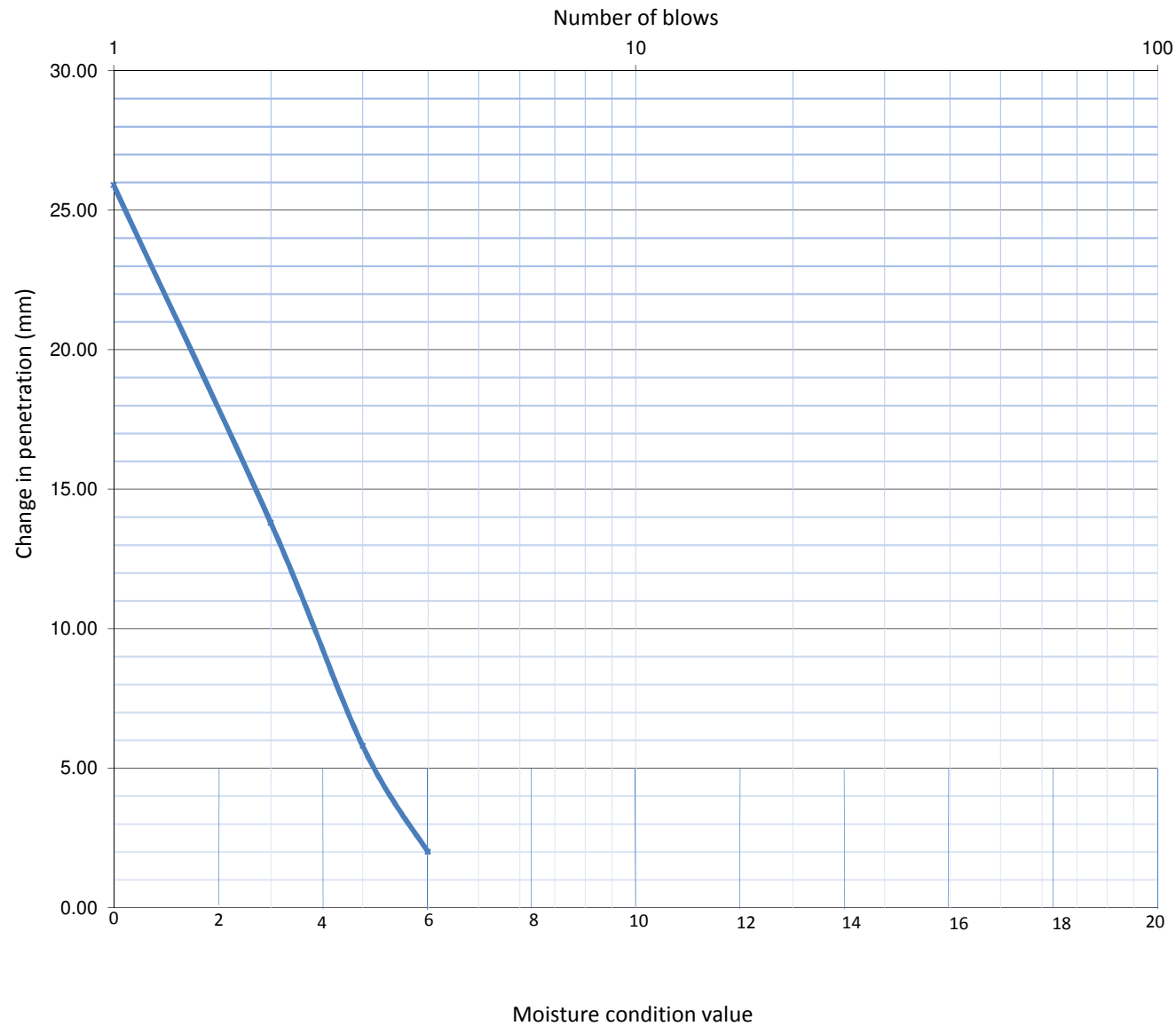
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 24.6
MCV: 5.1

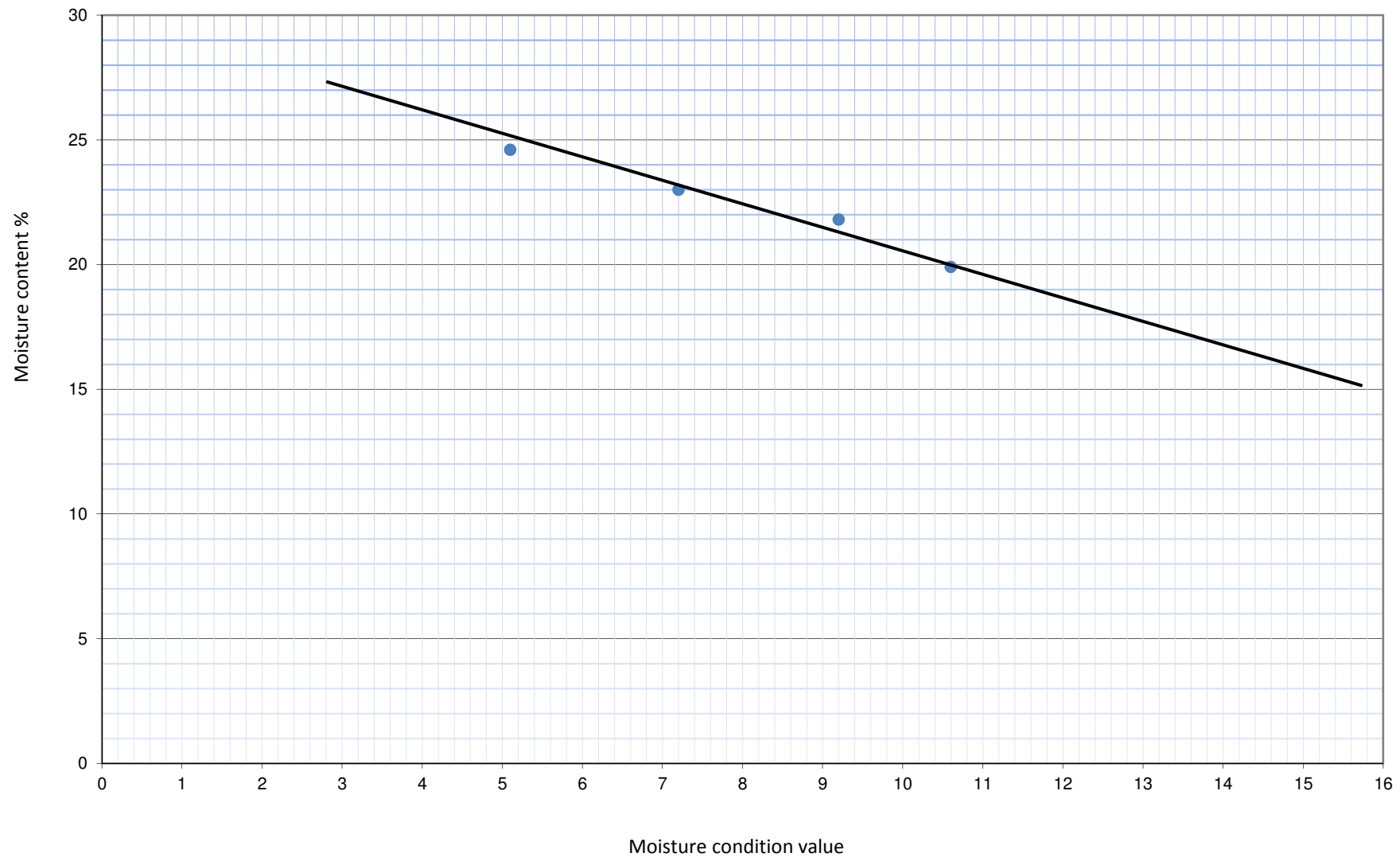
Initial wet mass sieved: 45879g
% retained on 20mm: 13.2
% retained on 37.5mm: 4.1

Sample type: disturbed

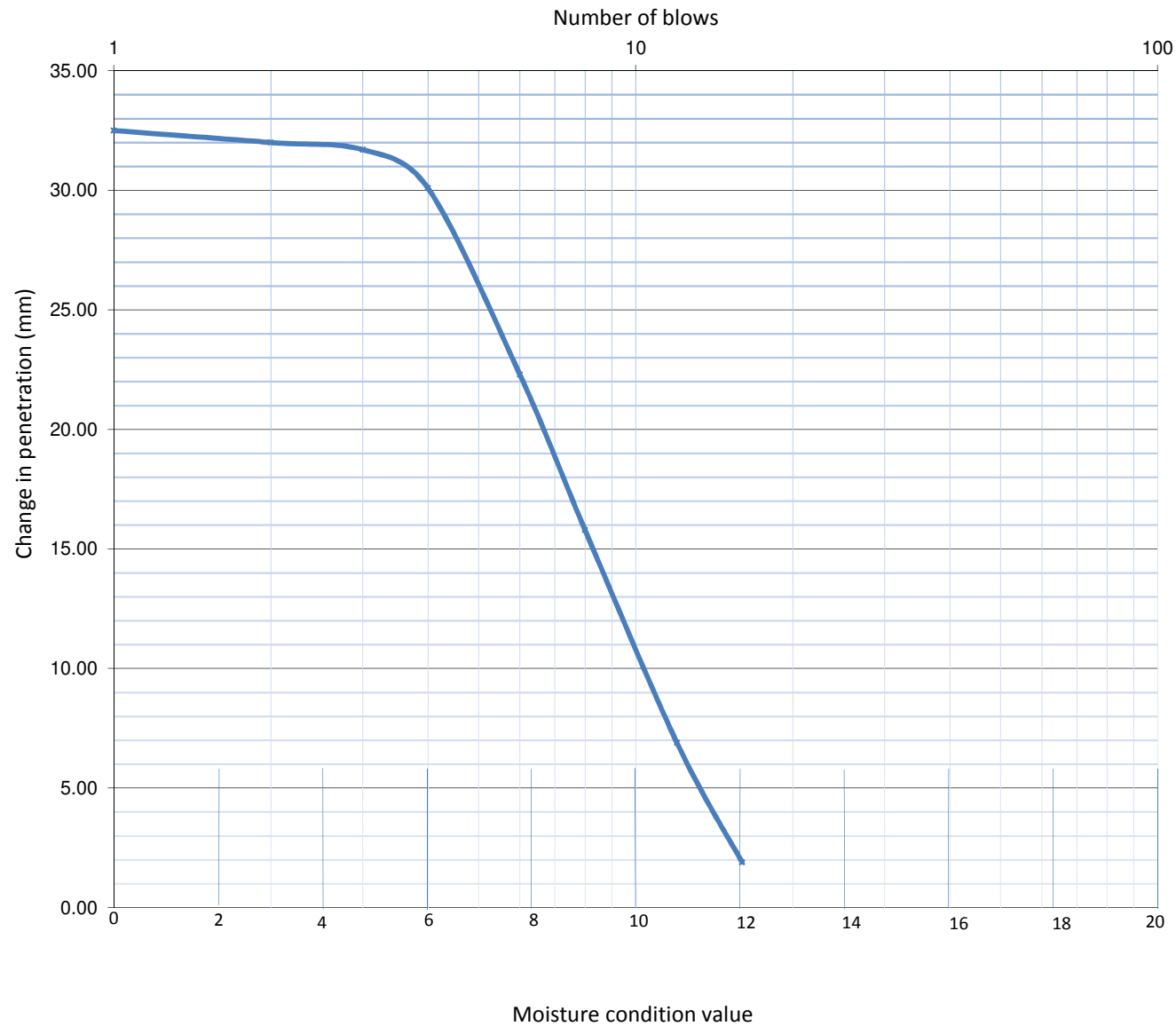
Method:
Sample prepared by passing 20mm
sieve
Batch prepared
Graph interpretation: steepest line
through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional
gravel and very occasional concrete

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 28.6

MCV: 11.2

Initial wet mass sieved: 40463g

% retained on 20mm: 7.7

% retained on 37.5mm: 5.8

Sample type: disturbed

Method:

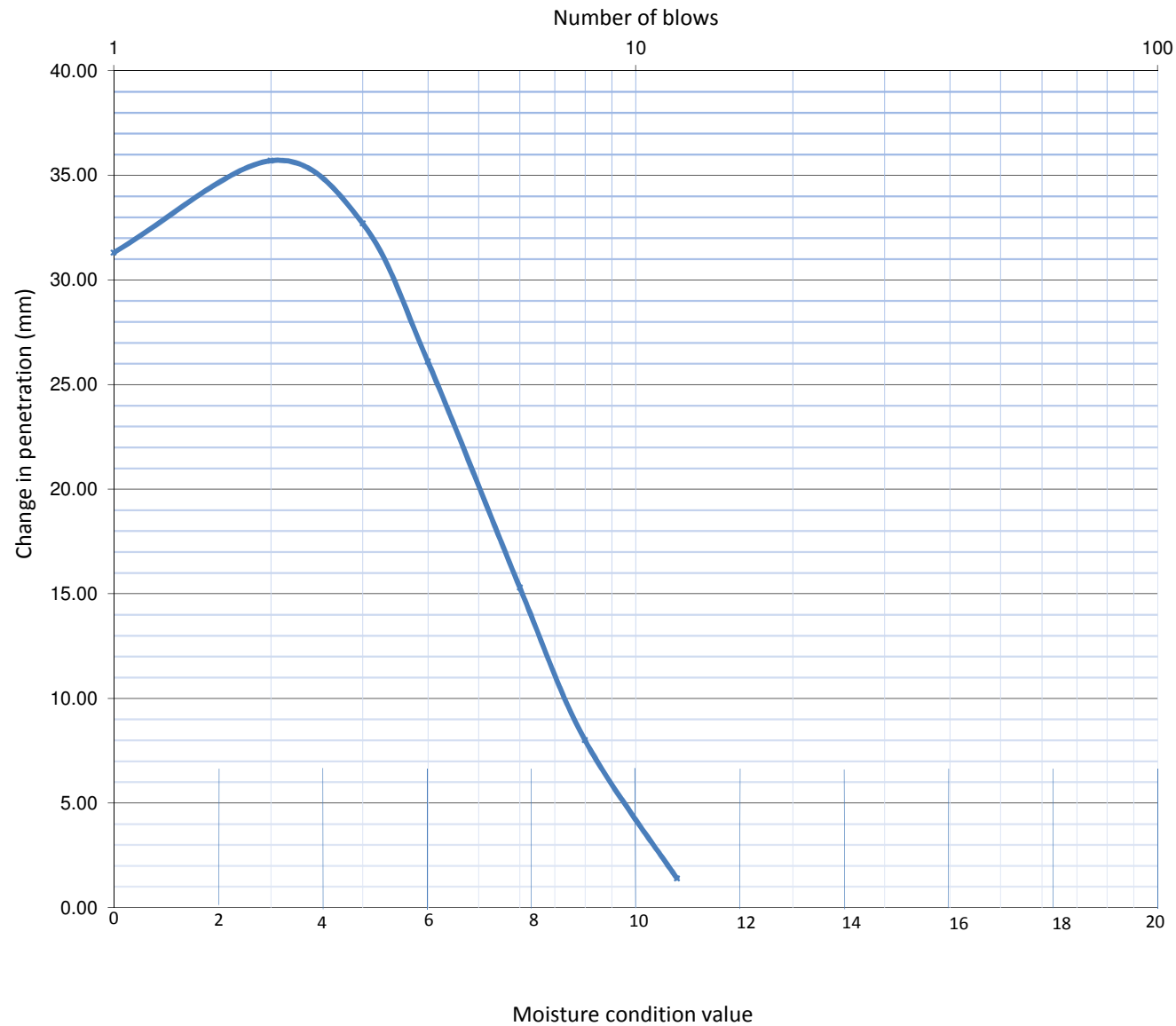
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 32.8

MCV: 9.8

Initial wet mass sieved: 40463g

% retained on 20mm: 7.7

% retained on 37.5mm: 5.8

Sample type: disturbed

Method:

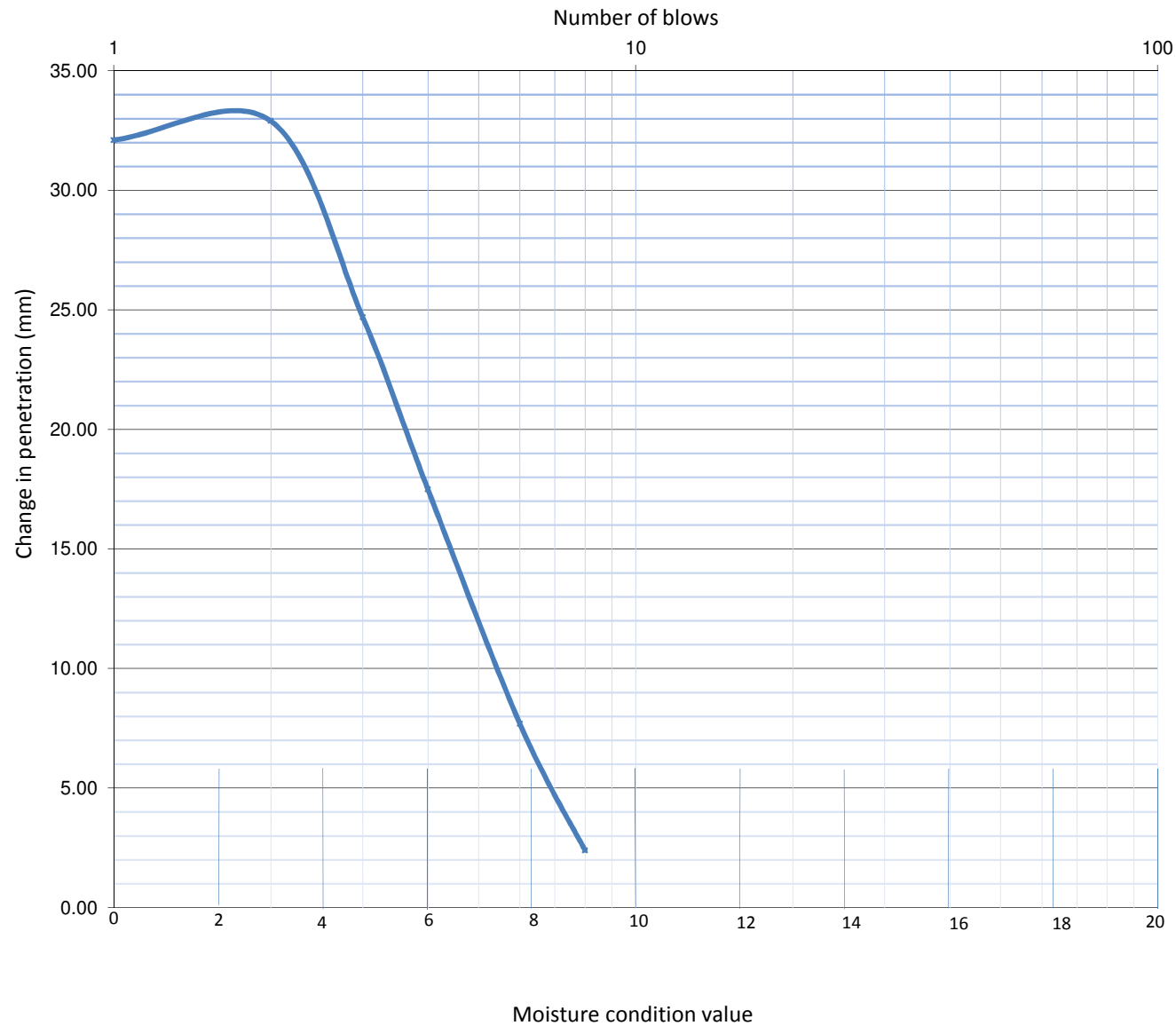
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 35.6

MCV: 8.4

Initial wet mass sieved: 40463g

% retained on 20mm: 7.7

% retained on 37.5mm: 5.8

Sample type: disturbed

Method:

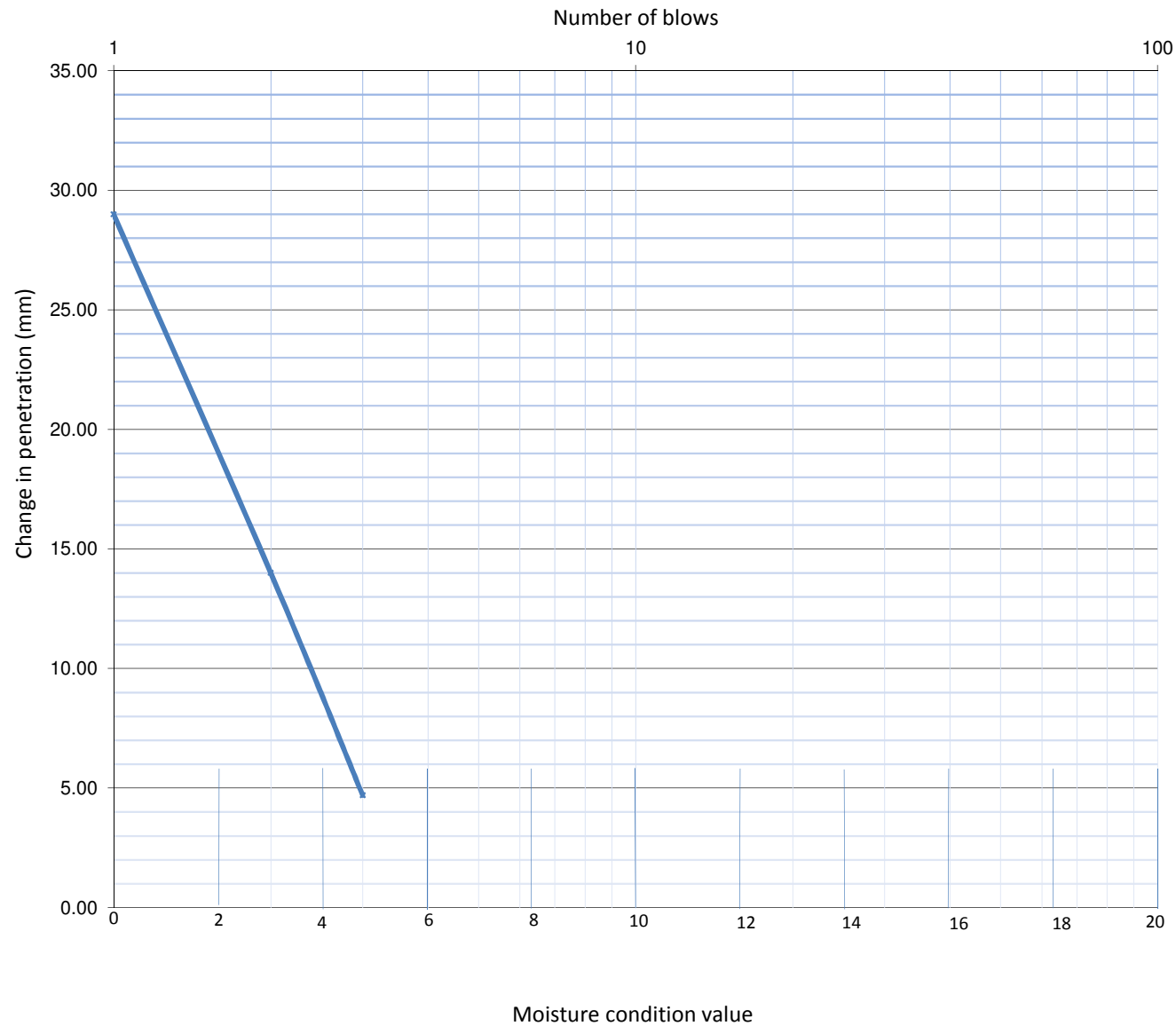
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 41.2

MCV: 4.8

Initial wet mass sieved: 40463g

% retained on 20mm: 7.7

% retained on 37.5mm: 5.8

Sample type: disturbed

Method:

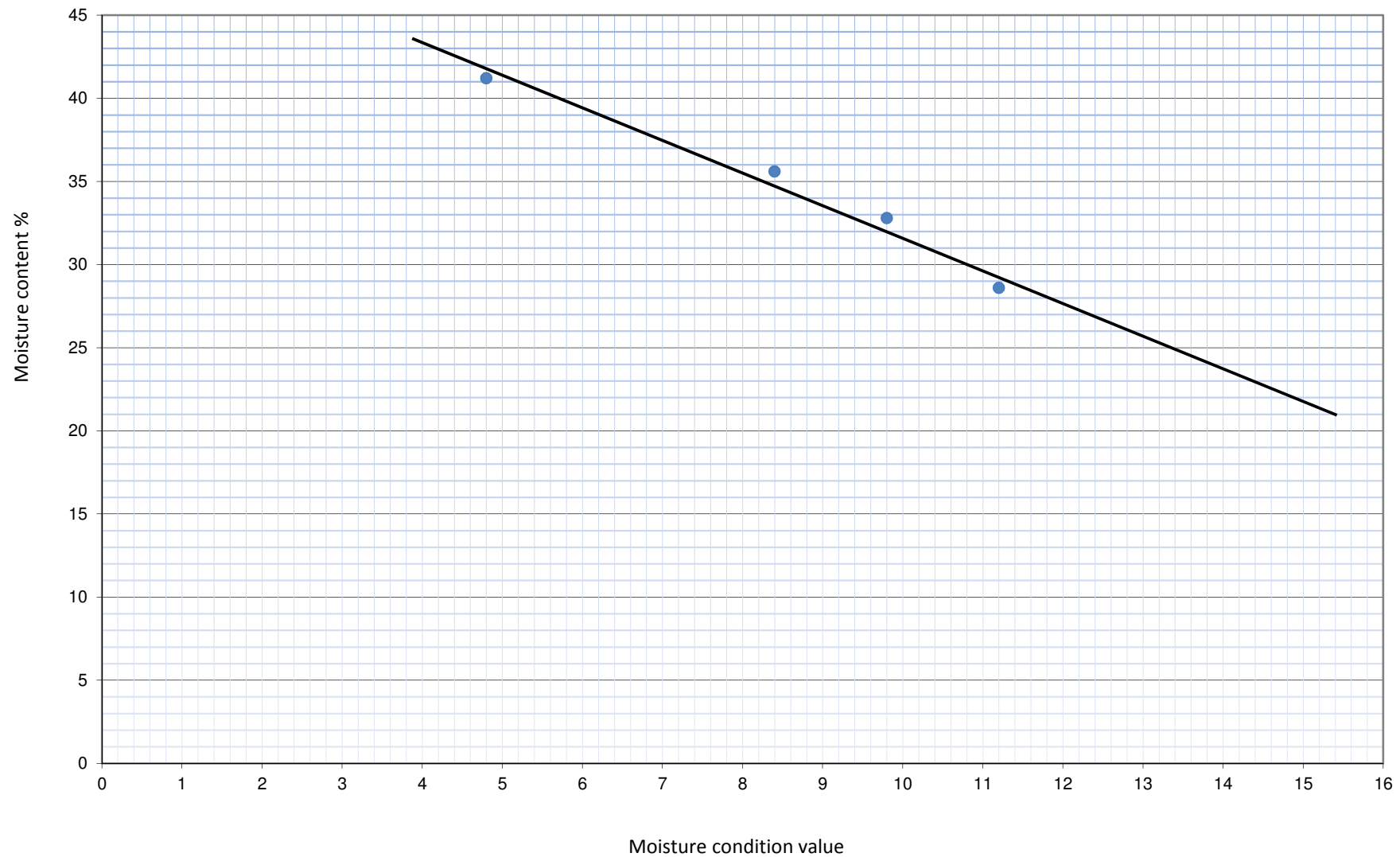
Sample prepared by passing 20mm sieve

Batch prepared

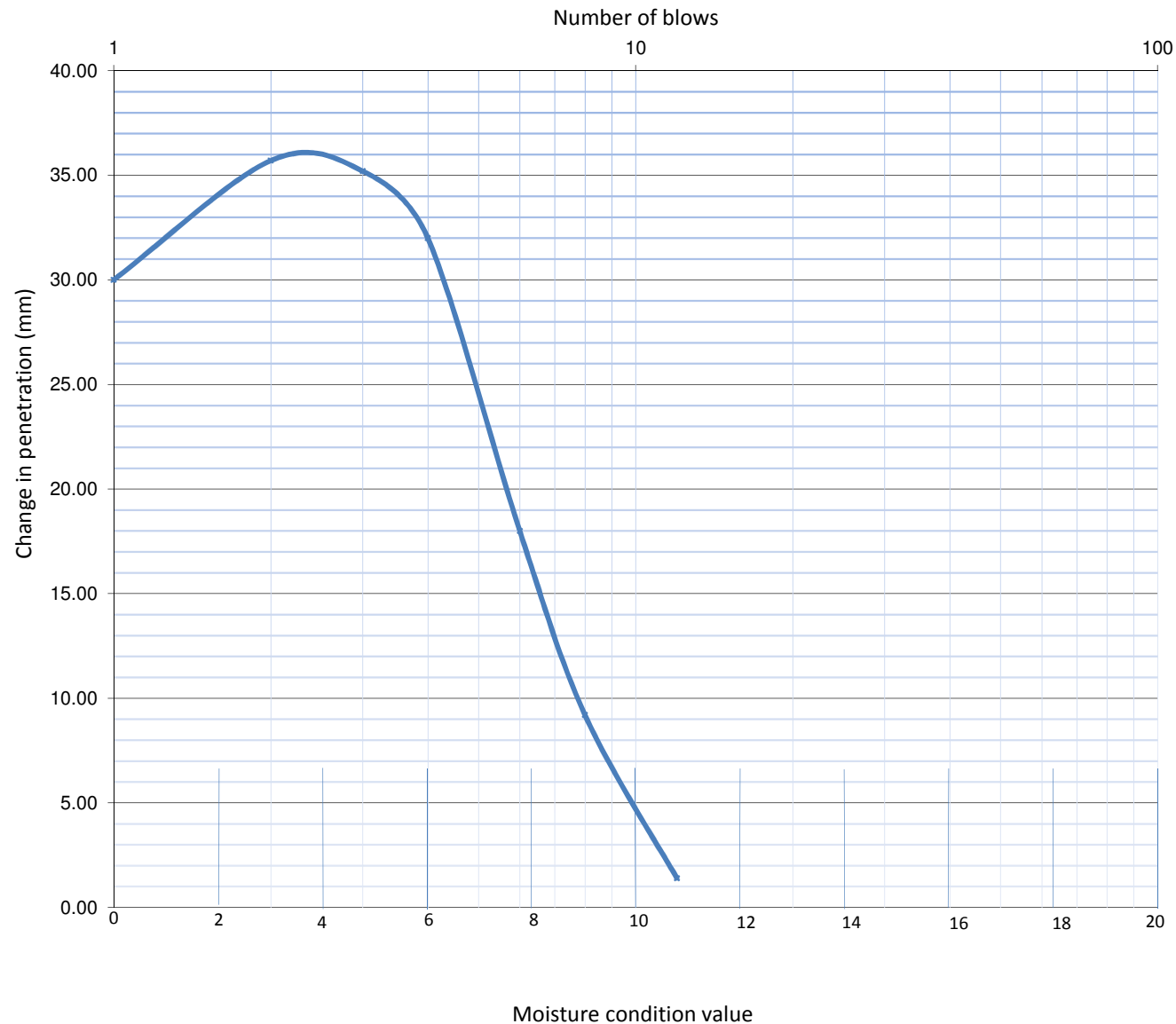
Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 26.8

MCV: 9.9

Initial wet mass sieved: 46530g

% retained on 20mm: 3.8

% retained on 37.5mm: 0

Sample type: disturbed

Method:

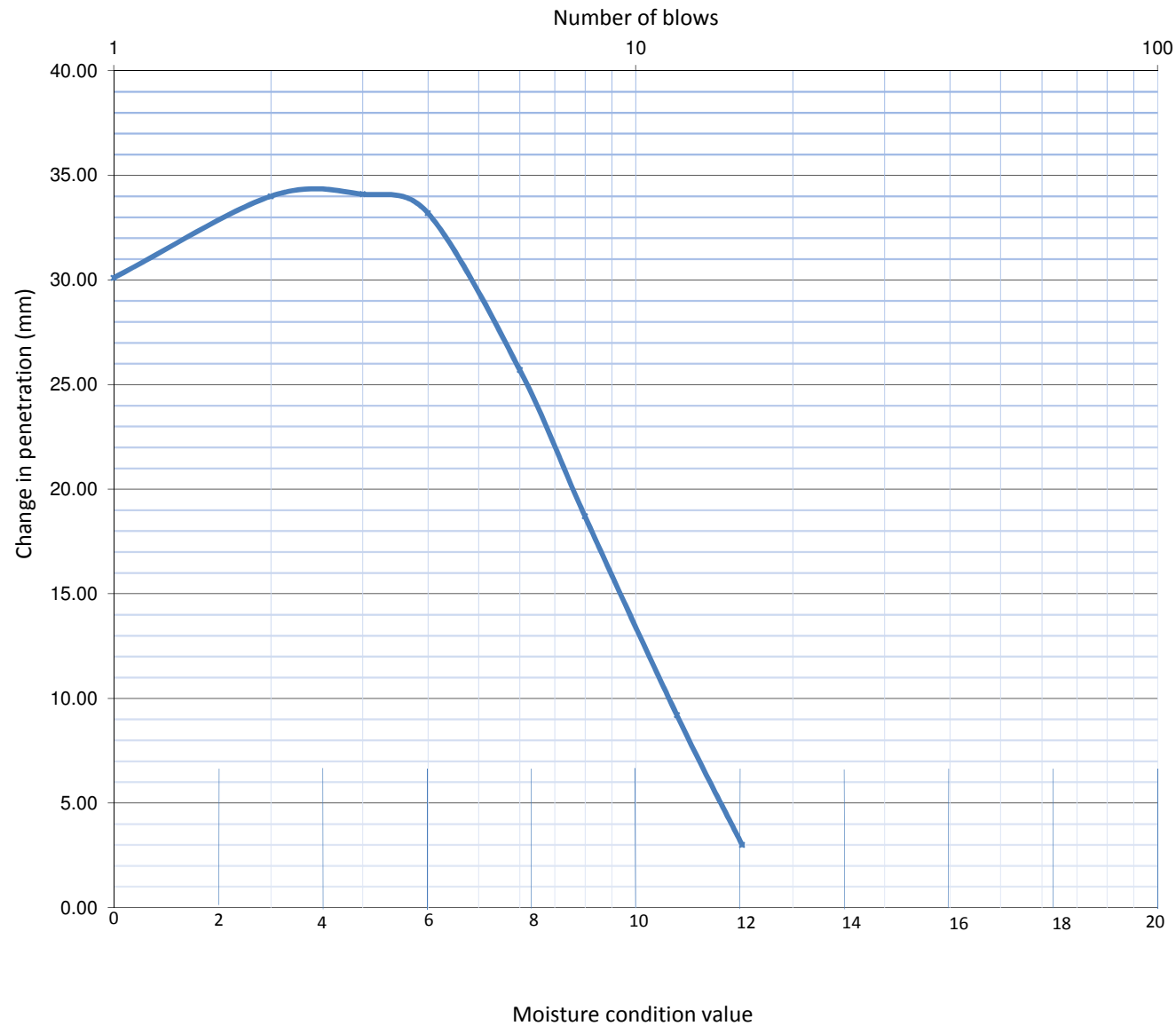
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 28.6
MCV: 11.6

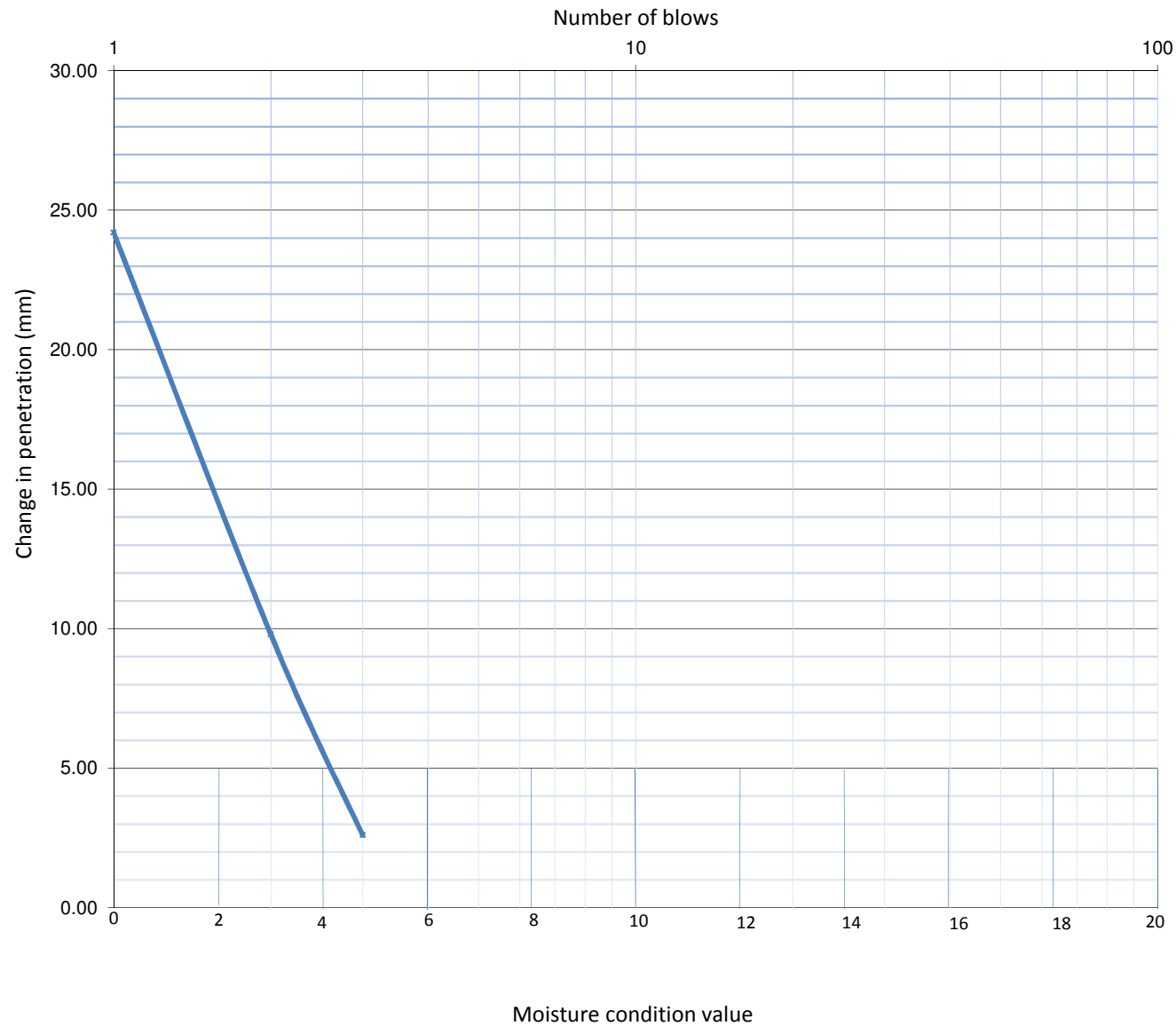
Initial wet mass sieved: 46530g
% retained on 20mm: 3.8
% retained on 37.5mm: 0

Sample type: disturbed

Method:
Sample prepared by passing 20mm
sieve
Batch prepared
Graph interpretation: steepest line
through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional
gravel and very occasional concrete
and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 37.7

MCV: 4.2

Initial wet mass sieved: 46530g

% retained on 20mm: 3.8

% retained on 37.5mm: 0

Sample type: disturbed

Method:

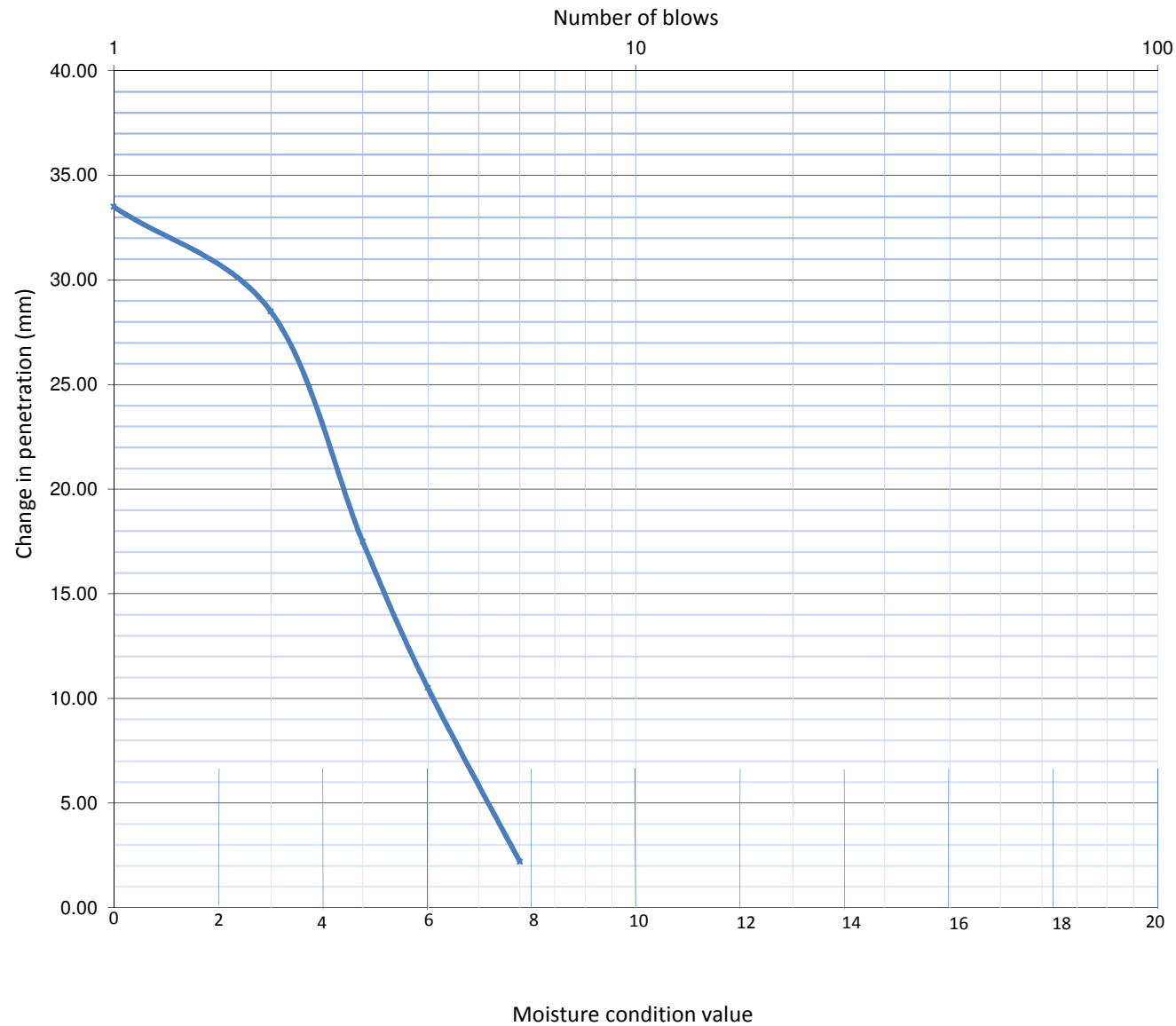
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 35.6
MCV: 7.2

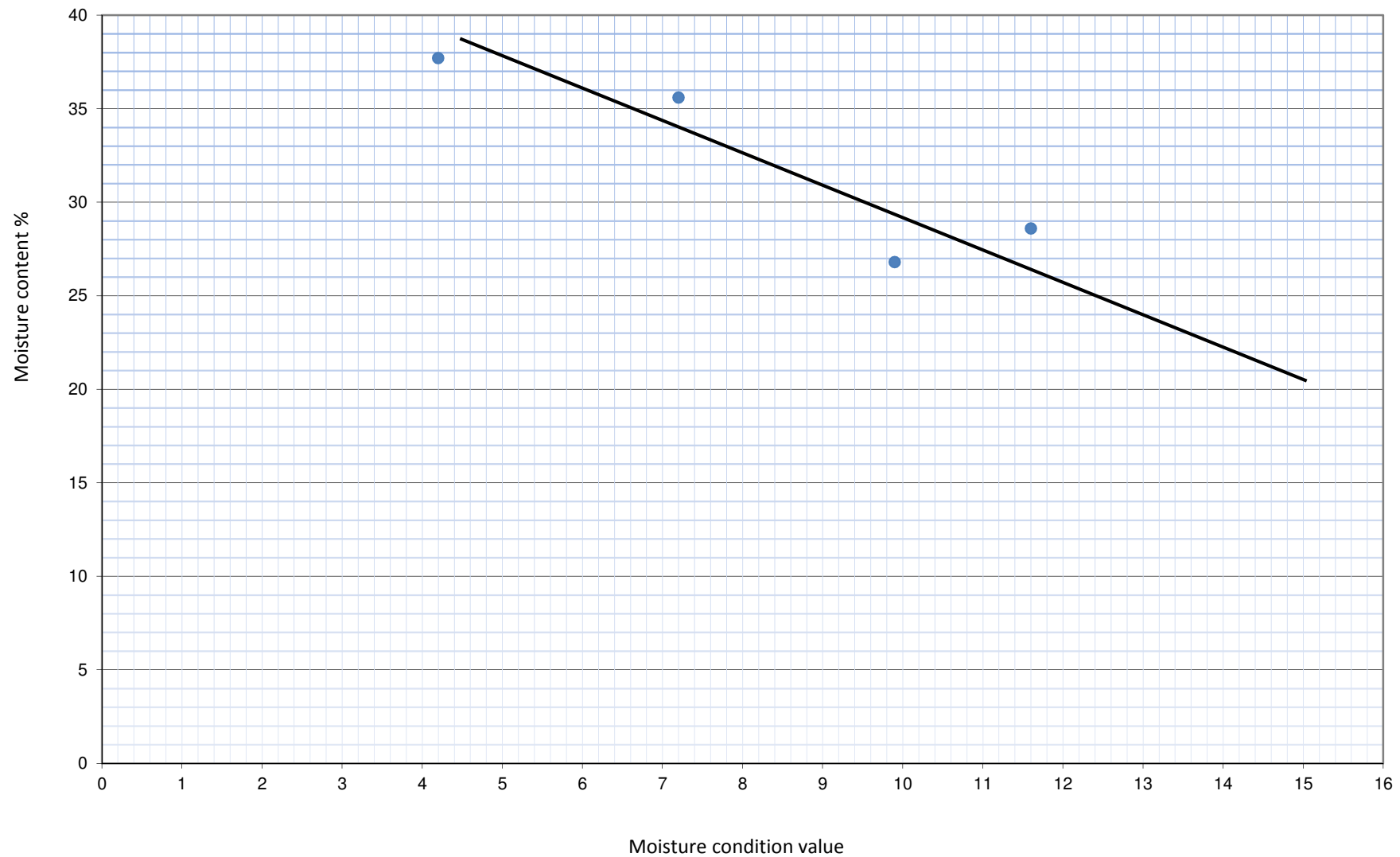
Initial wet mass sieved: 46530g
% retained on 20mm: 3.8
% retained on 37.5mm: 0

Sample type: disturbed

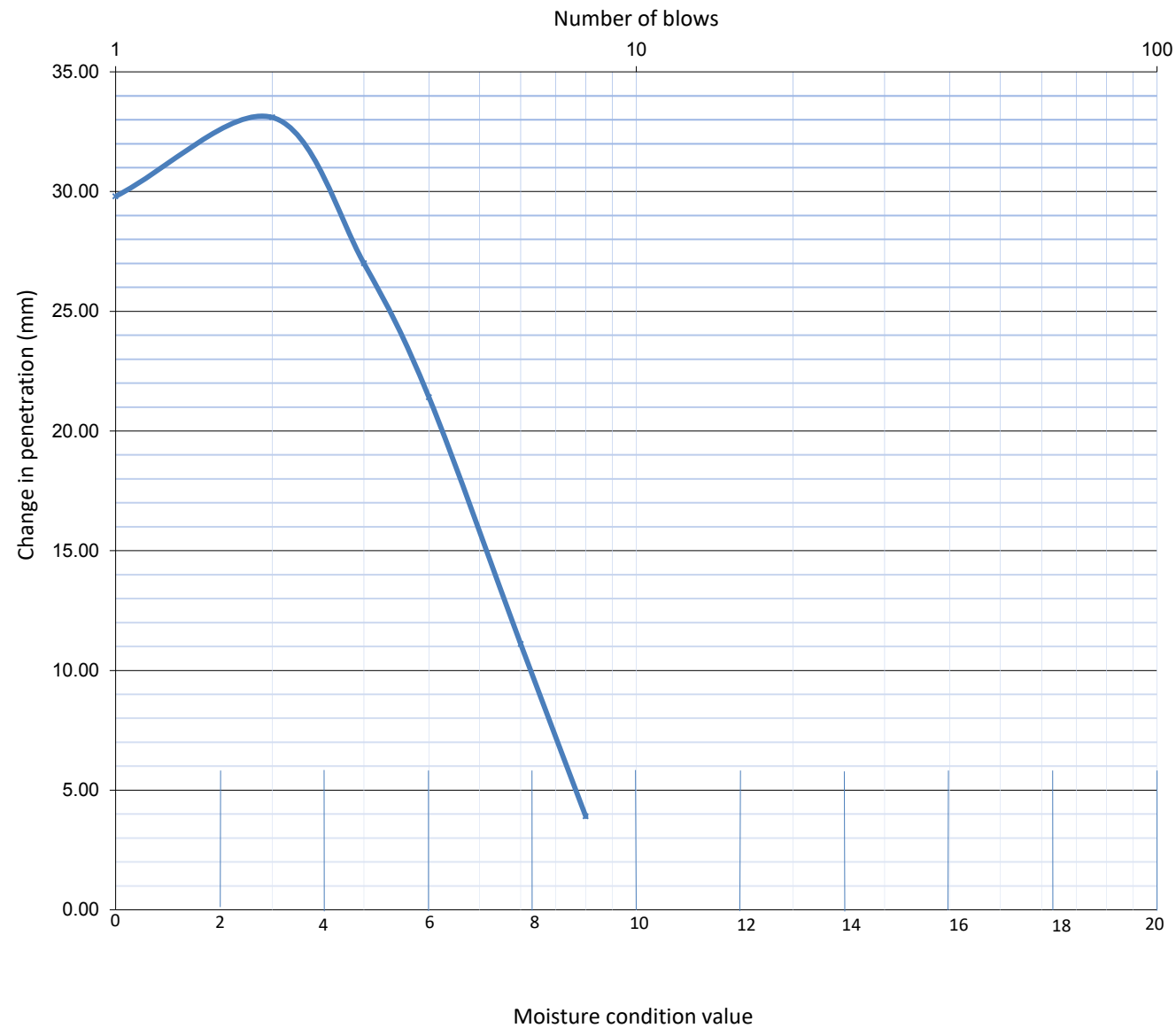
Method:
Sample prepared by passing 20mm
sieve
Batch prepared
Graph interpretation: steepest line
through 5mm change in penetration

Sample description: Made ground:
brown sandy clay with occasional
gravel and very occasional concrete
and brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 30.3

MCV: 8.7

Initial wet mass sieved: 37881g

% retained on 20mm: 13.0

% retained on 37.5mm: 6.7

Sample type: disturbed

Method:

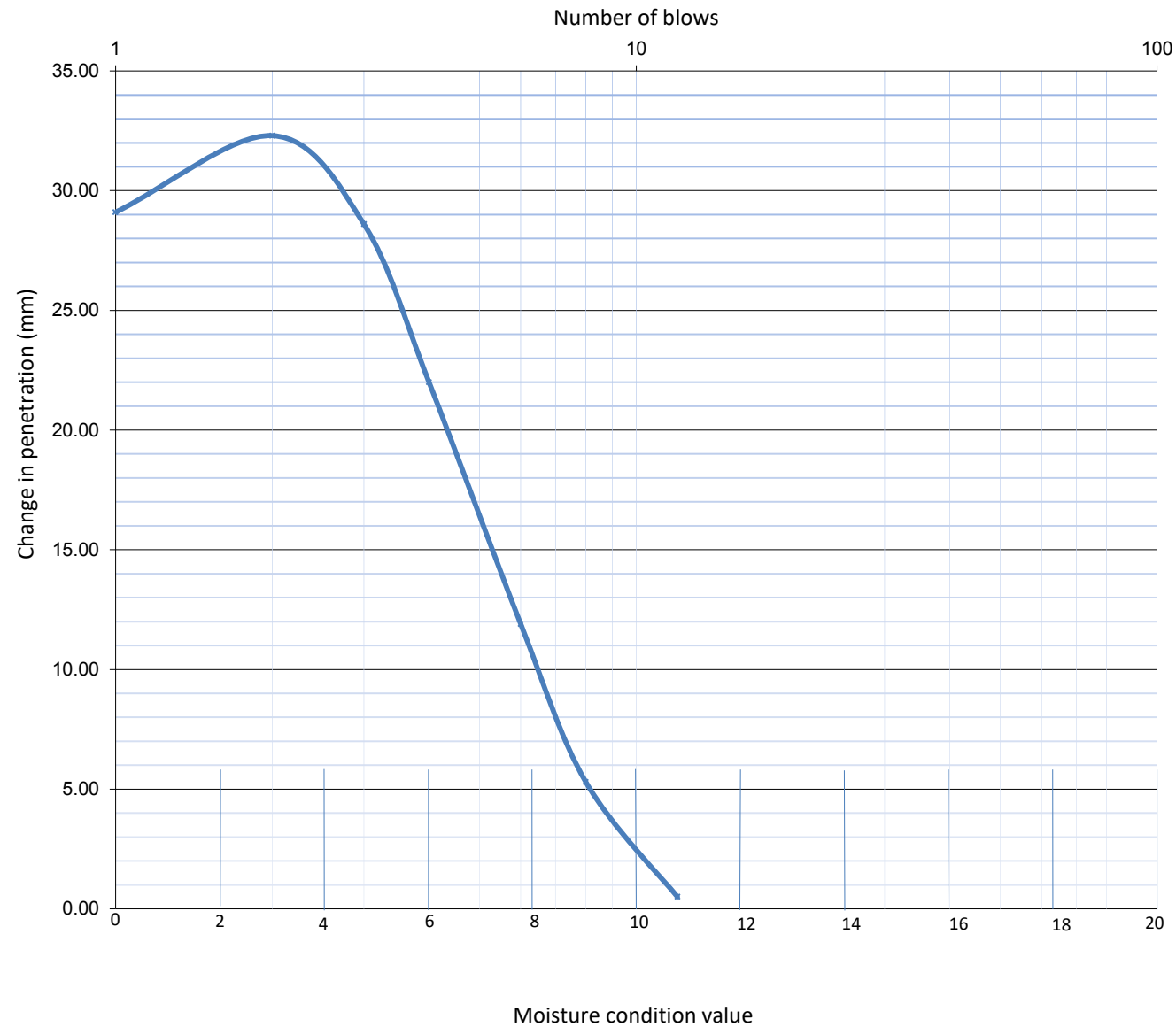
Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional brick

Determination of moisture condition value in accordance with BS1377 Part 4 Clause 5



Moisture content: 25.8

MCV: 9.2

Initial wet mass sieved: 9301g

% retained on 20mm: 17.1

% retained on 37.5mm: 0

Sample type: disturbed

Method:

Sample prepared by passing 20mm sieve

Batch prepared

Graph interpretation: steepest line through 5mm change in penetration

Sample description: Made ground: brown sandy clay with occasional gravel and very occasional concrete

APPENDIX C

Chemical Test Results

**Oliver Rhodes**

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i2 Analytical Ltd.
7 Woodshots Meadow,
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Analytical Report Number : 17-40686

Replaces Analytical Report Number : 17-40686, issue no. 1

Project / Site name:	Southall Access Advanced Works	Samples received on:	20/02/2017
Your job number:	CGN-03732-C	Samples instructed on:	22/02/2017
Your order number:	4052	Analysis completed by:	06/03/2017
Report Issue Number:	2	Report issued on:	06/03/2017
Samples Analysed:	6 soil samples		

Signed:

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Signed:

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

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

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

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

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

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Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706649	706650	706651	706652	706653
Sample Reference				TP101	TP103	TP104	TP105	TP107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.80	0.60	1.20	1.50
Date Sampled				17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	22	16	17	11
Total mass of sample received	kg	0.001	NONE	1.7	1.6	1.7	1.6	1.9

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	-	Chrysotile	-	Chrysotile
Asbestos in Soil	Type	N/A	ISO 17025	Detected	Not-detected	Detected	Not-detected	Detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	< 0.001	-	< 0.001	-	< 0.001
Asbestos Quantification Total	%	0.001	ISO 17025	< 0.001	-	< 0.001	-	< 0.001

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.1	8.0	8.1	8.3	8.7
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	3000	2200	1500	1600	4000
Organic Matter	%	0.1	MCERTS	2.6	0.8	0.8	0.6	2.3

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	0.18	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	mg/kg	0.1	MCERTS	0.29	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	0.1	MCERTS	0.37	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	mg/kg	0.1	MCERTS	4.3	< 0.10	< 0.10	< 0.10	0.78
Anthracene	mg/kg	0.1	MCERTS	1.1	< 0.10	< 0.10	< 0.10	0.22
Fluoranthene	mg/kg	0.1	MCERTS	6.2	< 0.10	0.54	0.62	1.9
Pyrene	mg/kg	0.1	MCERTS	4.9	< 0.10	0.52	0.66	1.7
Benzo(a)anthracene	mg/kg	0.1	MCERTS	3.5	< 0.10	0.38	0.43	1.1
Chrysene	mg/kg	0.05	MCERTS	2.7	< 0.05	0.31	0.37	1.0
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	3.2	< 0.10	0.38	0.51	1.2
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	2.2	< 0.10	0.32	0.46	0.95
Benzo(a)pyrene	mg/kg	0.1	MCERTS	3.3	< 0.10	0.43	0.55	1.3
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	1.9	< 0.10	0.25	0.33	0.71
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	0.52	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	2.2	< 0.05	0.30	0.37	0.88
Coronene	mg/kg	0.05	NONE	0.99	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	38	< 1.6	3.4	4.3	12
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	2.2	< 1.0	< 1.0	< 1.0	2.3
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	11	14	12	17
Barium (aqua regia extractable)	mg/kg	1	MCERTS	120	54	68	75	140
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.69	0.81	1.1	1.3	0.78
Boron (water soluble)	mg/kg	0.2	MCERTS	1.8	3.2	1.8	2.8	1.6
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (III)	mg/kg	1	NONE	30	39	31	32	31
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	40	31	32	31
Copper (aqua regia extractable)	mg/kg	1	MCERTS	46	36	29	26	57
Lead (aqua regia extractable)	mg/kg	1	MCERTS	78	58	23	33	330
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	25	33	36	33	24
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	51	59	48	46	42
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	100	77	68	62	150



Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706649	706650	706651	706652	706653
Sample Reference				TP101	TP103	TP104	TP105	TP107
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.80	0.60	1.20	1.50
Date Sampled				17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics

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

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	3.5	3.1	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	5.9	< 2.0	4.1	4.5	2.8
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	33	< 8.0	< 8.0	< 8.0	10
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	100	36	22	35	76
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	140	41	35	50	90

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	2.8	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	6.9	< 2.0	< 2.0	2.8	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	44	< 10	< 10	< 10	12
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	170	< 10	17	14	67
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	220	< 10	27	27	80



Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706654				
Sample Reference				TP108				
Sample Number				None Supplied				
Depth (m)				1.20				
Date Sampled				17/02/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	22				
Total mass of sample received	kg	0.001	NONE	1.9				

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-				
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected				
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-				
Asbestos Quantification Total	%	0.001	ISO 17025	-				

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Total Sulphate as SO ₄	mg/kg	50	MCERTS	700				
Organic Matter	%	0.1	MCERTS	0.6				

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.1	MCERTS	< 0.10				
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10				
Fluorene	mg/kg	0.1	MCERTS	< 0.10				
Phenanthrene	mg/kg	0.1	MCERTS	0.37				
Anthracene	mg/kg	0.1	MCERTS	< 0.10				
Fluoranthene	mg/kg	0.1	MCERTS	0.58				
Pyrene	mg/kg	0.1	MCERTS	0.51				
Benzo(a)anthracene	mg/kg	0.1	MCERTS	0.30				
Chrysene	mg/kg	0.05	MCERTS	0.29				
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.28				
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	0.27				
Benzo(a)pyrene	mg/kg	0.1	MCERTS	0.33				
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	0.22				
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	< 0.10				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.26				
Coronene	mg/kg	0.05	NONE	< 0.05				

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	3.4				
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	2.2				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.6				
Barium (aqua regia extractable)	mg/kg	1	MCERTS	73				
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.1				
Boron (water soluble)	mg/kg	0.2	MCERTS	2.2				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2				
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2				
Chromium (III)	mg/kg	1	NONE	36				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	36				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	32				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	29				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	39				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0				
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	56				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	79				



Analytical Report Number: 17-40686

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				706654				
Sample Reference				TP108				
Sample Number				None Supplied				
Depth (m)				1.20				
Date Sampled				17/02/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics

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

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0				
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0				
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0				
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	14				
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	18				

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1				
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0				
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0				
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10				
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	24				
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	35				



Analytical Report Number: 17-40686
Project / Site name: Southall Access Advanced Works
Your Order No: 4052

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

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

Quantitative Analysis

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

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

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

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
706649	TP101	1.00	124	Loose Fibres	Chrysotile	< 0.001	< 0.001
706651	TP104	0.60	118	Bitumen	Chrysotile	< 0.001	< 0.001
706653	TP107	1.50	122	Loose Fibres	Chrysotile	< 0.001	< 0.001

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



Analytical Report Number : 17-40686

Project / Site name: Southall Access Advanced Works

* 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 *
706649	TP101	None Supplied	1.00	Brown clay and loam with gravel and vegetation.
706650	TP103	None Supplied	0.80	Brown clay and loam with gravel.
706651	TP104	None Supplied	0.60	Brown clay and loam with gravel and vegetation.
706652	TP105	None Supplied	1.20	Brown clay and loam with gravel and vegetation.
706653	TP107	None Supplied	1.50	Brown loam and sand with glass and gravel
706654	TP108	None Supplied	1.20	Brown clay and loam with gravel and brick.

Analytical Report Number : 17-40686

Project / Site name: Southall Access Advanced Works

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in ouse method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, 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
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
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
Organic matter in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	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 WAC-17 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	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
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 sulphate (as SO4 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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

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.

Iss No 17-40686-2 Southall Access Advanced Works CGN-03732-C

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

Page 8 of 8

**Owen Flowers**

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Analytical Report Number : 17-41587

Project / Site name:	Southall Access Advanced Works	Samples received on:	20/02/2017
Your job number:	CGN-03732-C	Samples instructed on:	02/03/2017
Your order number:	4052	Analysis completed by:	06/03/2017
Report Issue Number:	1	Report issued on:	06/03/2017
Samples Analysed:	2 soil samples		

Signed:

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

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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Analytical Report Number: 17-41587

Project / Site name: Southall Access Advanced Works

Your Order No: 4052

Lab Sample Number				711643	711644			
Sample Reference				TP102	TP106			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.80	1.00			
Date Sampled				17/02/2017	17/02/2017			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		
Asbestos in Soil				Type	N/A	ISO 17025	Not-detected	Not-detected



Analytical Report Number : 17-41587

Project / Site name: Southall Access Advanced Works

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	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.

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Analytical Report Number : 17-43258

Replaces Analytical Report Number : 17-43258, issue no. 1

Project / Site name:	Southall	Samples received on:	17/03/2017
Your job number:	CGN-3732C	Samples instructed on:	21/03/2017
Your order number:		Analysis completed by:	27/03/2017
Report Issue Number:	2	Report issued on:	27/03/2017
Samples Analysed:	6 soil samples		

Signed:

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

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

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

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Analytical Report Number: 17-43258

Project / Site name: Southall

Lab Sample Number				721270	721271	721272	721273	721274
Sample Reference				TP101	TP102	TP103	TP105	TP107
Sample Number				D	D	D	D	D
Depth (m)				1.00	0.80	0.80	1.20	1.50
Date Sampled				17/02/2017	17/02/2017	17/02/2017	17/02/2017	17/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	9.2	12	7.6	10
Total mass of sample received	kg	0.001	NONE	0.11	0.13	0.10	0.10	0.08

General Inorganics

pH - Manual	pH Units	N/A	MCERTS	7.8	7.9	7.9	8.0	8.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	4300	1100	2700	1700	3300
Total Sulphate as SO ₄	%	0.005	MCERTS	0.430	0.108	0.273	0.170	0.330
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	1.5	0.34	1.2	0.47	1.5
Total Sulphur	mg/kg	50	MCERTS	1700	460	1400	1500	1200
Total Sulphur	%	0.005	MCERTS	0.167	0.046	0.138	0.152	0.122



Analytical Report Number: 17-43258

Project / Site name: Southall

Lab Sample Number				721275				
Sample Reference				TP108				
Sample Number				D				
Depth (m)				1.20				
Date Sampled				17/02/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	13				
Total mass of sample received	kg	0.001	NONE	0.10				

General Inorganics

pH - Manual	pH Units	N/A	MCERTS	8.1				
Total Sulphate as SO ₄	mg/kg	50	MCERTS	640				
Total Sulphate as SO ₄	%	0.005	MCERTS	0.064				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.091				
Total Sulphur	mg/kg	50	MCERTS	460				
Total Sulphur	%	0.005	MCERTS	0.046				



Analytical Report Number : 17-43258

Project / Site name: Southall

* 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 *
721270	TP101	D	1.00	Brown clay and sand with gravel.
721271	TP102	D	0.80	Brown clay and sand with gravel and vegetation.
721272	TP103	D	0.80	Brown clay and sand with gravel.
721273	TP105	D	1.20	Brown clay and sand with gravel.
721274	TP107	D	1.50	Brown clay and sand with gravel and vegetation.
721275	TP108	D	1.20	Brown clay and sand with gravel.



Analytical Report Number : 17-43258

Project / Site name: Southall

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	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
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	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-PL	D	MCERTS

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 Deviation Report



Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP101	D	S	17-43258	721270	c	pH in soil	L005-PL	c
TP102	D	S	17-43258	721271	c	pH in soil	L005-PL	c
TP103	D	S	17-43258	721272	c	pH in soil	L005-PL	c
TP105	D	S	17-43258	721273	c	pH in soil	L005-PL	c
TP107	D	S	17-43258	721274	c	pH in soil	L005-PL	c
TP108	D	S	17-43258	721275	c	pH in soil	L005-PL	c



Clark Smith Partnership

Western Access, Southall
*Earthworks Material Acceptability
and Waste Characterisation
(Lagoon Bund and Bridge Bund)*

May, 2017



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Reference	CGN/03732D	Revision 1
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FIGURES

Figure 1 – Site location plan

Figure 2 – Trial pit location plan

APPENDICES

Appendix A – Trial pit logs

Appendix B – Geotechnical test results

Appendix C – Chemical test results

Appendix D – WAC test results

1. INTRODUCTION

Card Geotechnics Limited (CGL) have been instructed by Clark Smith Partnership (CSP) to undertake initial trial pit and laboratory testing in order to provide a preliminary assessment of material suitability for direct transfer off-site or reuse on-site under a Materials Management Plan (MMP). Additionally, the testing has been scheduled to identify the suitability of these site won materials for lime or cement stabilisation.

The trial pitting undertaken within the Western Access site Southall was completed on the Friday 24th February 2017. This Letter Report specifically details the findings from the investigation undertaken at two locations; the Minet Tip lagoon bund and at the location of the proposed temporary access bridge referred to as 'Bridge 1'. The Preliminary Geotechnical Design Report (PGDR) detailing the ground conditions across the site was re-issued in December 2016¹.

An additional day of trial pitting was undertaken by CGL on Wednesday 8th March 2017, to understand the depth of groundwater likely to be encountered at site in relation to proposed formation levels. A total of 5no trial pits were undertaken at locations on either side of the proposed embankment to provide advanced information on likely formation depths and the likely groundwater levels at the site.

¹ CGL (December 2016). *CGN03732 Southall, Pump Lane Western Access*. Preliminary Geotechnical Design Report. Rev1

2. SITE DESCRIPTION

The development area as a whole covers approximately 7.66Ha. The area encompassing all three permanent earthworks is centred approximately on National Grid Reference (NGR) 511254, 179810. An overall site location plan is presented as Figure 1 and a trial pit location plan showing the site areas relevant to this report is presented as Figure 2.

The eastern most site considered during this investigation comprises a stockpile created by the deposition of canal dredging's upon the original ground level to form a 'lagoon' for the further deposition of material. The stockpile and lagoon (herein referred to as *Lagoon Bund*) represents a raised area of ground between the Yeading Brook and the Grand Union Canal. The western most site comprises a stockpile of material (herein referred to as *Bridge Bund*) located approximately 50m south-east of the A312/Pump Lane highway flyover and north-west of the River Crane. The Bridge Bund is proposed to be reduced in height to approximately 28mOD to facilitate the construction of a temporary access bridge and associated haul road. It is proposed that the excavated material be stockpiled approximately 50m further south along the west bank of the River Crane for future use within the earthworks construction, subject to suitability. Foundations for the proposed 'Bridge 1' abutments are to be located on the east and west banks of the River Crane flood channel.

There are currently no proposals for excavation of the Lagoon Bund in advance of the main earthworks, however the requirement is for the material to be tested to determine its acceptability for future use within the permanent embankments.

3. INTRUSIVE INVESTIGATION

3.1 Summary of works

Eight trial pits were excavated in the Bridge Bund and Lagoon Bund areas within Made Ground and natural strata sampled during the investigation undertaken on the 24th February 2017. Representative samples were taken from each trial pit location for the purposes of geotechnical and chemical testing and these are shown on the trial pits logs presented in Appendix A. In-situ hand shear vane testing was undertaken within trial pits TP-1B, TP-2B and TP-5B to assist in the design of the temporary bridge foundations. The results of these in-situ tests are reported under a separate cover².

A further five trial pits were excavated in the area between the River Crane and Grand Union Canal, located away from the Lagoon Tip, to determine the nature of sub surface ground conditions and the likely depth of groundwater across the site. These pits were targeted to understand how groundwater level will affect the likely formation level constraints imposed during the Arup Outline GDR.

3.2 Ground conditions

3.2.1 Lagoon Bund

The Lagoon Bund is comprised of Made Ground recorded as brown slightly sandy slightly gravelly silty clay with fragments of brick, glass, plastic, wood, metal and polystyrene. Whilst the material was heterogeneous in nature, no distinct differences in the material were recorded between the trial pit locations TP01 to TP03.

Trial pit TP04, undertaken away from the main *Lagoon Bund* and near to the Yeading Brook, was recorded to comprise dark brown topsoil overlying orangish brown slightly gravelly silty clay. The colour was noted to become grey and the gravel content increased at a depth of 1.0m below ground level, which represented the top surface of the River Terrace Deposits.

3.2.2 Bridge Bund

The Bridge Bund stockpile was recorded to comprise greyish brown very sandy gravelly clay and slightly clayey sandy gravel. A large quantity of anthropogenic material was noted within the bund itself and comprised; metal wires and bars, compressed metal containers, concrete slabs, brick, glass, wood, textile and plastic.

² CGL (February 2017). CGN03732C - Bridge 1 Detailed Design. Calculation Report. Rev1.

Trial pits TP-1B and TP-5B, undertaken away from the main Bridge Bund stockpile at the locations of west and east bridge abutments respectively, were recorded to comprise brown sandy gravelly clay with wood, plastic and glass (Made Ground) overlying yellowish brown slightly sandy slightly gravelly clay (Alluvium). The River Terrace Deposits were noted within trial pit TP-2B_A.

3.2.3 Visual and olfactory indicators of contamination

No visual and olfactory indicators of contamination were recorded within the material at either location.

3.3 Environmental laboratory testing

A total of five samples retrieved from the Lagoon Bund area and three samples from the Bridge Bund area were scheduled for testing for a range of contaminants including; heavy metals, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), BTEX and an asbestos. In addition to this testing, Waste Acceptance Criteria (WAC) tests were undertaken to assess the suitability of the material if disposal offsite to landfill is required.

3.4 Geotechnical laboratory testing

Seven samples from the Lagoon Bund area and seven samples from the Bridge Bund area were scheduled for geotechnical testing including; Atterberg Limits, particle size distribution, moisture content, MCV, MCV/mc relationship, mc/MDD relationship, unconsolidated undrained triaxial and sulphates.

4. MATERIAL CHARACTERISATION

CGL have compared the results of the geotechnical and chemical tests to the limiting criteria detailed in the Earthworks Specification contained within the PDGR and have assessed each of the locations under each of the three headings below:

- Material acceptability – compared against criteria within Appendix 6/1.

This indicates whether the material is acceptable for use in the earthworks based upon geotechnical properties. If the in-situ material is considered to be unacceptable, then the suitability for lime or cement stabilisation has been assessed;

- Contamination concentrations – compared against limiting values within Appendix 6/14

This indicates whether the material is acceptable for use in the earthworks based upon concentrations of contamination recorded within the in-situ materials. Where exceedances are noted, the material may be classified as Class U1B or U2 unacceptable material;

- Waste characterisation – compared against criteria outlined within WM3³

This indicates, for material that may be designated for direct transfer off-site, whether disposal at an inert, non-hazardous or hazardous waste facility would be required.

In order to assess the likely requirements for re-use and/or disposal off-site, CGL has reviewed the Morgan Tucker drawings (A720-E05-IW-MTU-EW-DR-0610 and A720-E05-IW-MTU-EW-DR-0600), which detail the proposed earthworks cut and fill volumes. Based upon a net cut of approximately 76,000m³ and a net fill of 80,400m³ across the development area, a deficit of approximately 4,300m³ of fill exists. The drawings indicate smaller zones of material balance across the site, however as these zones still generally cover larger areas than that sampled within this investigation, the volumes stated cannot be applied to these results.

4.1 Earthworks classification and acceptability testing

4.1.1 Sulfates

Testing was undertaken to TRL 477⁴ methods 1, 2 & 4 to determine the Total Potential Sulfate (TPS) within five samples taken from the Lagoon Bund area. The mean value of the

³ WM3 (2015). Waste Classification: *Guidance on the classification and assessment of waste* (1st Edition 2015).

two highest results has been reported in accordance with MCHW 1. The results are presented below in Table 1.

Table 1 - Summary of sulfate test results

	Total Potential Sulfate (%SO ₄) ¹	Acid Soluble Sulfate (%SO ₄) ²
Lagoon Bund	1.16	1.12
Bridge Bund	0.37	0.22
¹ Average of two highest recorded values		
² Maximum value across all samples		

The results indicate that Total Potential Sulfates (TPS) exceed the recommended limiting value of 0.25%⁵ for suitability for lime improvement and stabilisation. At the *Lagoon Bund* area TPS exceeds the upper bound limit of 1.00%, which could result in a high risk of expansion of lime treated material. The risk of expansion will be related to the percentage addition of lime required to achieved the necessary properties and can be further assessed by undertaking trials on lime treated material or the addition of additive.

4.1.2 Atterberg Limit & Moisture Content

Seven samples from the *Bridge Bund* area and six samples from the *Lagoon Bund* area were tested to determine the Plastic and Liquid Limits of the cohesive soils in accordance with BS 1377 (1990), Part 2, Clause 5.3. Full laboratory testing data is provided in Appendix B, and a summary of the Plastic and Liquid Limits for the site won materials is set out below in Table 2.

Table 2 - Summary of Atterberg Limit test results

Atterberg Limits							
Sample Location	No. of tests	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	% material <425µm	I _p ²	Volume change potential
<i>Bridge Bund</i>	4	10-15	43-50	24-26	36-48	7-12	Low
<i>Bridge 1 location</i>	3	11-30	48-54	NP-19	50-86	18-28	Medium
<i>Lagoon Bund</i>	3	21-60	64-85	35-43	78-89	23-37	Medium
<i>Area below Lagoon Bund</i>	1	22	72	28	69	30	Medium

The results indicate that the material meets the general requirements for acceptability based upon Liquid Limit or Plasticity Index and would not likely be classified as Class U1A on this basis.

⁴ TRL Limited (2001). *Sulfate specification for structural backfills*. TRL Report TRL447.

⁵ Britpave (2005). *Stabilisation of sulfate-bearing soils- Technical Guidelines*. Britpave: Camberley.

The majority of the samples taken from the Lagoon Bund area have a natural moisture content of between 44-60%. This is likely to be above the upper acceptability limit for the material, based upon a limit of Optimum Moisture Content + 2%. However, drying or lime modification may be employed to reduce the natural moisture content to within acceptable limits, further to an assessment of suitability for lime improvement.

The materials in the *Lagoon Bund* generally classify as a silt of high to very high plasticity. The material within the *Bridge Bund* generally classify as clay of intermediate to high plasticity.

4.1.3 Particle Size Distribution testing

Four samples from the both the *Bridge Bund* area and the *Lagoon Bund* area were tested for Particle Size Distribution (PSD) in accordance BS 1377:1990 Part 2:9.2. Full geotechnical laboratory testing data is provided in Appendix B.

- Bridge Bund area

The results indicate that all four samples conform to the Class 2C specification.

- Lagoon Bund area

The results indicate that the majority of samples conform to the Class 2A/B specification (75% of samples tested). One sample (TP4) relating to the natural River Terrace Deposits did not conform to the Class 2A specifications due to the lack of materials passing through the 2mm sieve during testing, and instead conform to Class 2C. This is consistent with the classification of the River Terrace Deposits at the *Bridge Bund* area.

All samples from the *Lagoon Bund* area predominantly comprise silt, which is highly sensitive to variations in moisture content. Strict control of this material during excavation, transportation and deposition will be essential to avoid the material deteriorating through trafficking into an unacceptable material. This indicates that lime improvement of the material in this area would be highly beneficial.

4.1.4 Maximum dry density/moisture content relationship

Four samples from the *Lagoon Bund* area and one sample from the *Bridge Bund* area were tested to determine the optimum moisture contents and maximum dry density of the soils in accordance with BS 1377 (1990), Part 4, Clause 3.3 using a 2.5kg proctor mould. Full

laboratory testing data is provided in Appendix B, and a summary of the maximum dry densities for the site won materials is set out below in Table 3.

Table 3 - Summary of compaction test results (2.5kg hammer method)

Material	Number of tests	Maximum dry density for method compaction (Mg/m ³)	Optimum moisture content range (%)
Lagoon Bund	4	1.07 – 1.60	21-54
Bridge Bund	1	1.80	15

The results indicate that all samples tested from the *Lagoon Bund* area were received as 'wet of optimum moisture content'. One sample (TP3) is recorded as having a lower maximum dry density and higher natural moisture content than other samples from the same location. This suggests that materials in this region may require division into a sub-class, which would require strict controls on-site to separate out materials. The results here further indicate that the material in this area would benefit from lime improvement. The results indicate that the single sample tested from the *Bridge Bund* area was received as slightly 'dry of optimum', but is considered workable as a fill material within minimum site working.

A further two samples from the *Bridge Bund* were tested in accordance with BS 1377 (1990), Part 4, Clause 3.7 using a vibrating hammer method, owing to the granular nature of the material. The results are displayed in Table 4 below.

Table 4 - Summary of compaction test results (Vibrating hammer method)

Material	Number of tests	Maximum dry density for method compaction (Mg/m ³)	Optimum moisture content range (%)
Bridge Bund	2	1.80-1.81	15-17

The results show these two samples were received as 'dry of optimum', indicating that some wetting may be required to achieve sufficient compaction, however this will depend on weather conditions and site controls during the transportation of material on site.

4.1.5 Moisture Condition Value (MCV) and MCV/mc relationship

Four samples from the *Lagoon Bund* area and three samples from the *Bridge Bund* area were tested to determine a single point Moisture Condition Value in accordance with BS 1377 (1990), Part 4. Full laboratory testing data is provided in Appendix B, and a summary of the undrained shear strength for the tested materials is set out below in Table 6.

Table 5 - Summary of MCV test results

Material	Number of tests	Single point Moisture Condition Value (MCV)
Lagoon Bund	4	6.7-11.6
Bridge Bund	3	8.5-13.6

The Moisture Condition Value can provide a simple controlling value for a given soil to obtain near-full compaction. The results indicate that nearly all samples from the *Lagoon Bund* area fall outside of typical limiting values for a Class 2A soil (lower limit 12 and upper limit 16).

Four samples from the *Lagoon Bund* area and one sample from the *Bridge Bund* area were also tested to determine the relationship between Moisture Condition Value and Moisture Content in accordance with BS 1377 (1990), Part 4, Clause 5.5. This provides a calibration line for the materials tested and allow a more specific assessment of limiting values of MCV. The results indicate that the samples from the *Lagoon Bund* area (Class 2A material) may warrant a MCV lower limit of 14-16 and an MCV upper limit of around 18, for use within the Earthworks Specification. These limits are higher than the general guidance values and therefore, this indicates that the material would benefit from stabilisation to improve compaction characteristics.

The results from the single sample at the *Bridge Bund* area indicate that a lower MCV range of between 7-11 may be appropriate for this material.

4.1.6 Undrained Shear Strength

Four samples from the *Lagoon Bund* area and one sample from the *Bridge Bund* area were tested to determine the undrained shear strength in accordance with BS 1377 (1990), Part 7. Full laboratory testing data is provided in Appendix B, and a summary of the undrained shear strength for the tested materials is set out below in Table 6.

Table 6 - Summary of unconsolidated undrained triaxial test results

Material	Number of tests	Undrained Shear Strength (kN/m ²)
Lagoon Bund	4	23-90
Bridge Bund	1	56

The results indicate that the majority of samples (80% of tested samples) exceed the value of undrained shear strength that has been assumed within the PGDR of 40kN/m². One sample (TP3) relating to the Lagoon Bund material recorded an undrained shear strength of 23kN/m², which is below the design value.

4.1.7 Summary of geotechnical results

The results of the geotechnical testing indicate the material from the *Lagoon Bund* area would be generally acceptable as a Class 2A material based upon grading. However the high natural moisture content and sensitivity to moisture content changes noted with this material would pose a risk to material handling on-site and would require significant drying in order to achieve compaction requirements. Additionally, the material is highly variable within the area sampled as shown by the compaction and strength testing, with some samples below the undrained shear strength required, and would make site processes for placement difficult without treatment. This material would benefit from lime improvement and probably stabilisation in order to render the material acceptable for use within the earthworks. However, the sulfate concentrations will necessitate that lime treatment trials are undertaken to determine the risk of expansion of the treated material. It may be necessary to stabilise the material using Ground Granulated Blastfurnace Slag (GGBS) in combination with lime.

The material from the *Bridge Bund* area is generally classified as a Class 2C material based upon grading. Natural moisture contents are recorded to be slightly dry of optimum moisture content (OMC), as determined by compaction testing. To achieve the compaction requirements, wetting of the material may be required however, it is anticipated that a small increase in moisture content would occur through the process of material handling on site during wet periods. The results indicate some variability in the material and it may be prudent to consider treatment using a low percentage of lime to produce a material that requires a lower level of site controls to manage. The material may require treatment trials to determine the expansion potential and it is likely that the addition of water would be needed to retain a moisture content at or near OMC.

4.2 Contamination assessment - Risks to human health

The chemical results have been compared against the limiting values within Appendix 6/14 of the PDGR, derived from the Generic Assessment Criteria (GACs) derived in house by CGL for the “commercial” land-use category, considered to be conservative in this scenario. None of the concentrations recorded within the Made Ground or natural soils exceeded the assessment criteria. In addition, no asbestos was identified in any samples.

4.3 Waste characterisation

The waste characterisation of the sampled material was undertaken in accordance with the waste classification guidance document, WM3⁶ to determine its characterisation and hazardous properties.

It should be noted that in May/June 2012, HMR&C issued Briefs 15/12 and 18/12 clarifying how construction spoil and excess soils will be assessed for landfill tax purposes. Detailed accurate descriptions of waste are required for all wastes to support the landfill tax assessment. Uncontaminated naturally occurring soils will remain inert by default and eligible for the lower rate of landfill tax. Similarly 'reworked soils' and demolition 'stone' comprising ONLY materials listed in the Schedule of the Landfill Tax (Qualifying Material) Order 2011 (SI 2011/1017) will also be eligible for the lower rate of landfill tax. However, Made Ground containing soil and foreign objects such as timber, plastic, rubber, metal, paper, plasterboard, asbestos etc., regardless of the results of chemical analysis for waste classification purposes, will be eligible for the standard (higher) rate of landfill tax. Therefore, to maximise eligibility for lower rate landfill tax on waste construction spoil/reworked ground, careful waste segregation and controls are necessary, and Made Ground recorded onsite will need sorting to remove foreign objects.

4.3.1 Lagoon Bund

The results of the preliminary assessment indicate that the material associated with the samples from the *Lagoon Bund* are deemed 'hazardous' on the basis of elevated concentrations of TPH. Two WAC tests were undertaken on this material. All concentrations recorded passed the Hazardous Waste Landfill criteria with the exception of Loss on ignition from one test. It is recommended that further WAC testing is undertaken to confirm whether the organic content (i.e. loss on ignition %) is characteristic of the stockpile as a whole or a more localised anomaly. On the basis of results received to date, it is likely the material from the *Lagoon Bund* will need to be sent to a soil treatment facility for recovery prior to disposal. Notwithstanding this, early discussions with potential landfill operators may allow the acceptance of this material to hazardous landfill without treatment.

4.3.2 Bridge Bund

The results of the preliminary assessment indicate that the material associated with the samples from the *Bridge Bund* are deemed 'not hazardous.' A singular WAC test was

undertaken on this material. All concentrations recorded passed the Inert Waste Landfill criteria. To qualify for the lower landfill tax rate foreign objects (recorded throughout the bund) will need to be removed and disposed of via the appropriate waste stream.

4.4 Groundwater and formation considerations

Five trial pits were excavated across the central part of the site between the Grand Union Canal and the River Crane to identify likely groundwater levels in relation to proposed formation strata. These trial pits did not encounter any significant groundwater strikes to excavated base within permeable material. However, TP04 and TP05 did encounter moderate seepage at the interface between the Topsoil and underlying gravels which is associated with surface water infiltration from the surrounding area. The site was noted to be waterlogged at surface level during the trial pitting works, which is anticipated to be as a result of the higher clay fraction within the upper River Terrace Deposits acting as a shallow low permeability surface.

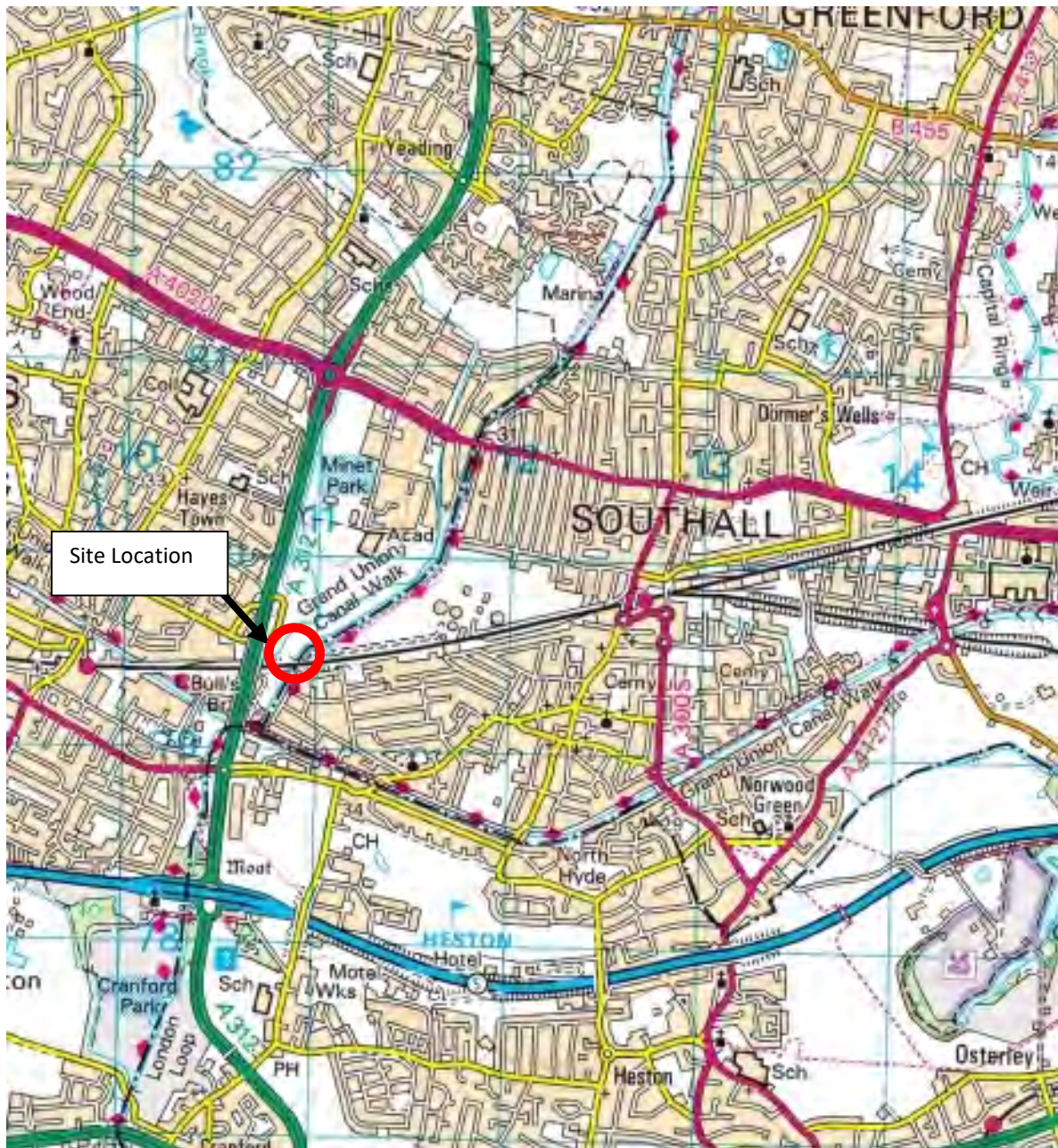
Trial pits all indicated that suitable formation strata for the proposed embankment is likely between depths of 0.8m and dependent on embankment loadings and ground conditions present (Alluvium or River Terrace Deposits). Where suitable forming strata was encountered, further excavation confirmed that likely formation levels would be in excess of 500mm above groundwater levels. However, further assessment of this should be picked up during the proposed additional advanced works to further classify the materials across the site.

Based on observations made during the site works on 8th March, the cohesive nature of upper formation strata likely encountered and the collection of surface water across parts of the central site, it is considered that care will have to be given during strip and construction works to protect the formation level from softening and weakening during site works and trafficking.

5. SUMMARY

This report provides the results of trial pitting and subsequent laboratory testing undertaken as part of the advanced works phase of the Western Access scheme. The results show that the material from the Lagoon Bund area has large variability in its geotechnical properties and as a result may benefit from treatment with lime to stabilise the material. The material from the Bridge Bund area demonstrates less variability and will likely be suitable for re-use providing good site controls are employed to manage the source materials on site.

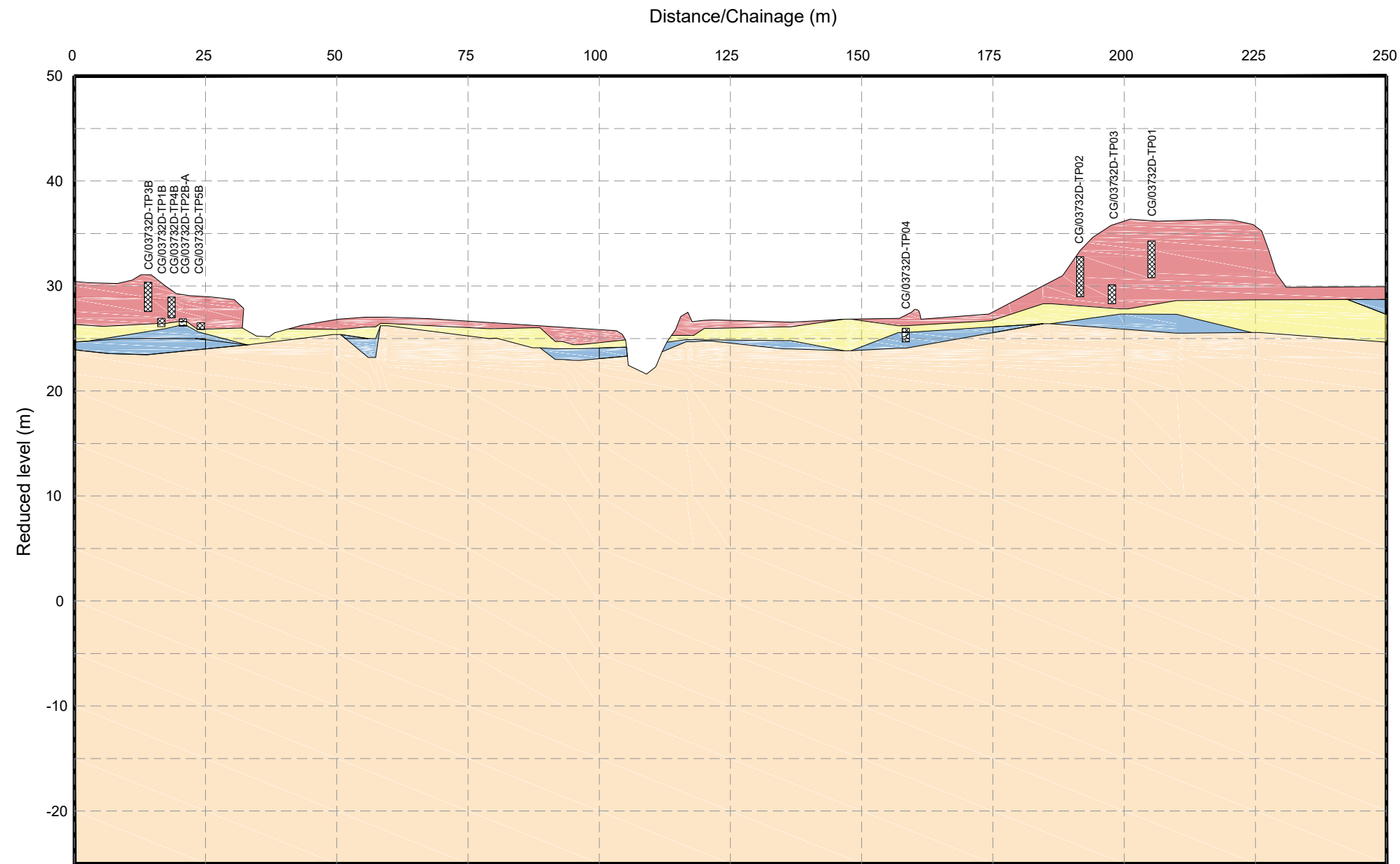
FIGURES



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Client	Project	Job No
CSP Limited	Southall Advanced Works	CGN/3732D
	Title	
	Site location plan	Figure 1

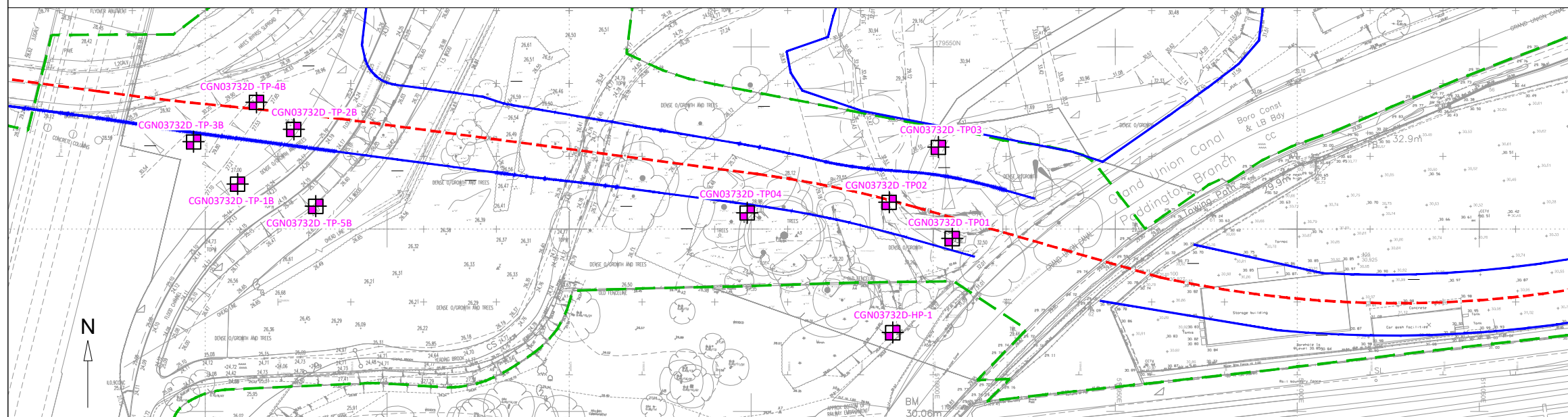


KEY

- Made Ground
- Alluvium
- Gravels
- London Clay Formation
- Trial pit
- Site boundary
- Road Alignment

Drawing produced from: A724-E05-PA-VEC-HW-DR-0001

0	09/03/17	
Rev	Date	Comments
 Card Geotechnics Ltd 4 Godalming Business Centre Woolsack Way Godalming Surrey GU7 1XW T: 01483 310600		
Project Pump Lane Access, Southall		
Client FM Conway Limited		
Drawing title Figure 2 - Trial pit location plan and longitudinal geological cross section		
Scale(s) NTS		Job No. CGN/03732D
Drawn TSS	09/03/17	Dwg No. A720-E05-IW-CGL-GEO-DR-0001
Checked		Rev. 0
Approved		
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APPENDIX A

Trial Pit Logs

TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP01
Job No CGN03732D	Date 24-02-17	Ground Level (m) 34.29	Co-Ordinates (m) E 510,905.2 N 179,497.5	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
2.60 2.60 2.60 2.60 2.60	B1 D1 ES1 B2 D2					MADE GROUND. Light to dark brown slightly sandy slightly gravelly slightly clayey SILT. Gravel is fine to coarse, angular to rounded of flint. Occasional lumps of clay with shell fragments. Frequent fragments of brick, glass, plastic, wood, metal, and polystyrene.
3.50 3.50	ES2 B3			30.79		(Pit terminated at 3.5m)

Plan	General Remarks
Stability:	1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. No groundwater encountered during excavation. 5. Pit terminated as a competent stratum was reached and to avoid breaching groundwater table. 6. Trial pit backfilled with arisings upon completion.

Method/ Plant Used	Field Crew	Logged By	Checked By
Tracked Excavator	Supplied by Client	ALD	BEJ

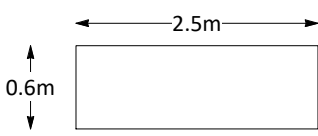
CGI TP LOG CGN03732D GPU GINT STD AGS 3.1 GDT 16/5/17

TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP02
Job No CGN03732D	Date 24-02-17	Ground Level (m) 32.78	Co-Ordinates (m) E 510,887.9 N 179,507.4	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
0.60 0.60	B1 ES1					MADE GROUND. Light to dark brown slightly sandy slightly gravelly slightly clayey SILT. Gravel is fine to coarse, angular to rounded of flint. Occasional lumps of clay with shell fragments. Frequent fragments of brick, glass, plastic, wood, metal, and polystyrene.
1.00	D1					
1.50	B2					
2.50 2.50 2.50	D2 D3 D4					
3.20	ES2					2.80 Becoming dark brown
3.60 3.60	B3 B4			28.98		3.80 (Pit terminated at 3.8m)

Plan  Stability:	General Remarks 1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. No groundwater encountered during excavation. 5. Pit terminated as a competent stratum was reached and to avoid breaching groundwater table. 6. Trial pit backfilled with arisings upon completion.
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Method/ Plant Used Tracked Excavator	Field Crew Supplied by Client	Logged By ALD	Checked By BEJ
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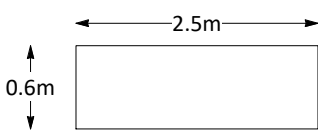
CGL TP LOG CGN03732D GPU GINT STD AGS 3.1 GDT 16/5/17

TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP03
Job No CGN03732D	Date 24-02-17	Ground Level (m) 30.11	Co-Ordinates (m) E 510,901.4 N 179,522.5	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
0.60 0.60 0.80	B1 D1 ES1					MADE GROUND. Light to dark brown slightly sandy slightly gravelly slightly clayey SILT. Gravel is fine to coarse, angular to rounded of flint. Occasional lumps of clay with shell fragments. Frequent fragments of brick, glass, plastic, wood, metal, and polystyrene.
1.00	D2			29.01		1.10
1.50 1.50 1.50 1.70 1.70	B2 ES2 D3 B3 D4			28.31		1.80
						(Pit terminated at 1.8m)

Plan  Stability:	General Remarks 1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. Slight groundwater inflow at 1.7m below ground level. 5. Pit terminated as a competent stratum was reached and to avoid breaching groundwater table. 6. Trial pit backfilled with arisings upon completion.
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Method/ Plant Used Tracked Excavator	Field Crew Supplied by Client	Logged By ALD	Checked By BEJ
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CGL TP LOG CGN03732D GPU GINT STD AGS 3.1 GDT 16/5/17

TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP04
Job No CGN03732D	Date 24-02-17	Ground Level (m) 26.97	Co-Ordinates (m) E 510,848.9 N 179,504.5	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
				26.62		(0.35) 0.35 Topsoil. Dark brown slightly gravelly silty clay with frequent roots and rootlets. Gravel is fine to medium, angular to rounded of flint.
0.40 0.50 0.60 0.60 0.60	D2 ES1 B1 D1 B2					(0.95) Firm orangish brown slightly gravelly silty CLAY with frequent roots and rootlets. Gravel is fine to coarse, angular to well rounded of flint. [RIVER TERRACE DEPOSITS]
1.30	ES2			25.67		1.10 Becoming mottled orangish brown and orangish grey 1.20 Becoming gravelly (Pit terminated at 1.3m)

Plan Stability:	General Remarks 1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. No groundwater encountered during excavation. 5. Pit terminated as a competent stratum was reached and to avoid breaching groundwater table. 6. Trial pit backfilled with arisings upon completion.
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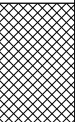
Method/ Plant Used Tracked Excavator	Field Crew Supplied by Client	Logged By ALD	Checked By BEJ
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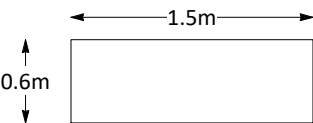
CGL TP LOG CGN03732D GPU GINT STD AGS 3.1 GDT 16/5/17

TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP-1B
Job No CGN03732D	Date 24-02-17	Ground Level (m) 26.92	Co-Ordinates (m) E 510,708.9 N 179,512.4	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thickness)	DESCRIPTION
0.80	HSV	60		26.42		(0.50) 0.50	Soft brown sandy gravelly CLAY with frequent rootlets. Gravel is subrounded to subangular medium to coarse of flint. Occasional brick cobbles. [MADE GROUND]
				26.12		(0.30) 0.80	Firm to stiff yellowish brown slightly sandy slight gravelly CLAY. Occasional flint cobbles. [ALLUVIUM]
							(Pit terminated at 0.8m)

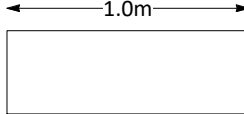
Plan	General Remarks
 Stability:	1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. No groundwater encountered during excavation. 5. Pit terminated as a competent stratum was reached and to avoid breaching groundwater table. 5. Trial pit backfilled with arisings upon completion.

Method/ Plant Used	Tracked Excavator	Field Crew Supplied by Client	Logged By OEF	Checked By BEJ
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CGI TP LOG CGN03732D.GPJ GINT STD AGS 3.1.GDT 16/5/17

Project Southall Advanced Earthworks				TRIAL PIT No TP-2B
Job No CGN03732D	Date 24-02-17	Ground Level (m)	Co-Ordinates (m)	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
					(0.25) 0.25	Soft brown slightly sandy slightly gravelly CLAY. Gravel is subround to subangular of mixed lithologies. Frequent plastic, glass, brick, textile and rootlets. Occasional wood. [MADE GROUND] Concrete <i>(Pit terminated at 0.25m)</i>

Plan	General Remarks
 Stability:	1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. No groundwater encountered during excavation. 5. Trial pit terminated at 0.25m bgl at concrete obstruction. Excavation re-commenced 0.5m to side of obstruction. 6. Pit backfilled with arisings upon completion.

Method/ Plant Used	Tracked Excavator	Field Crew Supplied by Client	Logged By OEF	Checked By BEJ
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CGL TP LOG CGN03732D.GPJ GINT STD AGS 3 1.GDT 16/5/17

TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP-2B_A
Job No CGN03732D	Date 24-02-17	Ground Level (m) 26.88	Co-Ordinates (m) E 510,724.4 N 179,527.4	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
0.20	ES			26.63		(0.25) 0.25 Soft brown slightly sandy slightly gravelly CLAY. Gravel is subround to subangular of mixed lithologies. Frequent plastic, glass, brick, textile and rootlets. Occasional wood. [MADE GROUND]
0.65	B			26.23		(0.40) 0.65 Firm to stiff orangish brown CLAY. [ALLUVIUM]
0.65	HSV	78		26.18		0.70 Firm light grey slightly sandy slightly clayey slightly sandy subrounded to angular coarse flint GRAVEL. [RIVER TERRACE DEPOSITS]
0.70	B					(Pit terminated at 0.7m)
0.70	HSV	63				

Plan Stability:	General Remarks 1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. Minor seepage observed at 0.65m bgl. No ingress. 5. Pit terminated as River Terrace Deposits encountered at shallow depth. 5. Trial pit backfilled with arisings upon completion.
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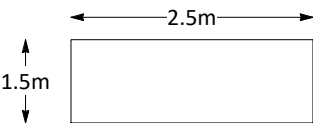
Method/ Plant Used Tracked Excavator	Field Crew Supplied by Client	Logged By OEF	Checked By BEJ
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TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP-3B
Job No CGN03732D	Date 24-02-17	Ground Level (m) 30.37	Co-Ordinates (m) E 510,696.8 N 179,524.0	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA		
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	DESCRIPTION
0.20	ES			30.17		Soft brown slightly sandy gravelly CLAY. Gravel is rounded to angular medium to coarse of flint with occasional concrete. Frequent rootlets, plastic and glass. [MADE GROUND]
1.50	B			28.67		Soft to firm light brown slightly sandy slightly silty GRAVEL with clods of firm orangey brown clay. Comprising; 5% metal wires and bars (up to 50mm diameter), 2% compressed metal drum (rusted, no odours or labels), 2% concrete slabs up to 0.7m by 0.5m, 2% plastic and textiles. [MADE GROUND]
2.70	ES/B			27.57		Light greyish brown slightly clayey slightly silty slightly sandy GRAVEL. Gravel is rounded to subangular fine to coarse of flint and concrete. Comprising 5% wood, 5% plastic, 10% metal wires and bars (up to 50mm diameter), 2% concrete slabs up to 0.7m by 0.5m and 1% textile. [MADE GROUND]
						(Pit terminated at 2.8m)

Plan  Stability:	General Remarks 1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. No groundwater encountered during excavation. 5. Pit terminated as approximate depth of bund had been excavated. 6. Trial pit backfilled with arisings upon completion.
--	---

Method/ Plant Used Tracked Excavator	Field Crew Supplied by Client	Logged By OEF	Checked By BEJ
--	----------------------------------	------------------	-------------------

CGL TP LOG CGN03732D GPU GINT STD AGS 3.1 GDT 16/5/17

TRIAL PIT LOG



Project Southall Advanced Earthworks				TRIAL PIT No TP-4B
Job No CGN03732D	Date 24-02-17	Ground Level (m) 28.96	Co-Ordinates (m) E 510,714.1 N 179,534.8	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION
0.50	ES					(1.00)	Soft greyish brown mottled orange slightly sandy gravelly CLAY with frequent rootlets. Gravel is rounded to subangular fine to coarse of flint. Occasional glass, tile and wood. [MADE GROUND]
				27.96		1.00	
1.50	ES/B					(1.00)	Greyish brown mottled orange slightly silty slightly sandy GRAVEL. Gravel is rounded to subangular medium to coarse of flint with occasional concrete and possible clinker. Rare metal, tile and plastic. [MADE GROUND]
				26.96		2.00	1.70 - 2.00 Frequent brick cobbles.
							(Pit terminated at 2m)

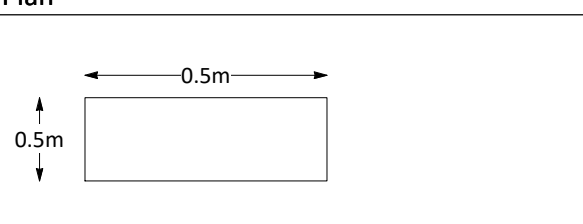
Plan	General Remarks
Stability:	1. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 2. No visual or olfactory evidence of contamination observed. 3. Pit sides were stable. 4. No groundwater encountered during excavation. 5. Pit terminated as full depth of bund had been excavated. 5. Trial pit backfilled with arisings upon completion.

Method/ Plant Used	Tracked Excavator	Field Crew	Supplied by Client	Logged By	OEF	Checked By	BEJ
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CGI TP LOG CGN03732D GPU GINT STD AGS 3.1 GDT 16/5/17

Project Southall Advanced Earthworks				TRIAL PIT No TP-5B
Job No CGN03732D	Date 24-02-17	Ground Level (m) 26.49	Co-Ordinates (m) E 510,730.4 N 179,506.3	
Client CSPL				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION
0.65	HSV	88		26.39		0.10	Soft dark greyish brown slightly sandy CLAY with frequent rootlets.
						(0.50)	Soft to firm brown slightly sandy gravelly CLAY with rare rootlets. Gravel is subrounded to subangular medium to coarse of flint with occasional brick, glass, wood and tile. [MADE GROUND]
				25.89		0.60	
				25.84		0.65	Firm orangish brown mottled brown slightly gravelly CLAY. [ALLUVIUM]
(Pit terminated at 0.65m)							

Plan	General Remarks
 Stability:	1. Pit was hand dug. 2. Samples: B - Bulk, D - Disturbed, ES - Environmental Sample. 3. No visual or olfactory evidence of contamination observed. 4. Pit sides were stable. 5. No groundwater encountered during excavation. 6. Trial terminated due to difficult digging with hand tools. 7. Trial pit backfilled with arisings upon completion.

Method/ Plant Used	Tracked Excavator	Field Crew Supplied by Client	Logged By OEF	Checked By BEJ
-----------------------	-------------------	----------------------------------	------------------	-------------------

CGL TP LOG CGN03732D.GPJ GINT STD AGS 3 1.GDT 16/5/17

APPENDIX B

Geotechnical Test Results



TEST CERTIFICATE

Determination of Moisture Content

Tested in Accordance with BS 1377-2:1990: Clause 3.2

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

Test results

Laboratory Reference	Sample Reference	Location	Depth Top [m]	Depth Base [m]	Sample Type	Description	Moisture Content [%]
712411	2	TP1	2.6	Not Given	B	Dark brown slightly gravelly slightly sandy clayey SILT	21
712412	3	TP2	2.5	Not Given	D	Dark brown gravelly sandy CLAY	41
712413	4	TP2	2.5	Not Given	D	Dark brown slightly gravelly sandy CLAY	44
712415	4	TP2	3.6	Not Given	B	Black slightly gravelly slightly sandy clayey SILT	44
712417	3	TP3	1.7	Not Given	B	Brown slightly gravelly slightly sandy clayey SILT	60
712419	2	TP4	0.6	Not Given	B	Yellowish brown slightly gravelly silty CLAY	22
712420	1	TP2B	0.2	Not Given	D	Dark brown gravelly clayey SAND	30
712421	1	TP2B	0.65	Not Given	B	Yellowish brown gravelly slightly sandy CLAY	19
712422	2	TP2B	0.7	Not Given	B	Yellowish brown slightly sandy silty GRAVEL	11
712423	1	TP3B	0.2	Not Given	D	Dark brown gravelly sandy CLAY	15

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Moisture Content

Tested in Accordance with BS 1377-2:1990: Clause 3.2

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

Test results

Laboratory Reference	Sample Reference	Location	Depth Top [m]	Depth Base [m]	Sample Type	Description	Moisture Content [%]
712424	1	TP3B	1.5	Not Given	B	Brown slightly sandy silty GRAVEL	11
712425	2	TP3B	2.7	Not Given	B	Brown slightly sandy clayey GRAVEL	12
712426	1	TP4B	1.5	Not Given	B	Dark brown slightly sandy clayey GRAVEL	10

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712411

Sample Reference: 2

Description: Dark brown slightly gravelly slightly sandy clayey SILT

Location: TP1

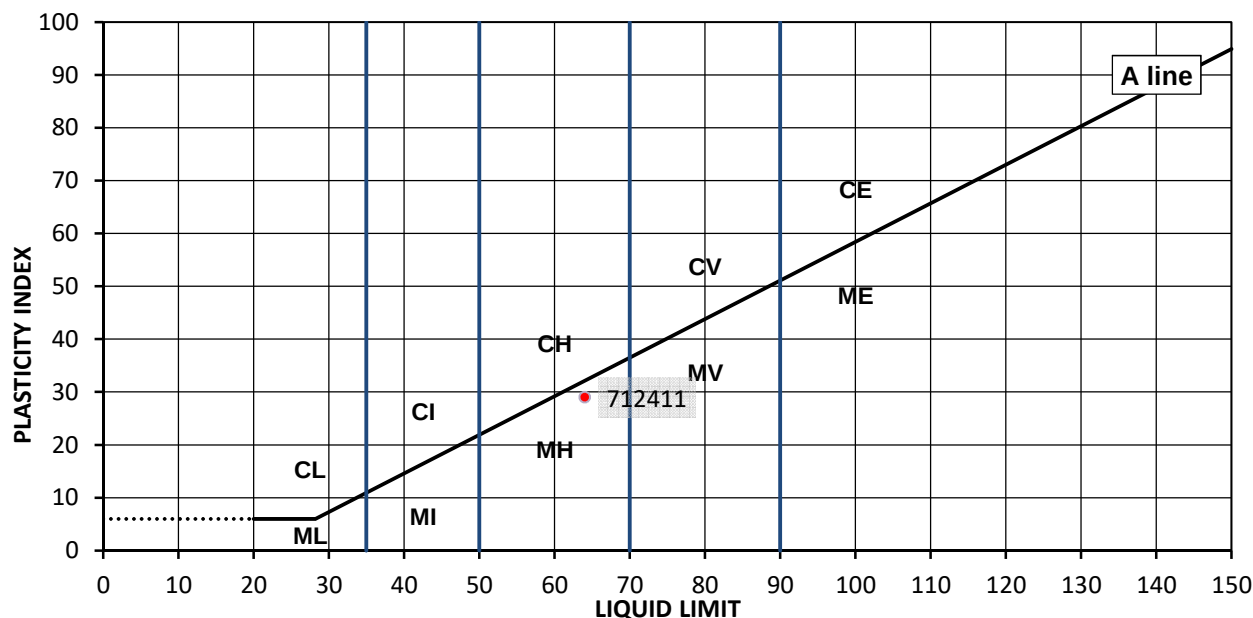
Sample Preparation: Tested after washing to remove >425um

Sample Type: B

Depth Top [m]: 2.6

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
21	64	35	29	79



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay	Plasticity	Liquid Limit
C	Clay	L Low	below 35
M	Silt	I Medium	35 to 50
		H High	50 to 70
		V Very high	70 to 90
		E Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712415

Sample Reference: 4

Description: Black slightly gravelly slightly sandy clayey SILT

Location: TP2

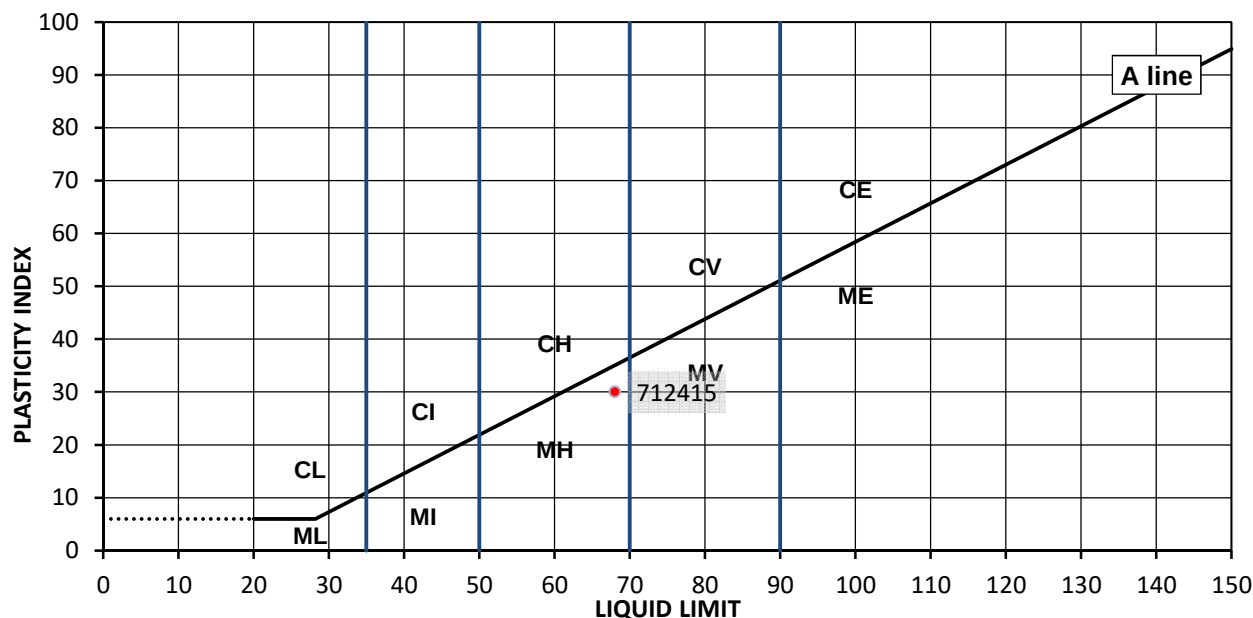
Sample Preparation: Tested after washing to remove >425um

Sample Type: B

Depth Top [m]: 3.6

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
44	68	38	30	78



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay	Plasticity	Liquid Limit
C	Clay	L Low	below 35
M	Silt	I Medium	35 to 50
		H High	50 to 70
		V Very high	70 to 90
		E Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712417

Sample Reference: 3

Description: Brown slightly gravelly slightly sandy clayey SILT

Location: TP3

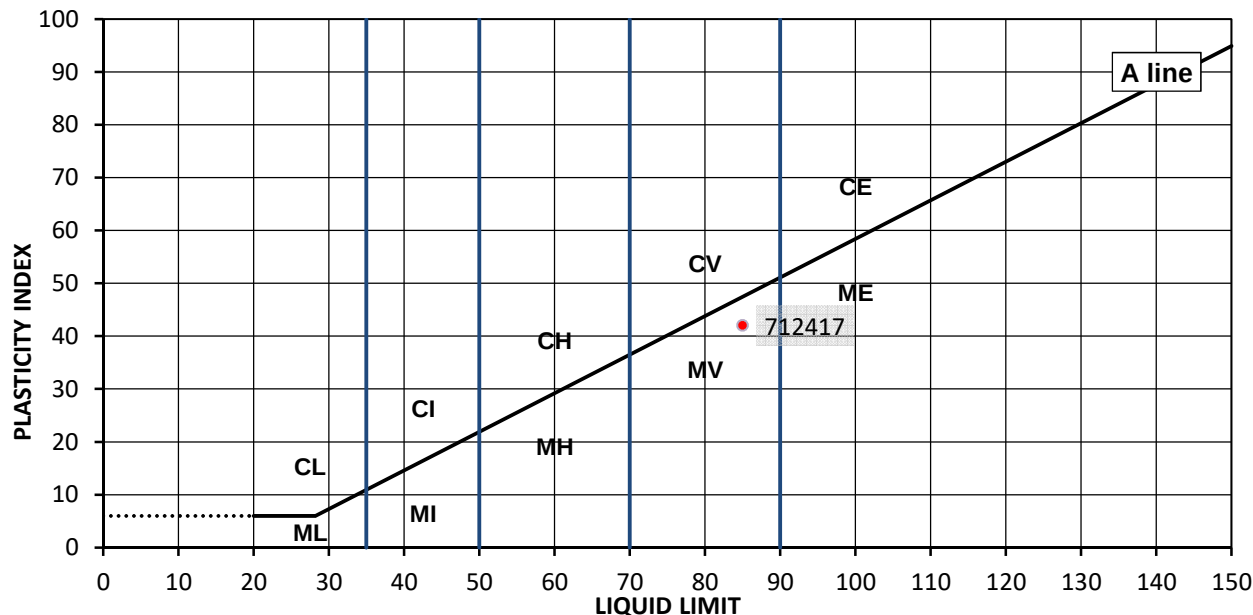
Sample Preparation: Tested after >425um removed by hand

Sample Type: B

Depth Top [m]: 1.7

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
60	85	43	42	89



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay	Plasticity	Liquid Limit
C	Clay	L Low	below 35
M	Silt	I Medium	35 to 50
		H High	50 to 70
		V Very high	70 to 90
		E Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712419

Sample Reference: 2

Description: Yellowish brown slightly gravelly silty CLAY

Location: TP4

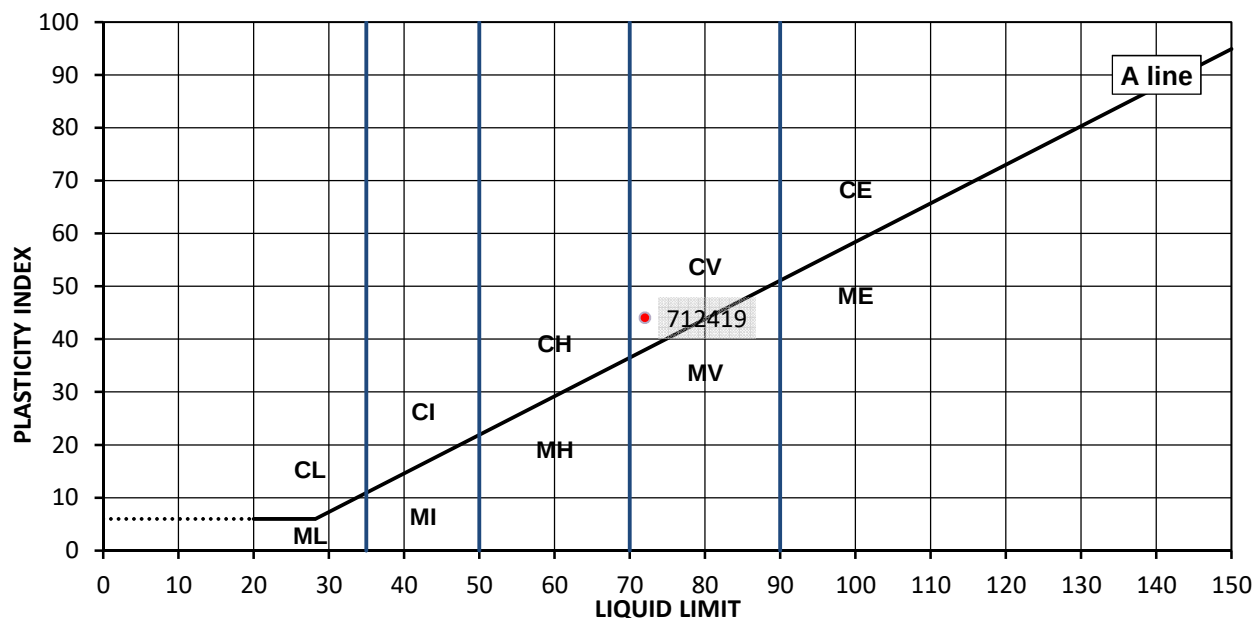
Sample Preparation: Tested after >425um removed by hand

Sample Type: B

Depth Top [m]: 0.6

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
22	72	28	44	69



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay	Silt	Plasticity	Liquid Limit
C	Clay		L Low	below 35
M		Silt	I Medium	35 to 50
			H High	50 to 70
			V Very high	70 to 90
			E Extremely high	exceeding 90
	Organic		O	append to classification for organic material (eg CHO)

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

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Technical Manager
(Geotechnical Division)

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4041

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712420

Sample Reference: 1

Description: Dark brown gravelly clayey SAND

Location: TP2B

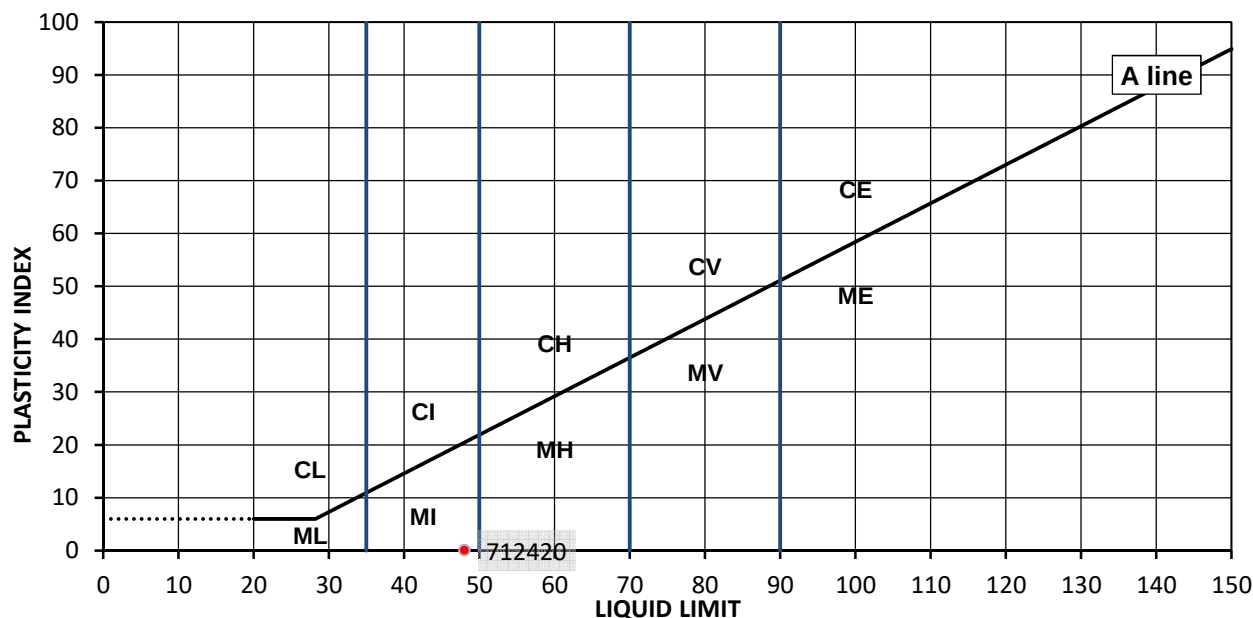
Sample Preparation: Tested after washing to remove >425um

Sample Type: D

Depth Top [m]: 0.2

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
30	48	NP*	NA*	57



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay	Silt	Plasticity	Liquid Limit
C	Clay		L Low	below 35
M		Silt	I Medium	35 to 50
			H High	50 to 70
			V Very high	70 to 90
			E Extremely high	exceeding 90
	Organic		O	append to classification for organic material (eg CHO)

Remarks: *Sample unsuitable for the test (PL)

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

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Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712421

Sample Reference: 1

Description: Yellowish brown gravelly slightly sandy CLAY

Location: TP2B

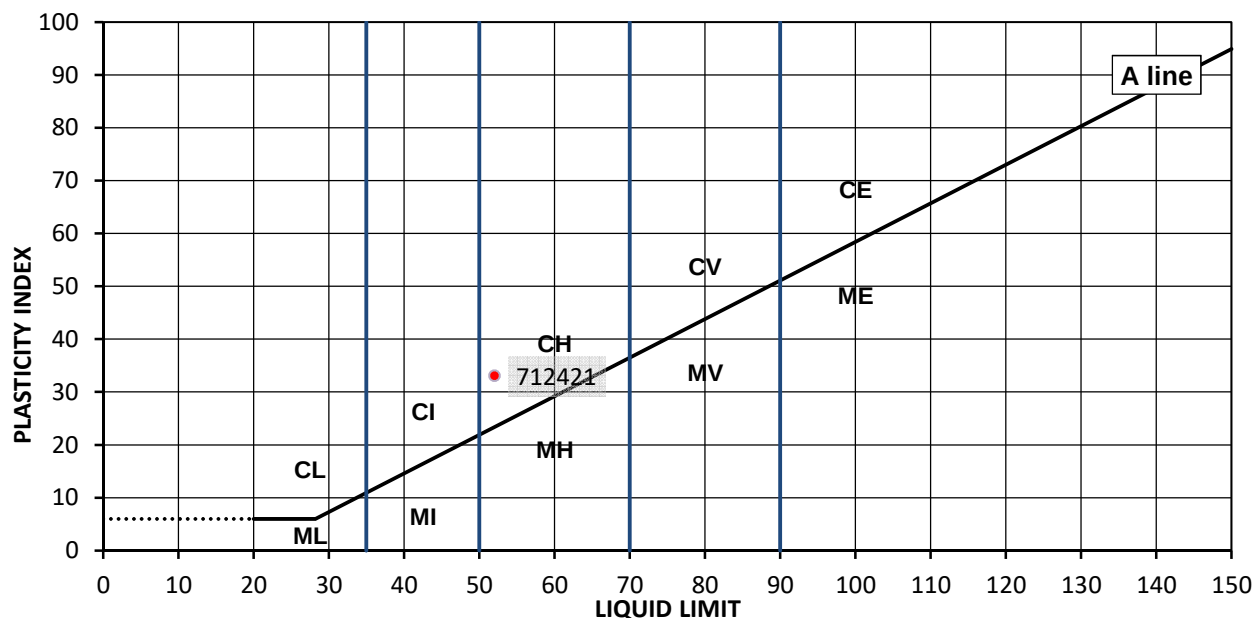
Sample Preparation: Tested after >425um removed by hand

Sample Type: B

Depth Top [m]: 0.65

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
19	52	19	33	86



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay		Plasticity		Liquid Limit
C	Clay	L	Low		below 35
M	Silt	I	Medium		35 to 50
		H	High		50 to 70
		V	Very high		70 to 90
		E	Extremely high		exceeding 90
	Organic	O	append to classification for organic material (eg CHO)		

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712422

Sample Reference: 2

Description: Yellowish brown slightly sandy silty GRAVEL

Location: TP2B

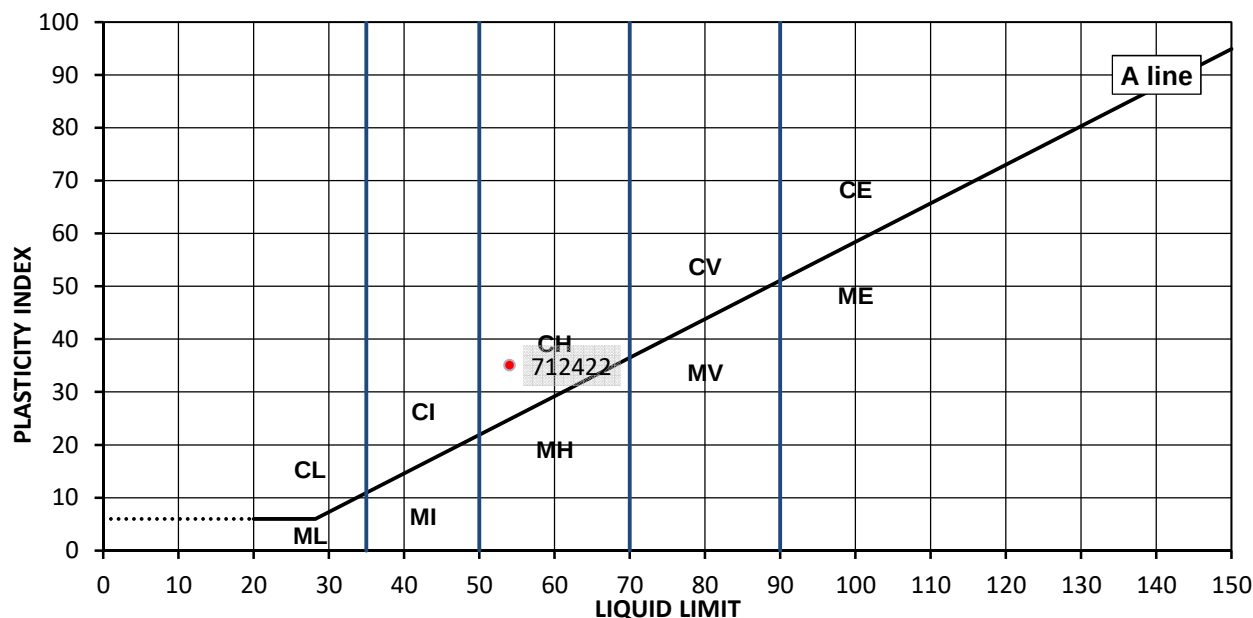
Sample Preparation: Tested after >425um removed by hand

Sample Type: B

Depth Top [m]: 0.7

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
11	54	19	35	50



Legend, based on BS 5930:2015 Code of practice for site investigations

Plasticity		Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
L	Low	50 to 70
I	Medium	70 to 90
H	High	exceeding 90
V	Very high	
E	Extremely high	
O	Organic	append to classification for organic material (eg CHO)

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712423

Sample Reference: 1

Description: Dark brown gravelly sandy CLAY

Location: TP3B

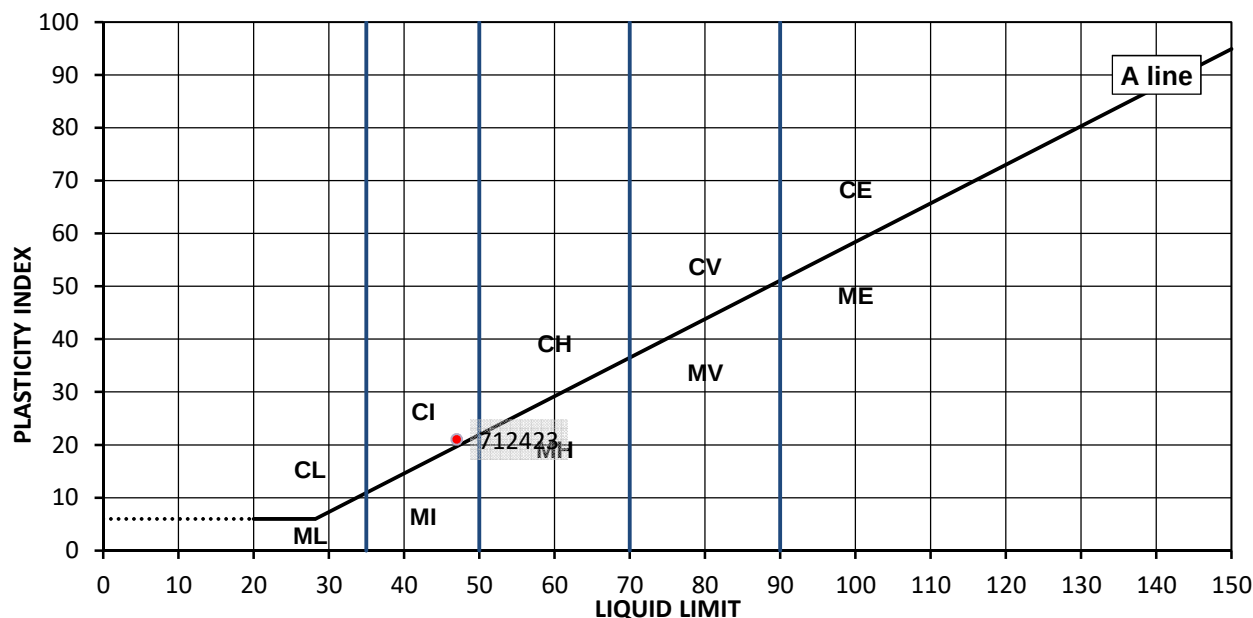
Sample Preparation: Tested after washing to remove >425um

Sample Type: D

Depth Top [m]: 0.2

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
15	47	26	21	48



Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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The analysis was carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland."



TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

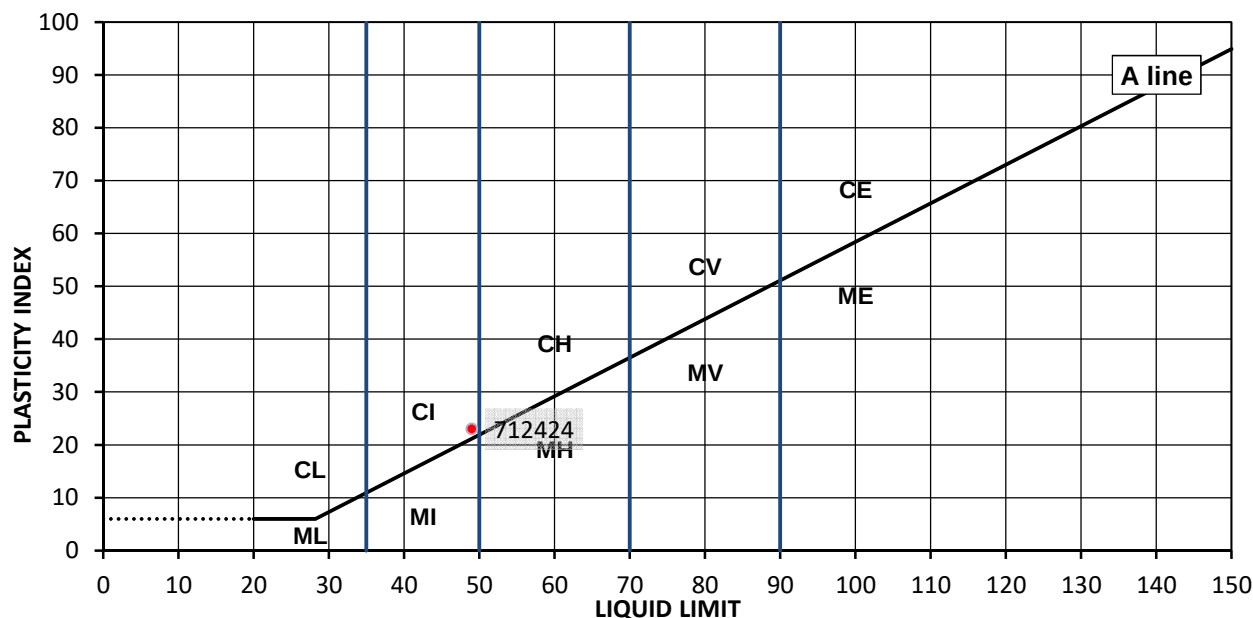
TEST RESULTS

Laboratory Reference: 712424
Sample Reference: 1

Description: Brown slightly sandy silty GRAVEL
Location: TP3B
Sample Preparation: Tested after washing to remove >425um

Sample Type: B
Depth Top [m]: 1.5
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
11	49	26	23	36



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay	Plasticity	Liquid Limit
C	Clay	L Low	below 35
M	Silt	I Medium	35 to 50
		H High	50 to 70
		V Very high	70 to 90
		E Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

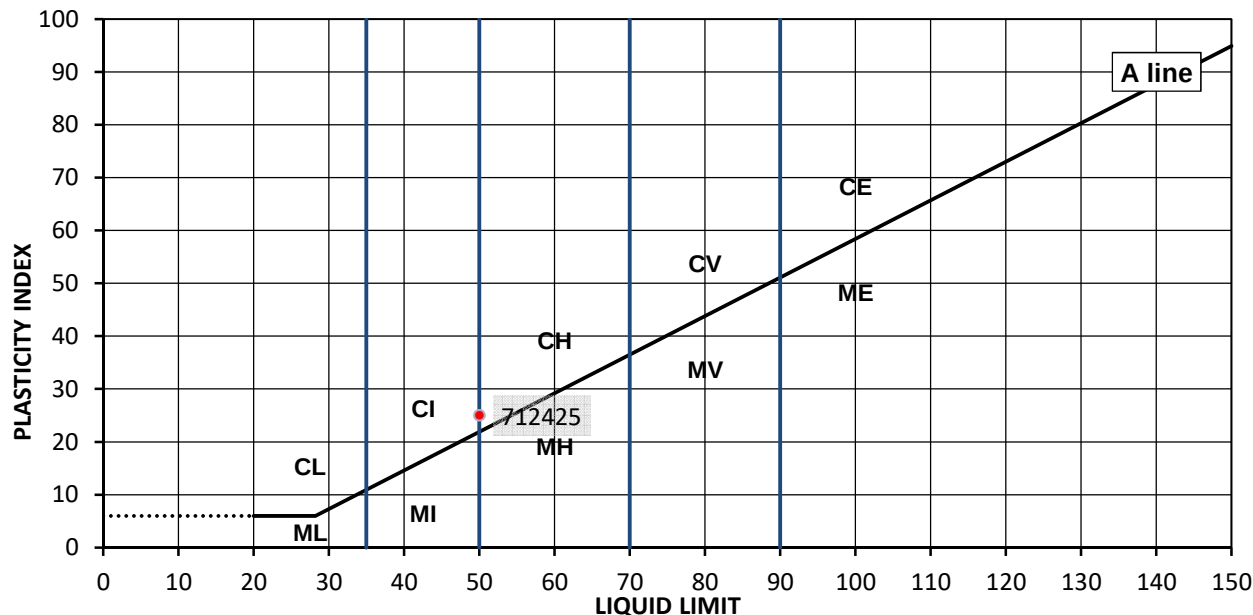
TEST RESULTS

Laboratory Reference: 712425
Sample Reference: 2

Description: Brown slightly sandy clayey GRAVEL
Location: TP3B
Sample Preparation: Tested after washing to remove >425um

Sample Type: B
Depth Top [m]: 2.7
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
12	50	25	25	48



Legend, based on BS 5930:2015 Code of practice for site investigations

	Clay	Plasticity	Liquid Limit
C	Clay	L Low	below 35
M	Silt	I Medium	35 to 50
		H High	50 to 70
		V Very high	70 to 90
		E Extremely high	exceeding 90
	Organic	O	append to classification for organic material (eg CHO)

Remarks

Approved:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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4041

TEST CERTIFICATE

Determination of Liquid and Plastic Limits

Tested in Accordance with BS1377-2: 1990: Clause 4.3 & 5: Definitive Method

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712426

Sample Reference: 1

Description: Dark brown slightly sandy clayey GRAVEL

Location: TP4B

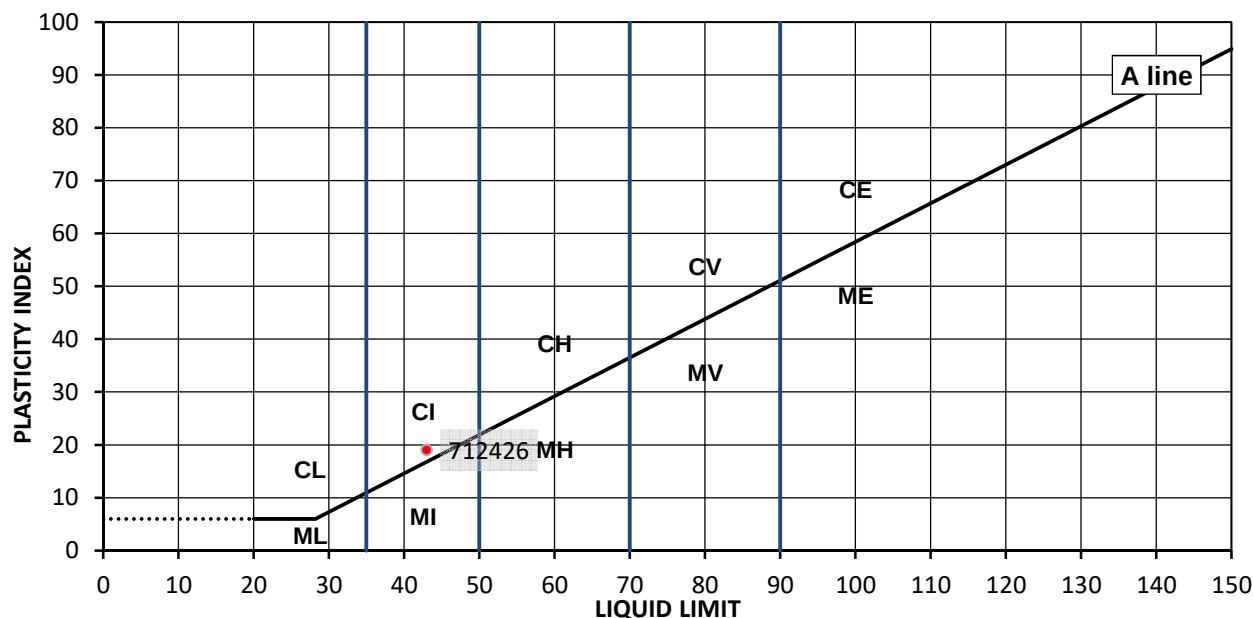
Sample Preparation: Tested after washing to remove >425um

Sample Type: B

Depth Top [m]: 1.5

Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
10	43	24	19	36



Legend, based on BS 5930:2015 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
	L	Low
	I	Medium
	H	High
	V	Very high
	E	Extremely high
Organic	O	append to classification for organic material (eg CHO)

Remarks

Approved:

Miroslawa Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Summary of Classification Test Results

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Soil Description	Density		M/C	Atterberg				PD
		Reference	Top depth [m]	Base depth [m]	Type		bulk	dry		% Passing 425um	LL	PL	PI	
							Mg/m3	Mg/m3		%	%	%	%	%
712411	TP1	2	2.60	Not Given	B	Dark brown slightly gravelly slightly sandy clayey SILT			21	79	64	35	29	
712415	TP2	4	3.60	Not Given	B	Black slightly gravelly slightly sandy clayey SILT			44	78	68	38	30	
712417	TP3	3	1.70	Not Given	B	Brown slightly gravelly slightly sandy clayey SILT			60	89	85	43	42	
712419	TP4	2	0.60	Not Given	B	Yellowish brown slightly gravelly silty CLAY			22	69	72	28	44	
712420	TP2B	1	0.20	Not Given	D	Dark brown gravelly clayey SAND			30	57	48	NP*	NA*	
712421	TP2B	1	0.65	Not Given	B	Yellowish brown gravelly slightly sandy CLAY			19	86	52	19	33	
712422	TP2B	2	0.70	Not Given	B	Yellowish brown slightly sandy silty GRAVEL			11	50	54	19	35	
712423	TP3B	1	0.20	Not Given	D	Dark brown gravelly sandy CLAY			15	48	47	26	21	
712424	TP3B	1	1.50	Not Given	B	Brown slightly sandy silty GRAVEL			11	36	49	26	23	
712425	TP3B	2	2.70	Not Given	B	Brown slightly sandy clayey GRAVEL			12	48	50	25	25	

Comments: *Sample unsuitable for the test (PL)

Approved:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager (Geotechnical
Division)

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Summary of Classification Test Results

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Soil Description	Density		M/C	Atterberg				PD
		Reference	Top depth [m]	Base depth [m]	Type		bulk	dry		% Passing 425um	LL	PL	PI	
							Mg/m3	Mg/m3						
712426	TP4B	1	1.50	Not Given	B	Dark brown slightly sandy clayey GRAVEL			10	36	43	24	19	

Comments:

Approved:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager (Geotechnical
Division)

for and on behalf of i2 Analytical Ltd

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4041

TEST CERTIFICATE**Determination of Particle Size Distribution**

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712411

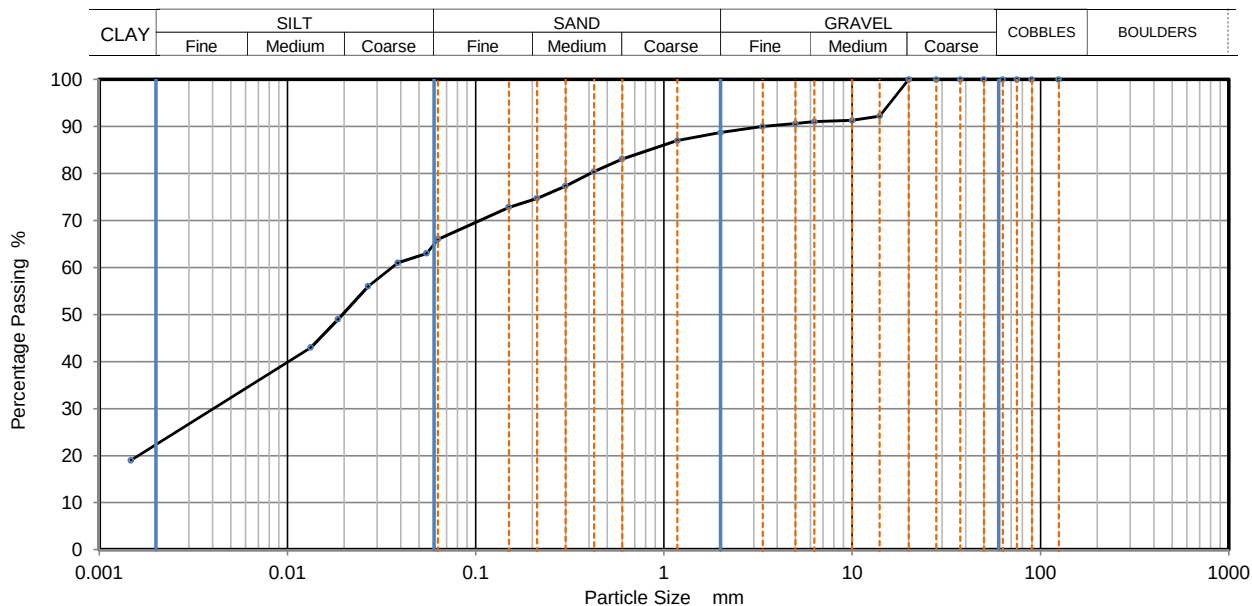
Sample Reference: 2

Sample description: Dark brown slightly gravelly slightly sandy clayey SILT

Sample Type: B

Location: TP1
Supplier: Not Given

Depth Top [m]: 2.6
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	66
90	100	0.0549	63
75	100	0.0386	61
63	100	0.0269	56
50	100	0.0186	49
37.5	100	0.0133	43
28	100	0.0015	19
20	100		
14	92		
10	91		
6.3	91		
5	91		
3.35	90		
2	89		
1.18	87		
0.6	83	Particle density (assumed) 2.65 Mg/m ³	
0.425	80		
0.3	77		
0.212	75		
0.15	73		
0.063	66		

Dry Mass of sample [g]: 195

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	11.30
Sand	22.70
Silt	43.50
Clay	22.50

Grading Analysis	
D100	mm 20
D60	mm 0.0365
D30	mm 0.00395
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Signed:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Particle Size Distribution

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377:Part 2:1990, clause 9.2

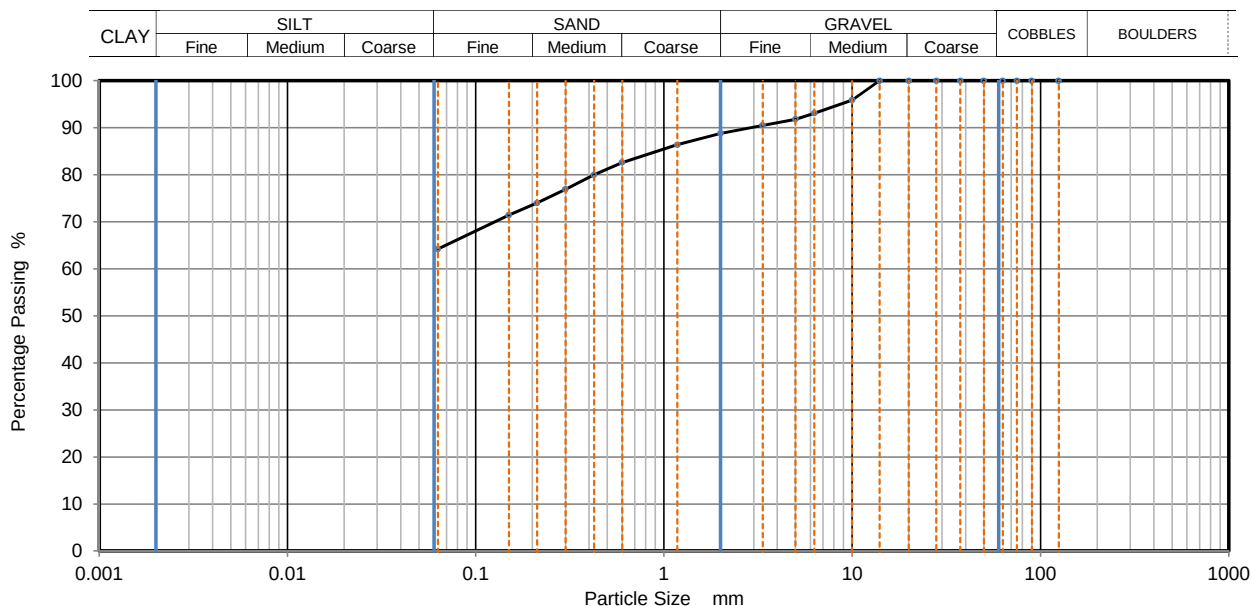
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 13/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712412
Sample description: Dark brown gravelly sandy CLAY
Location: TP2
Supplier: Not Given

Sample Reference: 3
Sample Type: D
Depth Top [m]: 2.5
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	96		
6.3	93		
5	92		
3.35	91		
2	89		
1.18	86		
0.6	83		
0.425	80		
0.3	77		
0.212	74		
0.15	71		
0.063	64		

Dry Mass of sample [g]: 205

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		11.20
Sand		24.60
Fines <0.063mm		64.20

Grading Analysis		
D100	mm	14
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 15/03/2017

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TEST CERTIFICATE

Determination of Particle Size Distribution

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377:Part 2:1990, clause 9.2

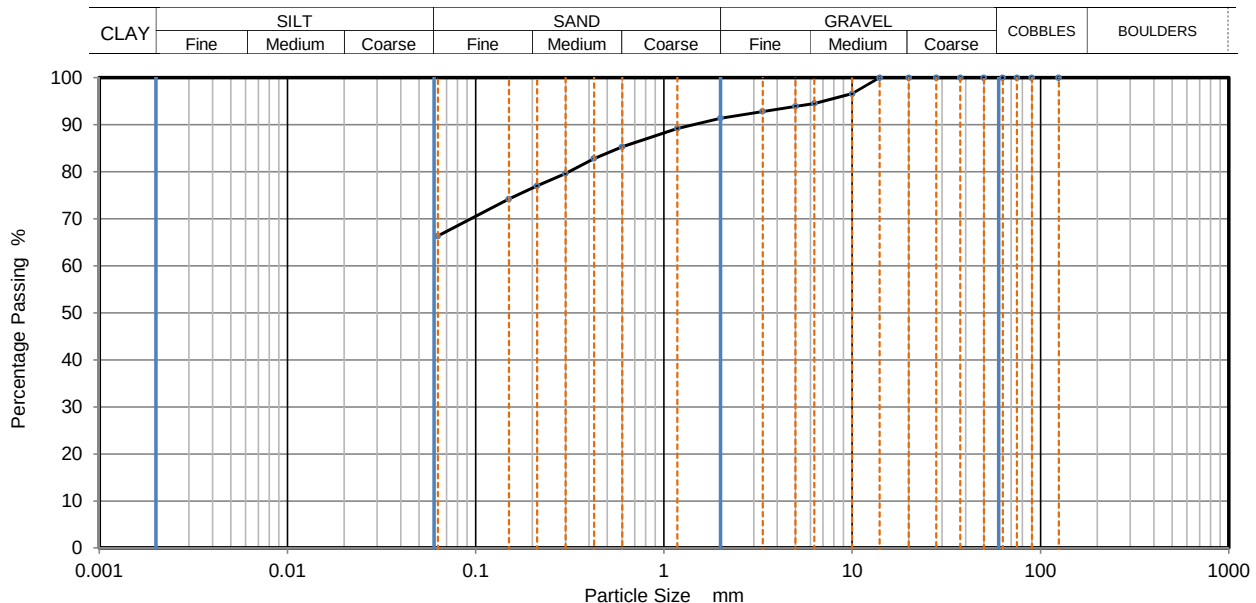
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 13/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712413
Sample description: Dark brown slightly gravelly sandy CLAY
Location: TP2
Supplier: Not Given

Sample Reference: 4
Sample Type: D
Depth Top [m]: 2.5
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	97		
6.3	95		
5	94		
3.35	93		
2	91		
1.18	89		
0.6	85		
0.425	83		
0.3	80		
0.212	77		
0.15	74		
0.063	66		

Dry Mass of sample [g]: 205

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		8.60
Sand		25.10
Fines <0.063mm		66.30

Grading Analysis		
D100	mm	14
D60	mm	
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

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TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



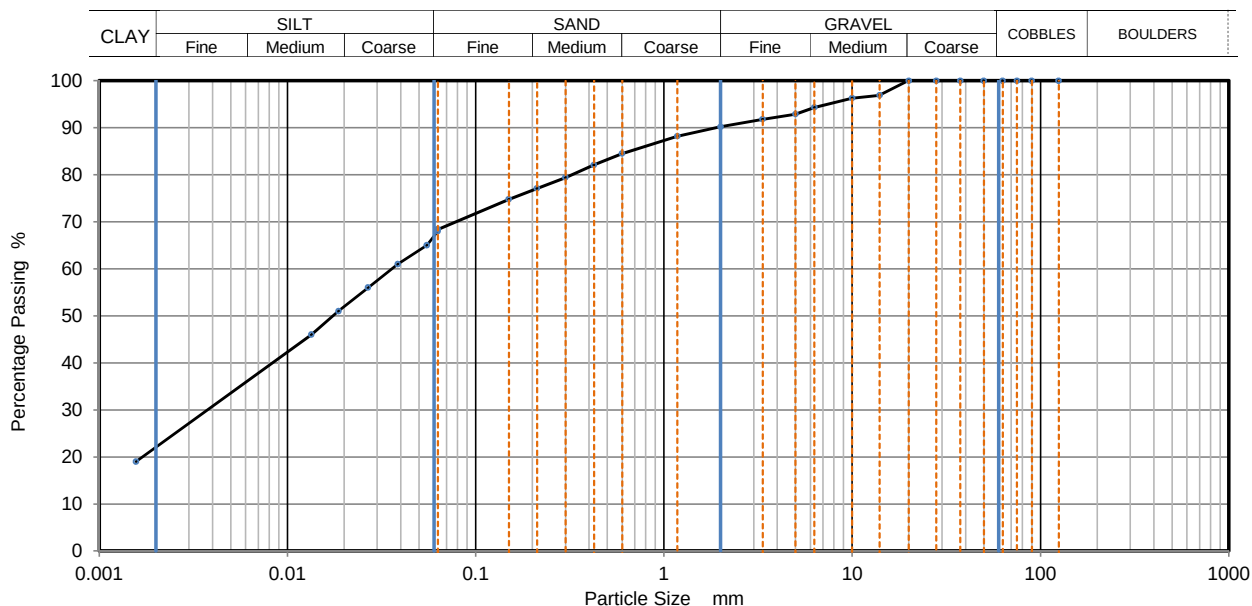
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712415
Sample description: Black slightly gravelly slightly sandy clayey SILT
Location: TP2
Supplier: Not Given

Sample Reference: 4
Sample Type: B
Depth Top [m]: 3.6
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	68
90	100	0.0552	65
75	100	0.0386	61
63	100	0.0269	56
50	100	0.0187	51
37.5	100	0.0134	46
28	100	0.0016	19
20	100		
14	97		
10	96		
6.3	94		
5	93		
3.35	92		
2	90		
1.18	88		
0.6	85	Particle density (assumed) 2.65 Mg/m ³	
0.425	82		
0.3	79		
0.212	77		
0.15	75		
0.063	68		

Dry Mass of sample [g]: 373

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		9.80
Sand		21.80
Silt		46.10
Clay		22.30

Grading Analysis		
D100	mm	20
D60	mm	0.0351
D30	mm	0.00376
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

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4041

TEST CERTIFICATE**Determination of Particle Size Distribution**

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712417

Sample Reference: 3

Sample description: Brown slightly gravelly slightly sandy clayey SILT

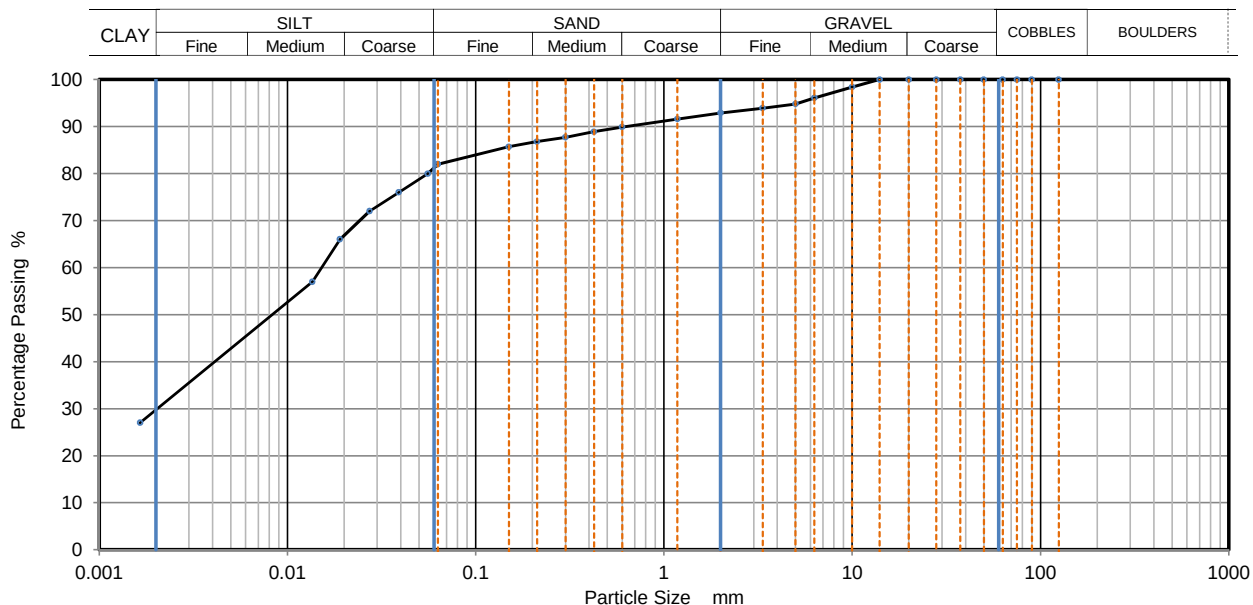
Sample Type: B

Location: TP3

Depth Top [m]: 1.7

Supplier: Not Given

Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	82
90	100	0.0557	80
75	100	0.0390	76
63	100	0.0273	72
50	100	0.0190	66
37.5	100	0.0136	57
28	100	0.0016	27
20	100		
14	100		
10	98		
6.3	96		
5	95		
3.35	94		
2	93		
1.18	92		
0.6	90	Particle density (assumed) 2.65 Mg/m ³	
0.425	89		
0.3	88		
0.212	87		
0.15	86		
0.063	82		

Dry Mass of sample [g]: 227

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	7.10
Sand	11.00
Silt	52.40
Clay	29.50

Grading Analysis	
D100	mm 14
D60	mm 0.0151
D30	mm 0.00207
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



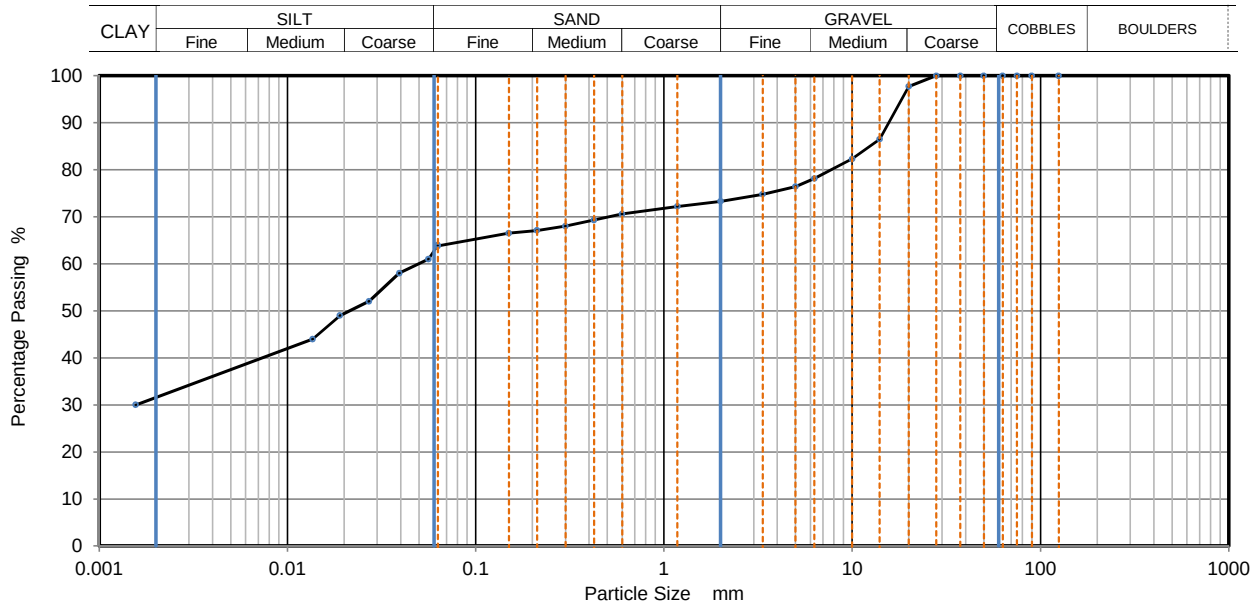
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712419
Sample description: Yellowish brown slightly gravelly silty CLAY
Location: TP4
Supplier: Not Given

Sample Reference: 2
Sample Type: B
Depth Top [m]: 0.6
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	64
90	100	0.0561	61
75	100	0.0393	58
63	100	0.0272	52
50	100	0.0190	49
37.5	100	0.0136	44
28	100	0.0016	30
20	98		
14	87		
10	82		
6.3	78		
5	76		
3.35	75		
2	73		
1.18	72		
0.6	71	Particle density (assumed) 2.65 Mg/m3	
0.425	69		
0.3	68		
0.212	67		
0.15	67		
0.063	64		

Dry Mass of sample [g]: 474

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		26.70
Sand		9.60
Silt		31.80
Clay		31.90

Grading Analysis		
D100	mm	28
D60	mm	0.0513
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



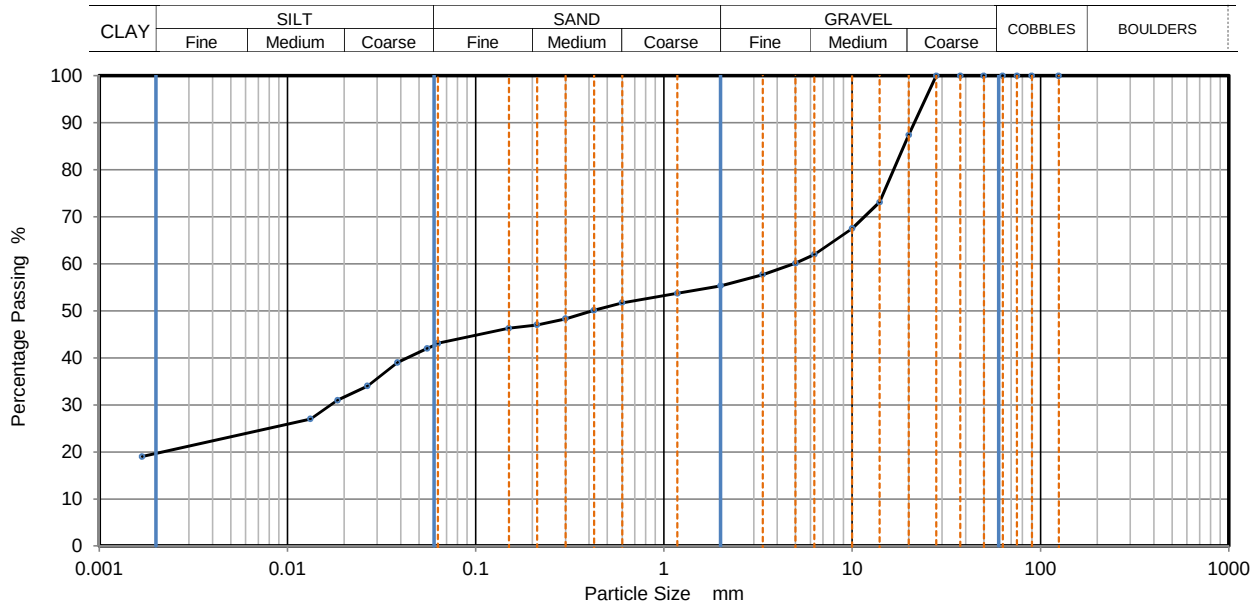
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712422
Sample description: Yellowish brown slightly sandy silty GRAVEL
Location: TP2B
Supplier: Not Given

Sample Reference: 2
Sample Type: B
Depth Top [m]: 0.7
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	43
90	100	0.0553	42
75	100	0.0384	39
63	100	0.0266	34
50	100	0.0185	31
37.5	100	0.0132	27
28	100	0.0017	19
20	87		
14	73		
10	68		
6.3	62		
5	60		
3.35	58		
2	55		
1.18	54		
0.6	52	Particle density (assumed) 2.65 Mg/m3	
0.425	50		
0.3	48		
0.212	47		
0.15	46		
0.063	43		

Dry Mass of sample [g]: 513

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		44.70
Sand		12.10
Silt		23.30
Clay		19.90

Grading Analysis		
D100	mm	28
D60	mm	4.93
D30	mm	0.0174
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 14/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



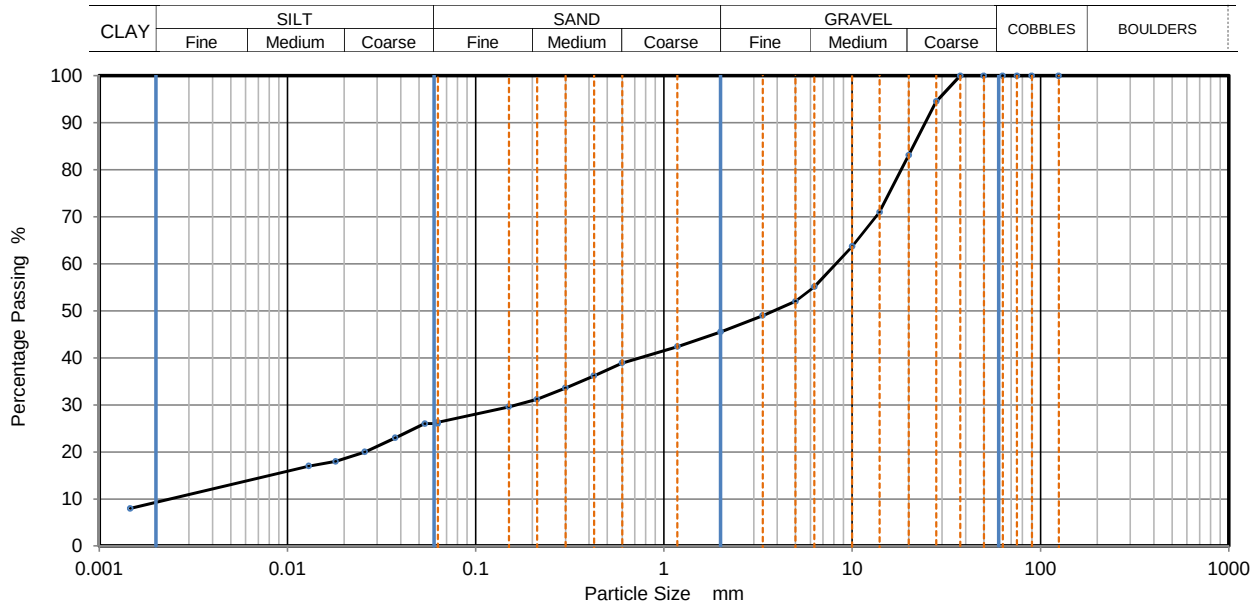
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712424
Sample description: Brown slightly sandy silty GRAVEL
Location: TP3B
Supplier: Not Given

Sample Reference: 1
Sample Type: B
Depth Top [m]: 1.5
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	26
90	100	0.0537	26
75	100	0.0374	23
63	100	0.0258	20
50	100	0.0180	18
37.5	100	0.0130	17
28	95	0.0015	8
20	83		
14	71		
10	64		
6.3	55		
5	52		
3.35	49		
2	46		
1.18	42		
0.6	39	Particle density (assumed) 2.65 Mg/m ³	
0.425	36		
0.3	34		
0.212	31		
0.15	30		
0.063	26		

Dry Mass of sample [g]: 549

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		54.50
Sand		19.10
Silt		17.20
Clay		9.20

Grading Analysis		
D100	mm	37.5
D60	mm	8.21
D30	mm	0.164
D10	mm	0.00243
Uniformity Coefficient		3400
Curvature Coefficient		1.3

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 14/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



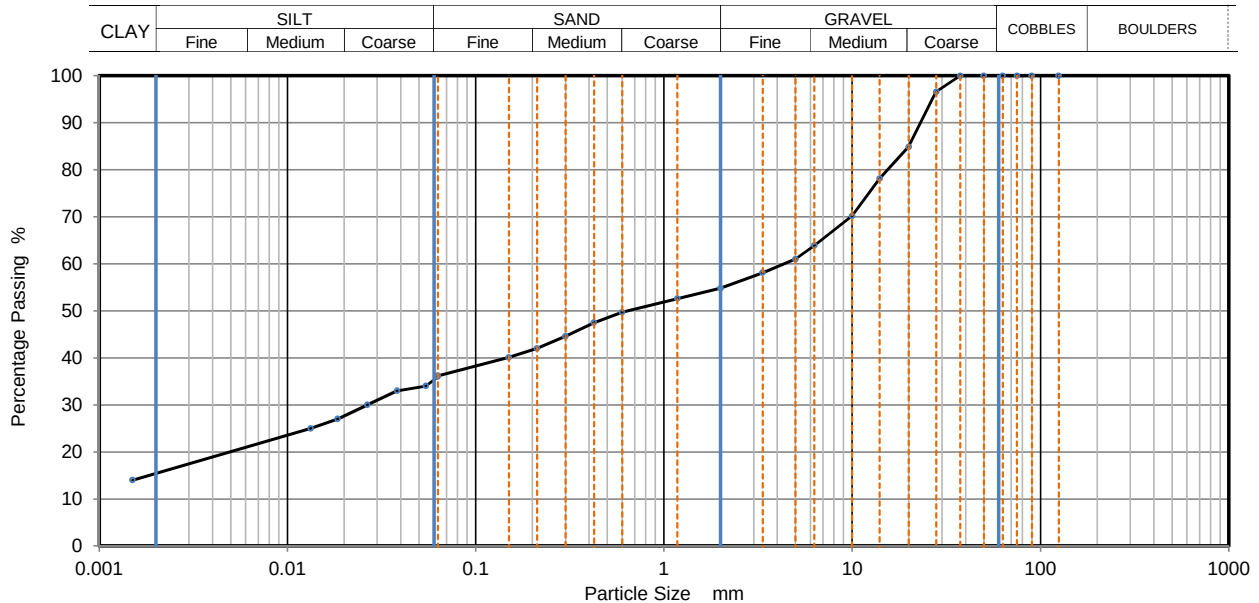
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712425
Sample description: Brown slightly sandy clayey GRAVEL
Location: TP3B
Supplier: Not Given

Sample Reference: 2
Sample Type: B
Depth Top [m]: 2.7
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	36
90	100	0.0544	34
75	100	0.0382	33
63	100	0.0266	30
50	100	0.0185	27
37.5	100	0.0133	25
28	97	0.0015	14
20	85		
14	78		
10	70		
6.3	64		
5	61		
3.35	58		
2	55		
1.18	53		
0.6	50	Particle density (assumed) 2.65 Mg/m ³	
0.425	48		
0.3	45		
0.212	42		
0.15	40		
0.063	36		

Dry Mass of sample [g]: 2836

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		45.20
Sand		18.60
Silt		20.70
Clay		15.50

Grading Analysis		
D100	mm	37.5
D60	mm	4.35
D30	mm	0.026
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



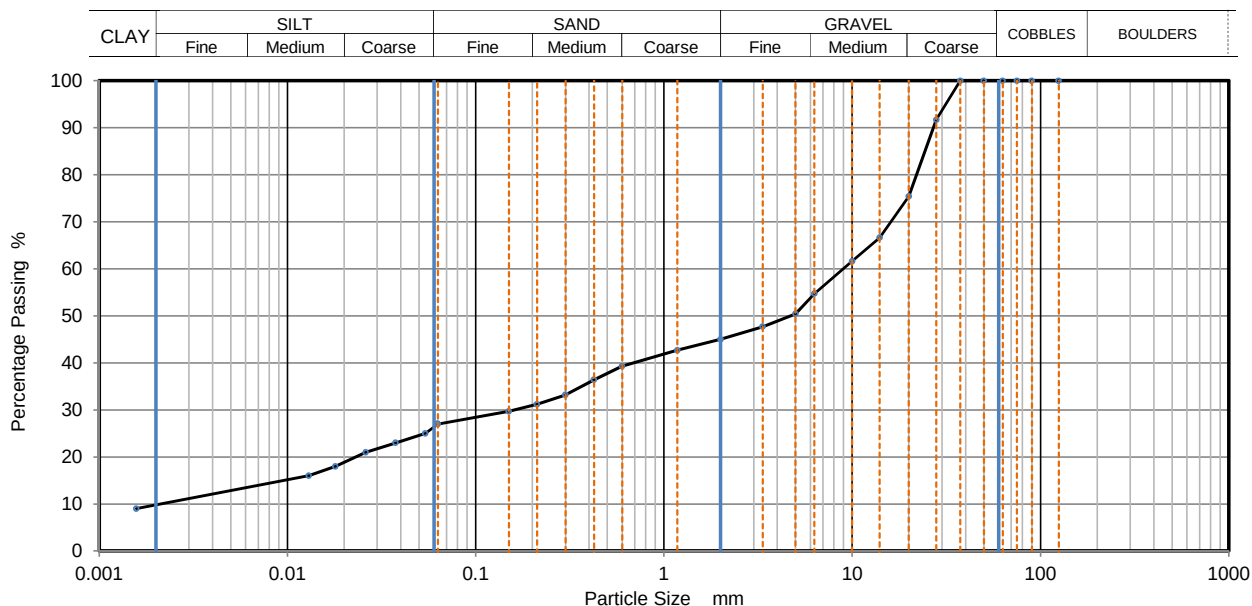
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712426
Sample description: Dark brown slightly sandy clayey GRAVEL
Location: TP4B
Supplier: Not Given

Sample Reference: 1
Sample Type: B
Depth Top [m]: 1.5
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	27
90	100	0.0541	25
75	100	0.0376	23
63	100	0.0261	21
50	100	0.0180	18
37.5	100	0.0130	16
28	92	0.0016	9
20	75		
14	67		
10	62		
6.3	55		
5	50		
3.35	48		
2	45		
1.18	43		
0.6	39	Particle density (assumed) 2.65 Mg/m ³	
0.425	36		
0.3	33		
0.212	31		
0.15	30		
0.063	27		

Dry Mass of sample [g]: 2583

Sample Proportions		% dry mass
Very coarse		0.00
Gravel		55.00
Sand		18.00
Silt		17.00
Clay		10.00

Grading Analysis		
D100	mm	37.5
D60	mm	9
D30	mm	0.162
D10	mm	0.00198
Uniformity Coefficient		4600
Curvature Coefficient		1.5

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 14/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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4041

TEST CERTIFICATE**Dry Density / Moisture Content Relationship
Light Compaction**

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in accordance with BS 1377-4:1990: Clause 3.3 using 2.5kg[light] Rammer

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW

Client Reference: CGN/3732D

Job Number: 17-41710

Date Sampled: 24/02/2017

Date Received: 28/02/2017

Date Tested: 10/03/2017

Sampled By: Not Given

Contact: Owen Flowers

Site Name: Southall

Site Address: Not Given

TEST RESULTS

Laboratory Reference: 712410

Hole No.: TP1

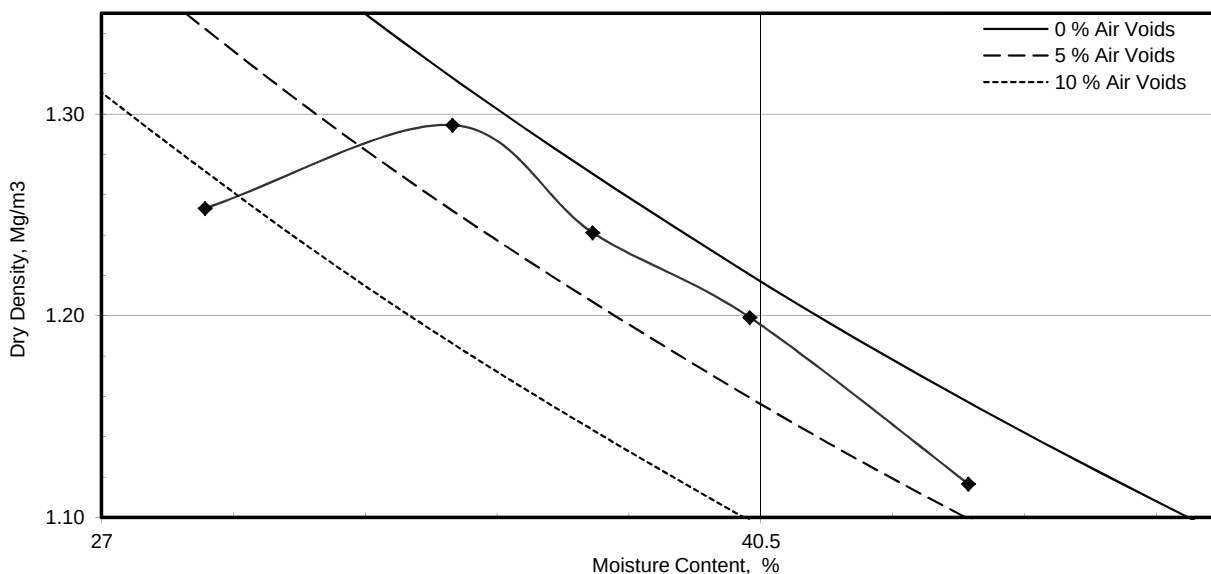
Sample Reference: 1

Sample Description: Dark brown slightly gravelly clayey SAND

Depth Top [m]: 2.6

Depth Base [m]: Not Given

Sample Type: B



Preparation		Material used was natural
Mould Type		1 Litre
Samples Used		Composite specimens tested
Material Retained on 37.5 mm Sieve	%	0
Material Retained on 20.0 mm Sieve	%	2
Particle Density - Assumed	Mg/m³	2.40
As received Moisture Content	%	37
Maximum Dry Density	Mg/m³	1.29
Optimum Moisture Content	%	34

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE**Dry Density / Moisture Content Relationship
Light Compaction**

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Environmental Science

Tested in accordance with BS 1377-4:1990: Clause 3.3 using 2.5kg[light] Rammer

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW

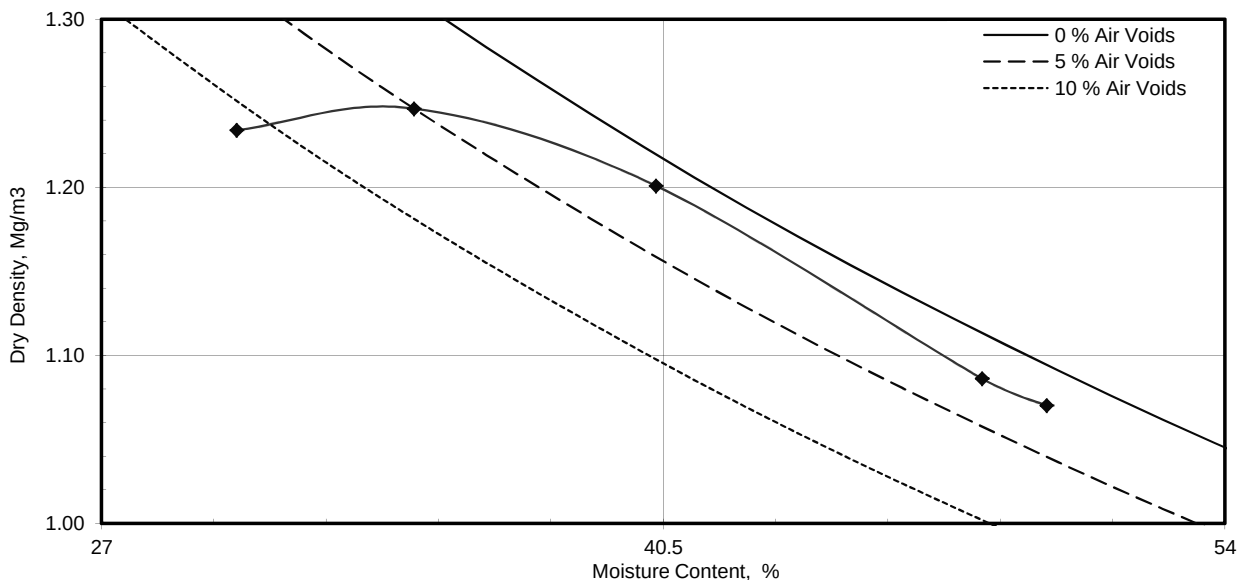
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712414
Hole No.: TP2
Sample Reference: 3
Sample Description: Brown gravelly slightly sandy CLAY

Depth Top [m]: 3.6
Depth Base [m]: Not Given
Sample Type: B



Preparation	Material used was natural	
Mould Type	1 Litre	
Samples Used	Composite specimens tested	
Material Retained on 37.5 mm Sieve	%	0
Material Retained on 20.0 mm Sieve	%	5
Particle Density - Assumed	Mg/m³	2.40
As received Moisture Content	%	48
Maximum Dry Density	Mg/m³	1.25
Optimum Moisture Content	%	35

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE**Dry Density / Moisture Content Relationship
Light Compaction**

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in accordance with BS 1377-4:1990: Clause 3.3 using 2.5kg[light] Rammer

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW

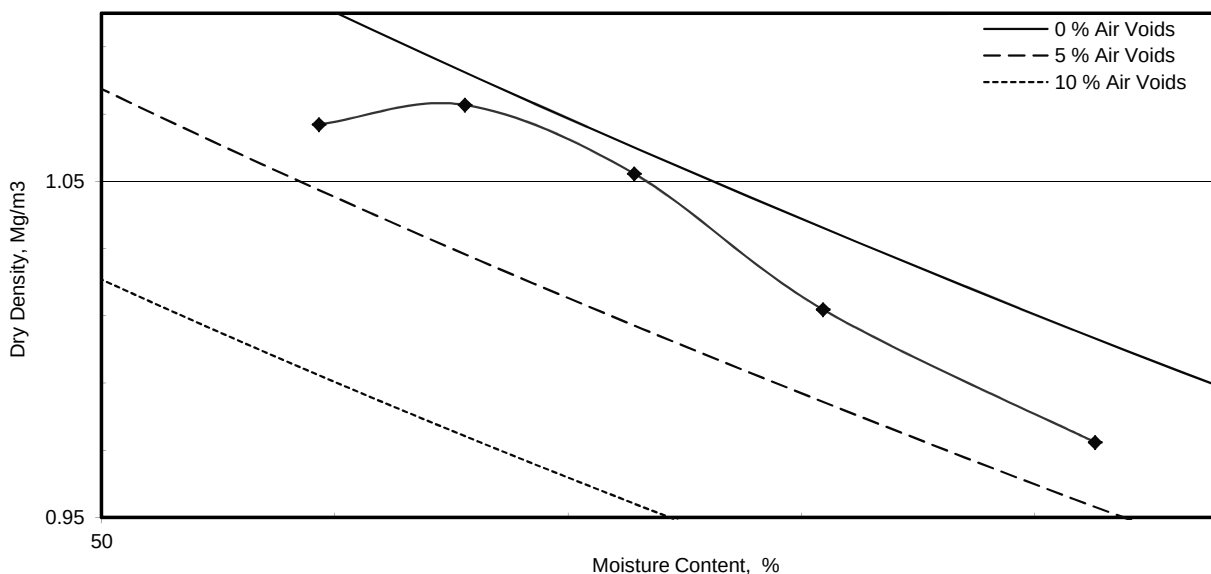
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712416
Hole No.: TP3
Sample Reference: 2
Sample Description: Brown slightly gravelly slightly sandy CLAY

Depth Top [m]: 1.5
Depth Base [m]: Not Given
Sample Type: B



Preparation		Material used was natural
Mould Type		1 Litre
Samples Used		Composite specimens tested
Material Retained on 37.5 mm Sieve	%	0
Material Retained on 20.0 mm Sieve	%	0
Particle Density - Assumed	Mg/m ³	2.62
As received Moisture Content	%	61
Maximum Dry Density	Mg/m³	1.07
Optimum Moisture Content	%	54

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE**Dry Density / Moisture Content Relationship**
Light Compactioni2 Analytical Ltd
7 Woodshots Meadow
Croxtley Green Business Park
Watford Herts WD18 8YS

Tested in accordance with BS 1377-4:1990: Clause 3.3 using 2.5kg[light] Rammer

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW

Client Reference: CGN/3732D

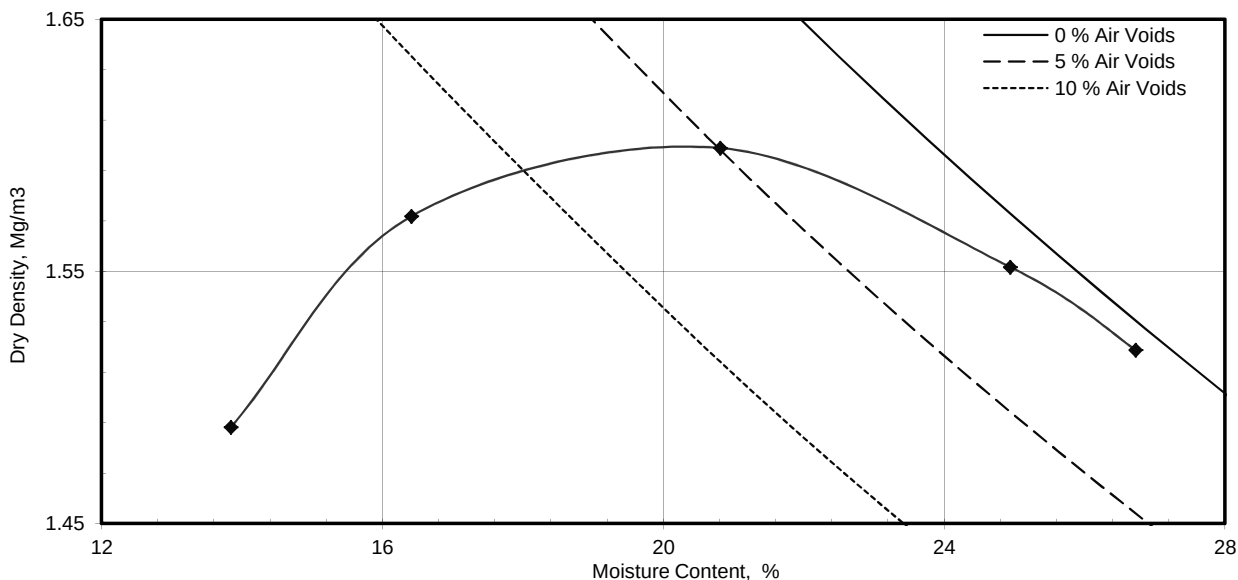
Job Number: 17-41710

Date Sampled: 24/02/2017

Date Received: 28/02/2017

Date Tested: 10/03/2017

Sampled By: Not Given

Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given**TEST RESULTS**Laboratory Reference: 712418
Hole No.: TP4
Sample Reference: 1
Sample Description: Brown gravelly slightly sandy CLAYDepth Top [m]: 0.4
Depth Base [m]: Not Given
Sample Type: B

Preparation		Material used was natural
Mould Type		1 Litre
Samples Used		Composite specimens tested
Material Retained on 37.5 mm Sieve	%	6
Material Retained on 20.0 mm Sieve	%	7
Particle Density - Assumed	Mg/m³	2.59
As received Moisture Content	%	27
Maximum Dry Density	Mg/m³	1.60
Optimum Moisture Content	%	21

Remarks

Insufficient material - compacted in proctor mould

Approved:

Signed:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical SectionSushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE**Dry Density / Moisture Content Relationship
Light Compaction**

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Environmental Science

Tested in accordance with BS 1377-4:1990: Clause 3.3 using 2.5kg[light] Rammer

Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW

Client Reference: CGN/3732D

Job Number: 17-41710

Date Sampled: 24/02/2017

Date Received: 28/02/2017

Date Tested: 10/03/2017

Sampled By: Not Given

Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

TEST RESULTS

Laboratory Reference: 712424

Hole No.: TP3B

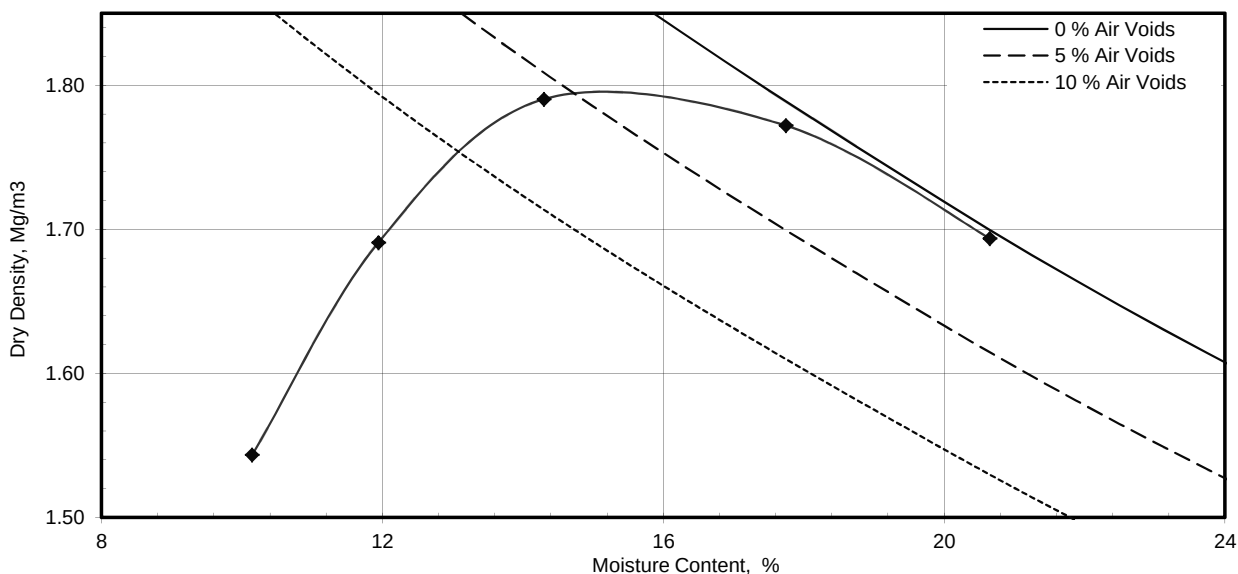
Sample Reference: 1

Sample Description: Brown slightly sandy silty GRAVEL

Depth Top [m]: 1.5

Depth Base [m]: Not Given

Sample Type: B



Preparation		Material used was natural
Mould Type		1 Litre
Samples Used		Composite specimens tested
Material Retained on 37.5 mm Sieve	%	3
Material Retained on 20.0 mm Sieve	%	11
Particle Density - Assumed	Mg/m³	2.62
As received Moisture Content	%	14
Maximum Dry Density	Mg/m³	1.80
Optimum Moisture Content	%	15

Remarks

Insufficient material - compacted in proctor mould

Approved:

Signed:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 14/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Moisture Condition Value

Tested in Accordance with BS 1377-4: 1990: Clause 5.4

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Lab Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 13/03/2017
Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Soil Description	Retained on 20mm sieve %	Moisture Content <20mm %	Moisture Condition Value	Method of Interpretation	Remarks
		Reference	Depth Top [m]	Depth Base [m]	Type						
712410	TP1	1.00	2.6	Not Given	B	Dark brown slightly gravelly clayey SAND	2	37	11.6	Steepest straight line	
712414	TP2	3.00	3.6	Not Given	B	Brown gravelly slightly sandy CLAY	5	48	8.2	Steepest straight line	
712416	TP3	2.00	1.5	Not Given	B	Brown slightly gravelly slightly sandy CLAY	0	62	6.7	Steepest straight line	
712418	TP4	1.00	0.4	Not Given	B	Brown gravelly slightly sandy CLAY	13	27	10.1	Steepest straight line	
712424	TP3B	1.00	1.5	Not Given	B	Brown slightly sandy silty GRAVEL	14	14	8.7	Steepest straight line	
712425	TP3B	2.00	2.7	Not Given	B	Brown slightly sandy clayey GRAVEL	18	11	13.6	Steepest straight line	
712426	TP4B	1.00	1.5	Not Given	B	Dark brown slightly sandy clayey GRAVEL	19	12	8.5	Steepest straight line	

Comments:

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 15/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Dry Density/ Moisture Content Relationship Vibrating Hammer Compaction

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in accordance with BS 1377-4: 1990: Clause 3.7 using Vibrating Hammer

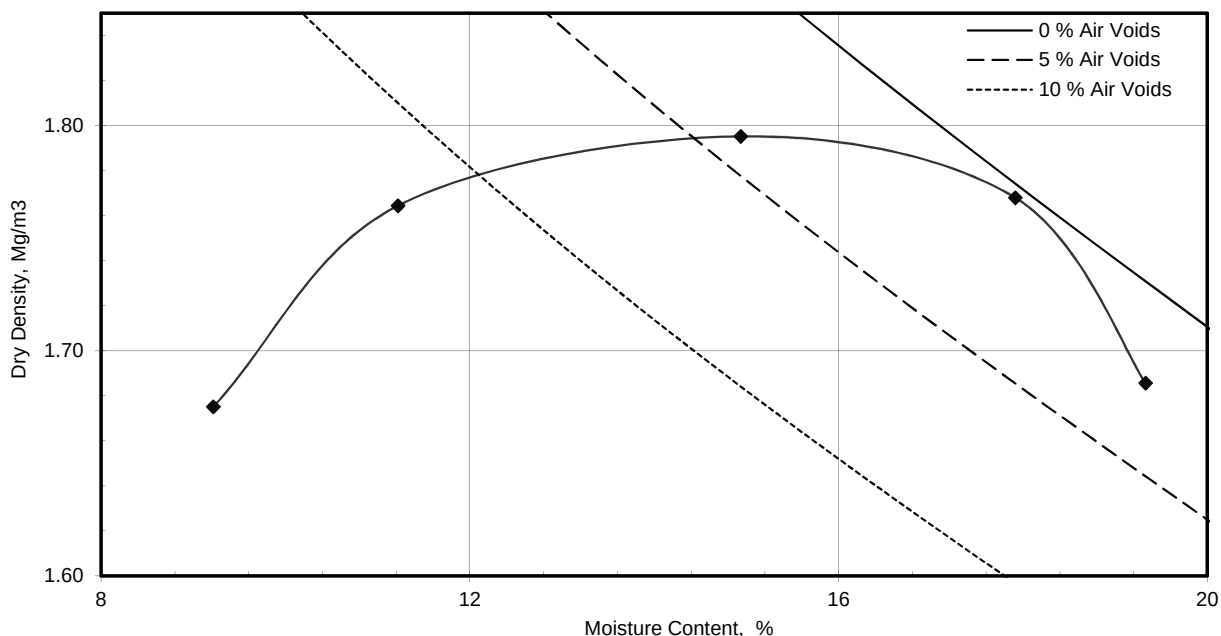
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712425
Hole No.: TP3B
Sample Reference: 2
Sample Description: Brown slightly sandy clayey GRAVEL

Depth Top [m]: 2.7
Depth Base [m]: Not Given
Sample Type: B



Preparation		Material used was natural
Mould Type		CBR
Samples Used		Composite specimens tested
Material Retained on 37.5 mm Sieve	%	4
Material Retained on 20.0 mm Sieve	%	14
Particle Density - Assumed	Mg/m³	2.60
As received Moisture Content	%	11
Maximum Dry Density	Mg/m³	1.80

Optimum Moisture Content	%	15
--------------------------	---	----

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 15/03/2017

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Dry Density/ Moisture Content Relationship Vibrating Hammer Compaction

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in accordance with BS 1377-4: 1990: Clause 3.7 using Vibrating Hammer

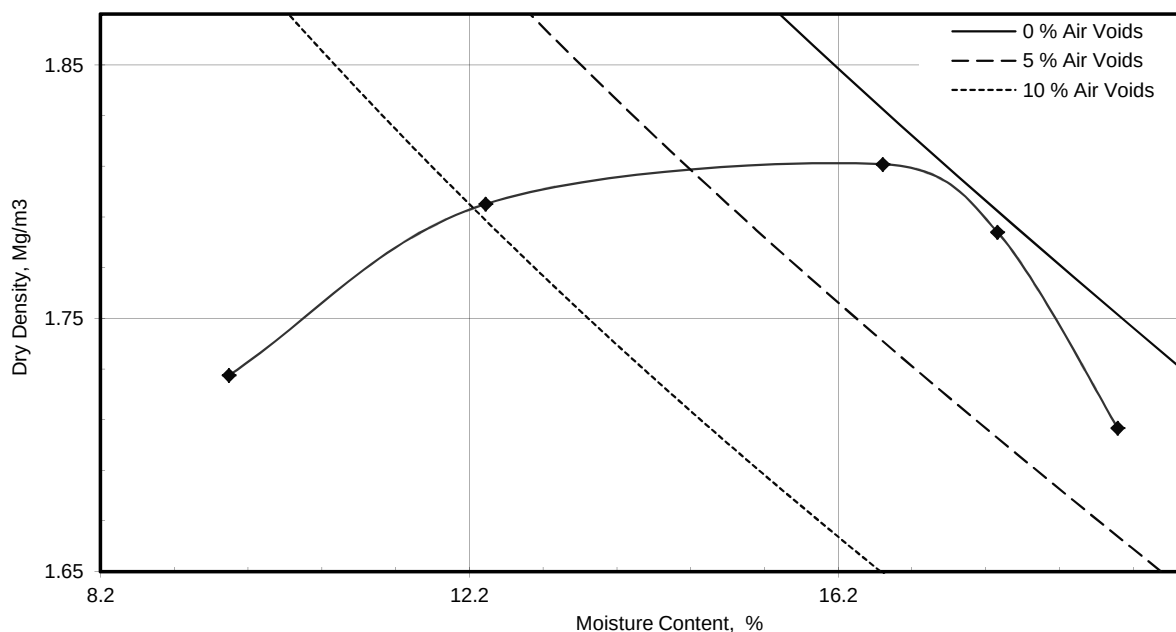
Client: Card Geotechnics Ltd
Client Address: 4 Godalming Business Centre
Woolsack Way
Godalming
Surrey GU7 1XW
Contact: Owen Flowers
Site Name: Southall
Site Address: Not Given

Client Reference: CGN/3732D
Job Number: 17-41710
Date Sampled: 24/02/2017
Date Received: 28/02/2017
Date Tested: 10/03/2017
Sampled By: Not Given

TEST RESULTS

Laboratory Reference: 712426
Hole No.: TP4B
Sample Reference: 1
Sample Description: Dark brown slightly sandy clayey GRAVEL

Depth Top [m]: 1.5
Depth Base [m]: Not Given
Sample Type: B



Preparation		Material used was natural
Mould Type		CBR
Samples Used		Composite specimens tested
Material Retained on 37.5 mm Sieve	%	4
Material Retained on 20.0 mm Sieve	%	16
Particle Density - Assumed	Mg/m ³	2.64
As received Moisture Content	%	12
Maximum Dry Density	Mg/m ³	1.81

Optimum Moisture Content	%	17
--------------------------	---	----

Remarks

Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

Date Reported: 15/03/2017

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Moisture Condition Value / Moisture Content Relationship

Job Ref 17-41710

Borehole/Pit No. TP2

Environmental Science

Site Name	Southall			Sample No.	4
Soil Description	Black slightly gravelly slightly sandy clayey SILT			Depth	3.6
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description				KeyLAB ID	712415
Test Method	BS1377:Part4:1990:clause 5.5			Date started	13/03/2017

Sample preparation

Amount of material larger than 20mm sieve removed	0	%
Natural Moisture Content of sample	43.6	%
Initial Moisture Content of test sample below 20mm	43.6	%
Composite of fresh and reused material tested		

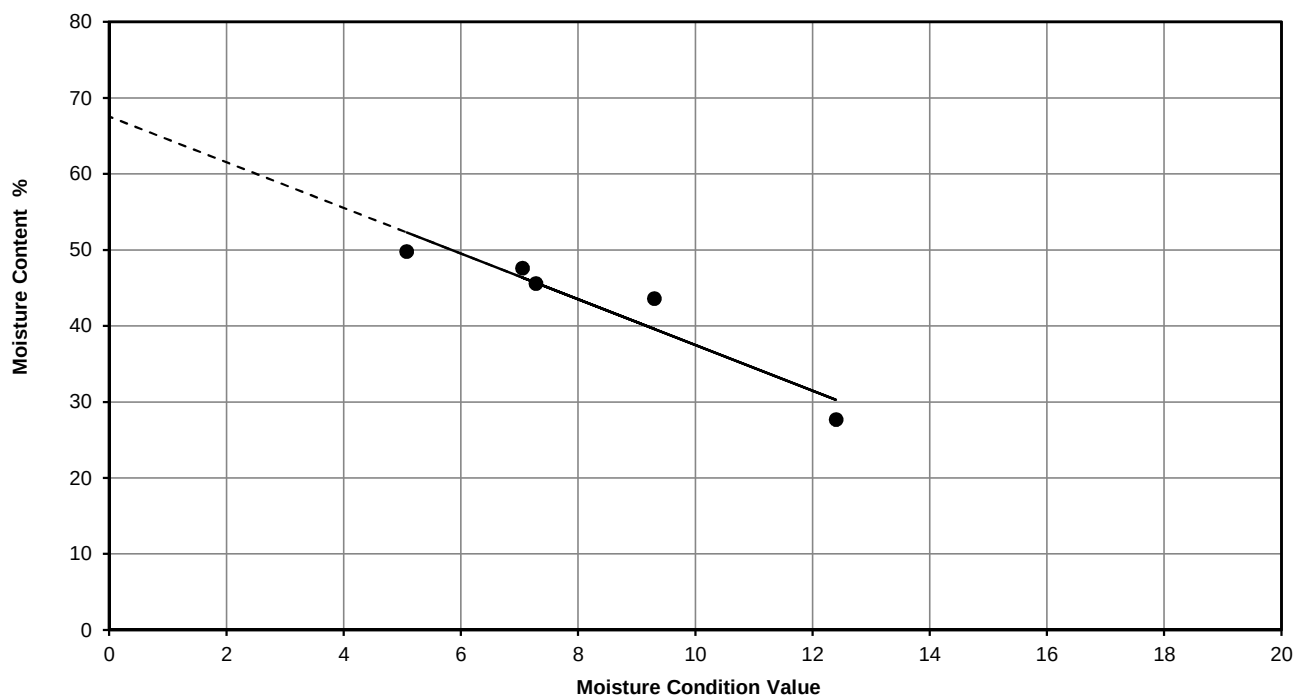
General remarks

Table of results

MCV Test Number
Moisture Content, %
Moisture Condition Value
MCV report
Effective / Valid data point
Specimen remarks

1	2	3	4	5
27.7	43.6	45.6	47.6	49.8
12.4	9.3	7.3	7.0	5.1
12.4	9.3	7.3	7	5.1
YES	YES	YES	YES	YES

● valid points × invalid points - - - - - extended regression — linear regression



Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

for and on behalf of i2 Analytical Ltd

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Moisture Condition Value / Moisture Content Relationship

Job Ref 17-41710

Borehole/Pit No. TP3

Site Name	Southall			Sample No.	3
Soil Description	Brown slightly gravelly slightly sandy clayey SILT			Depth	1.7
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description				KeyLAB ID	712417
Test Method	BS1377:Part4:1990:clause 5.5			Date started	13/03/2017

Sample preparation

Amount of material larger than 20mm sieve removed	0	%
Natural Moisture Content of sample	60.4	%
Initial Moisture Content of test sample below 20mm	60.4	%
Composite of fresh and reused material tested		

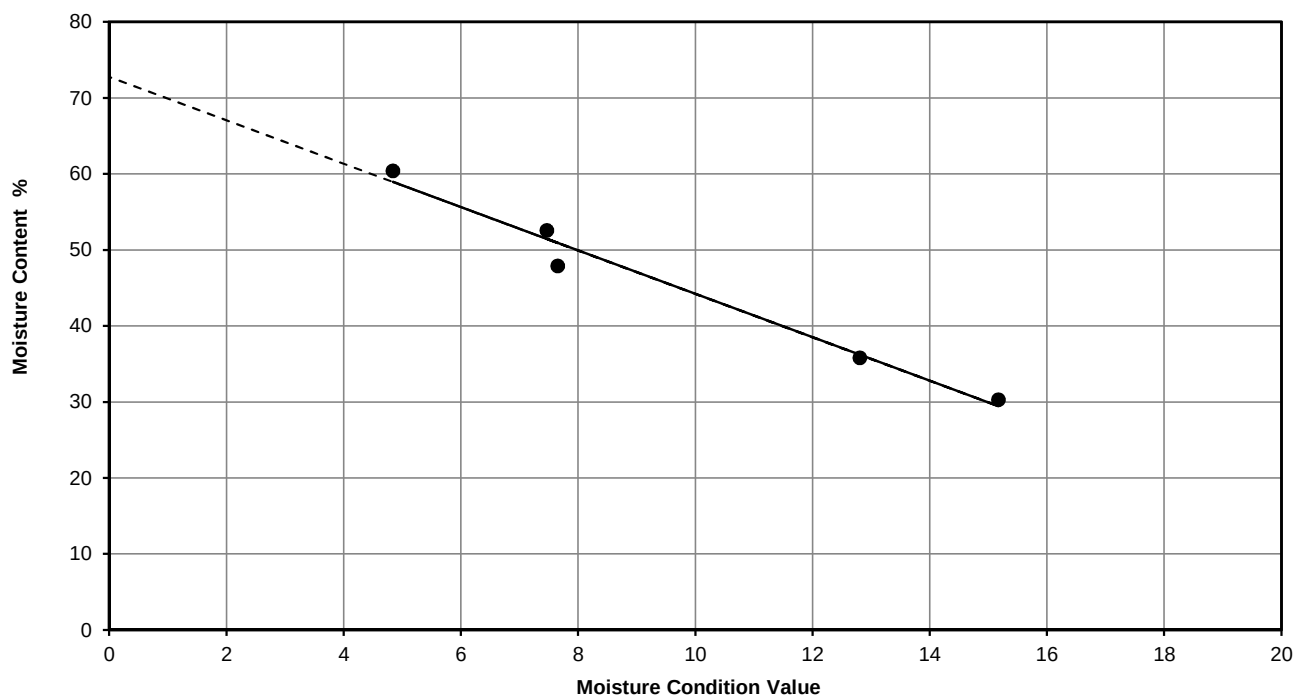
General remarks

Table of results

MCV Test Number
Moisture Content, %
Moisture Condition Value
MCV report
Effective / Valid data point
Specimen remarks

1	2	3	4	5
30.3	35.8	47.9	52.6	60.4
15.2	12.8	7.7	7.5	4.8
15.2	12.8	7.7	7.5	4.8
YES	YES	YES	YES	YES

● valid points × invalid points - - - - - extended regression — linear regression



Approved:

Mirosława Pytlik
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

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Moisture Condition Value / Moisture Content Relationship

Job Ref 17-41710

Borehole/Pit No. TP3B

Site Name	Southall			Sample No.	1
Soil Description	Brown slightly sandy silty GRAVEL			Depth	1.5
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description				KeyLAB ID	712424
Test Method	BS1377:Part4:1990:clause 5.5			Date started	13/03/2017

Sample preparation

Amount of material larger than 20mm sieve removed	14	%
Natural Moisture Content of sample	N/A	%
Initial Moisture Content of test sample below 20mm	14.3	%
Composite of fresh and reused material tested		

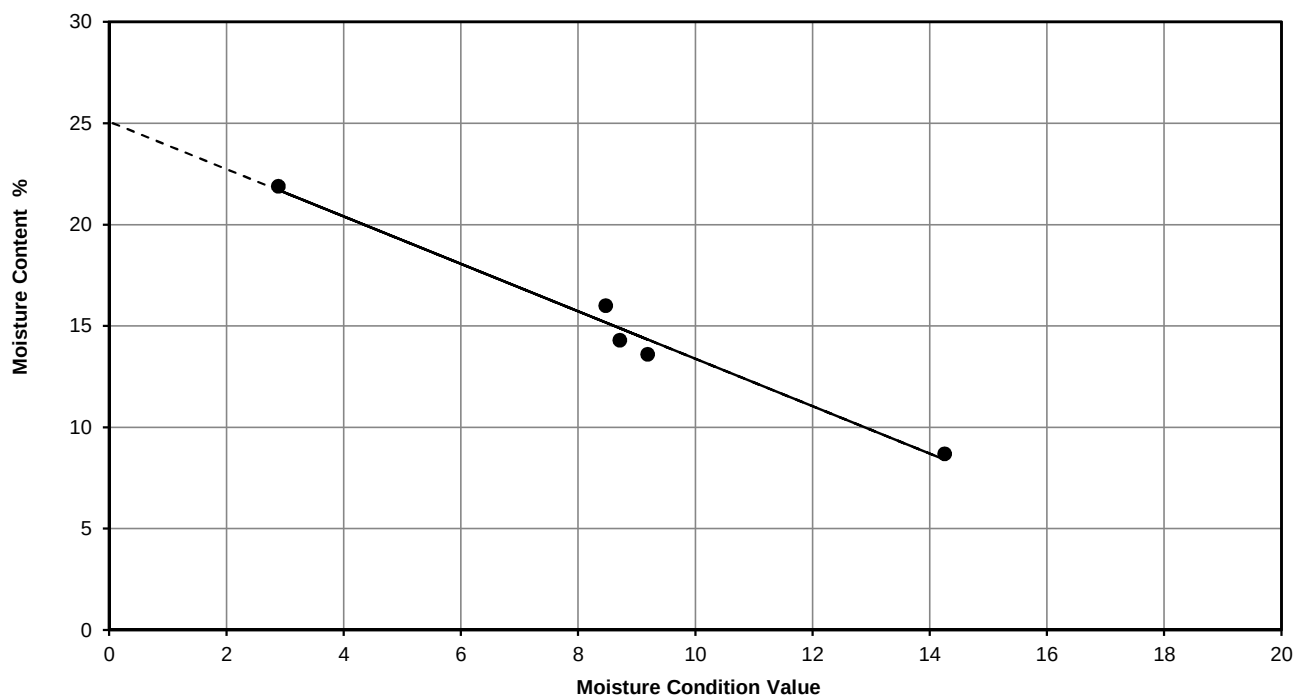
General remarks

Table of results

MCV Test Number
Moisture Content, %
Moisture Condition Value
MCV report
Effective / Valid data point
Specimen remarks

1	2	3	4	5
8.7	13.6	14.3	16.0	21.9
14.3	9.2	8.7	8.5	2.9
14.3	9.2	8.7	8.5	2.9
YES	YES	YES	YES	YES

● valid points × invalid points - - - - - extended regression — linear regression



Approved:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
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Moisture Condition Value / Moisture Content Relationship

Job Ref 17-41710

Borehole/Pit No. TP4

Environmental Science

Site Name	Southall			Sample No.	2
Soil Description	Yellowish brown slightly gravelly silty CLAY			Depth	0.6
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description				KeyLAB ID	712419
Test Method	BS1377:Part4:1990:clause 5.5			Date started	13/03/2017

Sample preparation

Amount of material larger than 20mm sieve removed	6	%
Natural Moisture Content of sample	N/A	%
Initial Moisture Content of test sample below 20mm	23.6	%
Composite of fresh and reused material tested		

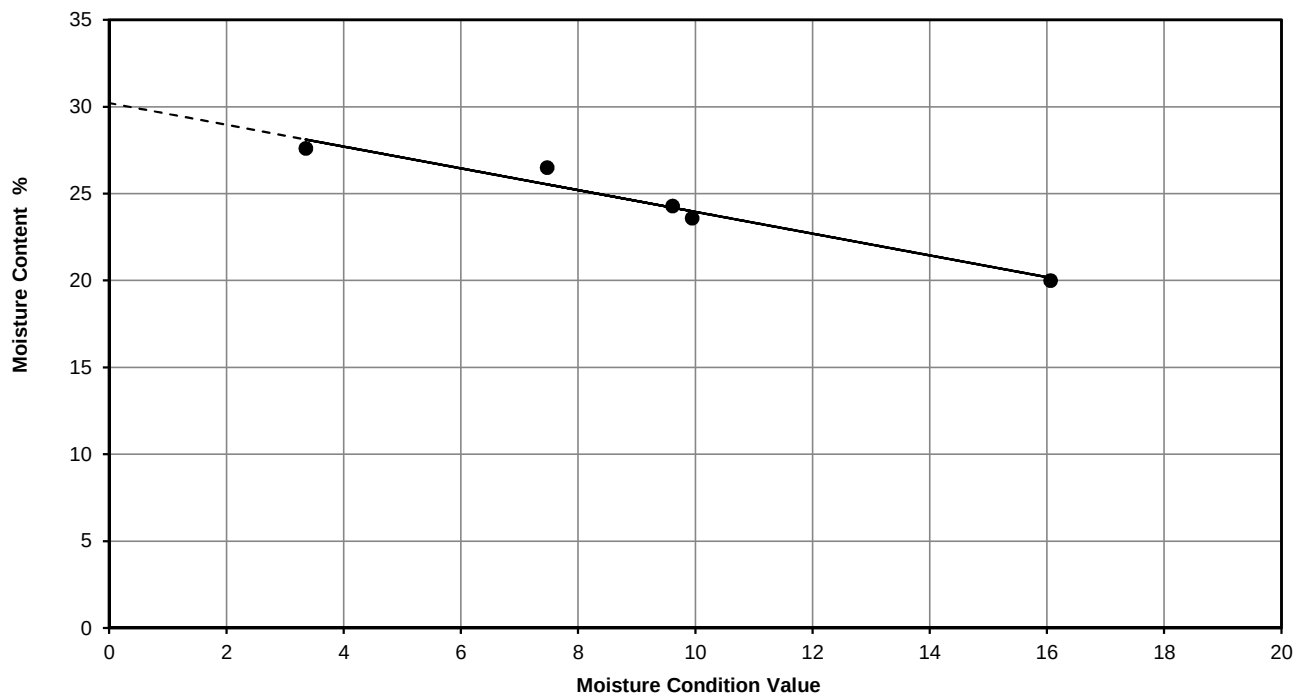
General remarks

Table of results

MCV Test Number
Moisture Content, %
Moisture Condition Value
MCV report
Effective / Valid data point
Specimen remarks

1	2	3	4	5
20.0	23.6	24.3	26.5	27.6
16.1	9.9	9.6	7.5	3.4
16.1	9.9	9.6	7.5	3.4
YES	YES	YES	YES	YES

● valid points × invalid points - - - - - extended regression — linear regression



Approved:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

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Sushil Sharda
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Moisture Condition Value / Moisture Content Relationship

Job Ref 17-41710

Borehole/Pit No. TP1

Site Name	Southall			Sample No.	1
Soil Description	Dark brown slightly gravelly clayey SAND			Depth	2.6
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description				KeyLAB ID	712410
Test Method	BS1377:Part4:1990:clause 5.5			Date started	13/03/2017

Sample preparation

Amount of material larger than 20mm sieve removed	2	%
Natural Moisture Content of sample	N/A	%
Initial Moisture Content of test sample below 20mm	37.1	%
Composite of fresh and reused material tested		

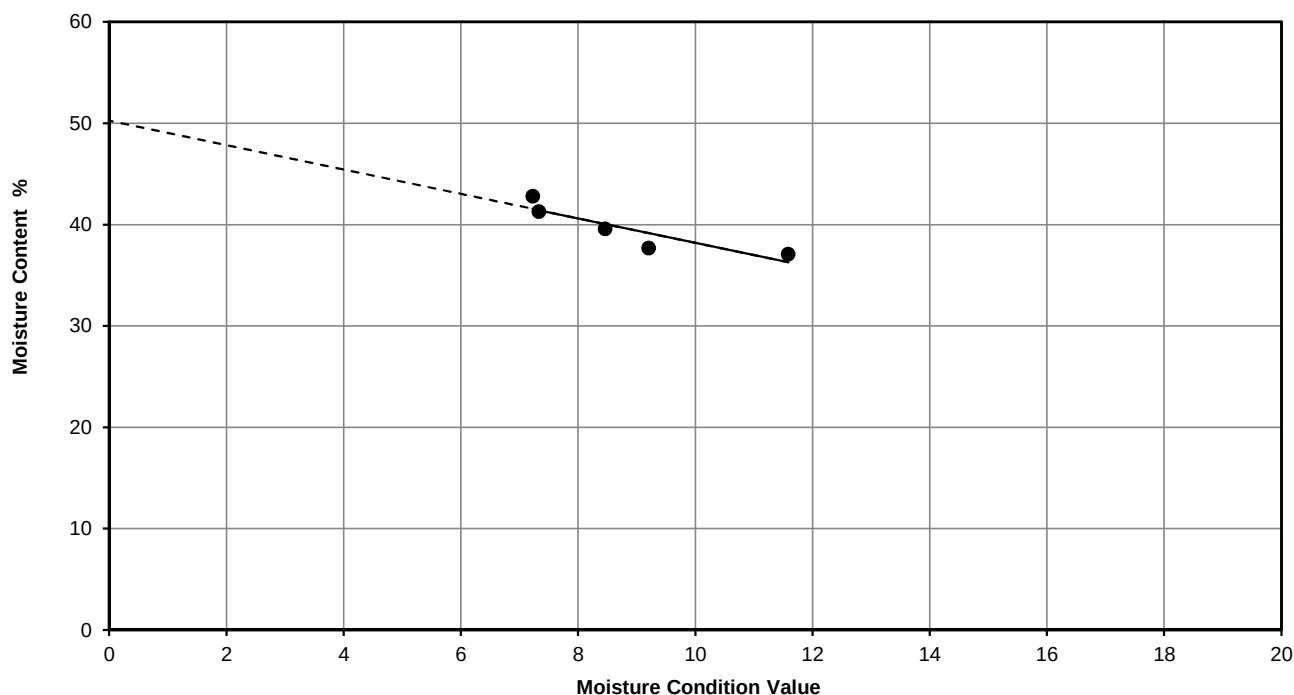
General remarks

Table of results

MCV Test Number
Moisture Content, %
Moisture Condition Value
MCV report
Effective / Valid data point
Specimen remarks

1	2	3	4	5
37.1	37.7	39.6	41.3	42.8
11.6	9.2	8.5	7.3	7.2
11.6	9.2	8.5	7.3	7.2
YES	YES	YES	YES	YES

● valid points × invalid points - - - - - extended regression — linear regression



Approved:

Mirosława Pytlík
PL Snr Quality Specialist
Geotechnical Section

Date Reported: 15/03/2017

Signed:

Sushil Sharda
Technical Manager
(Geotechnical Division)

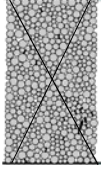
for and on behalf of i2 Analytical Ltd

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Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	2.60		
	Description	Dark brown slightly gravelly slightly sandy clayey SILT		
	Type	B		
	Initial Sample Length	L ₀	(mm)	70.6
	Initial Sample Diameter	D ₀	(mm)	37.7
	Initial Sample Weight	W ₀	(gr)	129.3
	Bulk Density	ρ ₀	(Mg/m ³)	1.64
	Particle Density	ρ _s	(Mg/m ³)	2.65

Initial Conditions				
Initial Cell Pressure	σ ₃	(kPa)	52	
Strain Rate	m _s	(mm/min)	1.41220	
Membrane Thickness	m _b	(mm)	0.21	
Displacement Input	L _{IP}	(mm)	CH 2	
Load Input	N _{IP}	(N)	CH 1	
Initial Moisture	ω _i %	(%)	27	
Initial Dry Density	ρ _{d0}	(Mg/m ³)	1.29	
Initial Voids Ratio	e ₀	.	1.06	
Initial Degree of Saturation	S _o	(%)	69	

Final Conditions				
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$	(kPa)	181	
Membrane Correction	m_c	(kPa)	1.688	
Strain At Max Stress	ϵ_f	(%)	12.35	
Shear Strength	c_u	(kPa)	90	
Final Moisture	ω_f	(%)	27	
Final Dry Density	ρ_{df}	(Mg/m ³)	1.29	
Final Voids Ratio	e_f	.	1.06	
Final Degree of Saturation	S_f	(%)	68.6	
Notes				
Triaxial at over burden				
				Failure Sketch (surface inclination)

 Environmental Science	Test Method		BS1377-7 : 1990 Clause 8		Test Name		712411				
	Database:		. \SQLEXPRESS \ 6171-I2 Analytical		Test Date		13/03/2017				
	Site Reference		Southall		Borehole		TP1				
	Jobfile		17-41710		Sample		2				
	Client		Card		Depth		2.60				
	Operator		palmowska		Checked		pytlikm		Approved		pytlikm

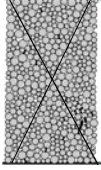
i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	3.60		
	Description	Black slightly gravelly slightly sandy clayey SILT		
	Type	B		
	Initial Sample Length	L_0	(mm)	70.3
	Initial Sample Diameter	D_0	(mm)	37.5
	Initial Sample Weight	W_0	(gr)	116.4
	Bulk Density	ρ_0	(Mg/m ³)	1.50
	Particle Density	ρ_s	(Mg/m ³)	2.65

Initial Conditions				
Initial Cell Pressure	σ_3	(kPa)	72	
Strain Rate	$\dot{\epsilon}$	(mm/min)	1.40620	
Membrane Thickness	m_b	(mm)	0.24	
Displacement Input	L_{IP}	(mm)	CH 2	
Load Input	N_{IP}	(N)	CH 1	
Initial Moisture	ω_i	(%)	46	
Initial Dry Density	ρ_{d0}	(Mg/m ³)	1.03	
Initial Voids Ratio	e_0	.	1.58	
Initial Degree of Saturation	S_o	(%)	77	

Final Conditions			
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$ (kPa)	110	
Membrane Correction	m_c (kPa)	1.464	
Strain At Max Stress	ϵ_f (%)	9.12	
Shear Strength	c_u (kPa)	55	
Final Moisture	ω_f (%)	46	
Final Dry Density	ρ_{df} (Mg/m ³)	1.03	
Final Voids Ratio	e_f .	1.58	
Final Degree of Saturation	S_f (%)	77.1	
Notes			
Triaxial at over burden; unable to take a photo			
			Failure Sketch
			(surface inclination)

	Test Method	BS1377-7 : 1990 Clause 8		Test Name	712415
	Database:	. \SQLEXPRESS \ 6171-I2 Analytical		Test Date	13/03/2017
	Site Reference	Southall		Borehole	TP2
	Jobfile	17-41710		Sample	4
	Client	Card		Depth	3.60
Operator palmowska			Checked pytlkm	Approved pytlkm	

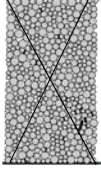
i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	1.70		
	Description	Brown slightly gravelly slightly sandy clayey SILT		
	Type	B		
	Initial Sample Length	L ₀	(mm)	74.3
	Initial Sample Diameter	D ₀	(mm)	37.6
	Initial Sample Weight	W ₀	(gr)	130.1
	Bulk Density	ρ ₀	(Mg/m ³)	1.58
	Particle Density	ρ _s	(Mg/m ³)	2.65

Initial Conditions				
Initial Cell Pressure	σ ₃	(kPa)	34	
Strain Rate	m _s	(mm/min)	1.48560	
Membrane Thickness	m _b	(mm)	0.27	
Displacement Input	L _{IP}	(mm)	CH 2	
Load Input	N _{IP}	(N)	CH 1	
Initial Moisture	ω _i %	(%)	58	
Initial Dry Density	ρ _{d0}	(Mg/m ³)	1.00	
Initial Voids Ratio	e ₀	.	1.64	
Initial Degree of Saturation	S _o	(%)	93	

Final Conditions				
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$	(kPa)	47	
Membrane Correction	m_c	(kPa)	1.637	
Strain At Max Stress	ϵ_f	(%)	8.91	
Shear Strength	c_u	(kPa)	23	
Final Moisture	ω_f	(%)	58	
Final Dry Density	ρ_{df}	(Mg/m ³)	1.00	
Final Voids Ratio	e_f	.	1.64	
Final Degree of Saturation	S_f	(%)	92.8	
Notes				
Triaxial at over burden				
				Failure Sketch (surface inclination)

 Environmental Science	Test Method		BS1377-7 : 1990 Clause 8		Test Name		712417				
	Database:		.\SQLEXPRESS \ 6171-I2 Analytical		Test Date		13/03/2017				
	Site Reference		Southall		Borehole		TP3				
	Jobfile		17-41710		Sample		3				
	Client		Card		Depth		1.70				
	Operator		palmowska		Checked		pytlikm		Approved		pytlikm

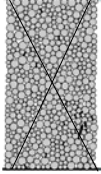
i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	0.60		
	Description	Yellowish brown slightly gravelly silty CLAY		
	Type	B		
	Initial Sample Length	L_0	(mm)	78.3
	Initial Sample Diameter	D_0	(mm)	37.9
	Initial Sample Weight	W_0	(gr)	179.2
	Bulk Density	ρ_0	(Mg/m ³)	2.03
	Particle Density	ρ_s	(Mg/m ³)	2.65

Initial Conditions				
Initial Cell Pressure	σ_3	(kPa)	12	
Strain Rate	$\dot{\epsilon}_s$	(mm/min)	1.56520	
Membrane Thickness	m_b	(mm)	0.21	
Displacement Input	L_{IP}	(mm)	CH 2	
Load Input	N_{IP}	(N)	CH 1	
Initial Moisture	$\omega_i\%$	(%)	22	
Initial Dry Density	ρ_{d0}	(Mg/m ³)	1.66	
Initial Voids Ratio	e_0	.	0.59	
Initial Degree of Saturation	S_o	(%)	98	

Final Conditions			
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$ (kPa)	134	
Membrane Correction	m_c (kPa)	1.233	
Strain At Max Stress	ϵ_f (%)	7.54	
Shear Strength	c_u (kPa)	67	
Final Moisture	ω_f (%)	22	
Final Dry Density	ρ_{df} (Mg/m ³)	1.66	
Final Voids Ratio	e_f	0.59	
Final Degree of Saturation	S_f (%)	98.2	
Notes			
Triaxial at over burden			
			
Failure Sketch (surface inclination)			



Failure Sketch
(surface inclination)

	Test Method	BS1377-7 : 1990 Clause 8	Test Name	712419
	Database:	.\SQLEXPRESS \ 6171-I2 Analytical	Test Date	13/03/2017
	Site Reference	Southall	Borehole	TP4
	Jobfile	17-41710	Sample	2
	Client	Card	Depth	0.60
Operator		palmowska	Checked	pytlikm
		Approved		pytlikm

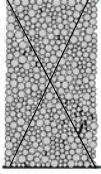
i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Total Stress Triaxial Compression

Unconsolidated Undrained (Single Stage)

Summary Report

Sample Details  <i>sketch showing specimen location in original sample</i>	Depth	1.50		
	Description	Brown slightly sandy silty GRAVEL		
	Type	B		
	Initial Sample Length	L ₀	(mm)	70.6
	Initial Sample Diameter	D ₀	(mm)	37.6
	Initial Sample Weight	W ₀	(gr)	135.9
	Bulk Density	ρ ₀	(Mg/m ³)	1.73
	Particle Density	ρ _s	(Mg/m ³)	2.65

Initial Conditions				
Initial Cell Pressure	σ ₃	(kPa)	30	
Strain Rate	m _s	(mm/min)	1.41100	
Membrane Thickness	m _b	(mm)	0.22	
Displacement Input	L _{IP}	(mm)	CH 2	
Load Input	N _{IP}	(N)	CH 1	
Initial Moisture	ω _i %	(%)	16	
Initial Dry Density	ρ _{d0}	(Mg/m ³)	1.50	
Initial Voids Ratio	e ₀	.	0.77	
Initial Degree of Saturation	S _o	(%)	54	

Final Conditions				
Max Deviator Stress	$(\sigma_1 - \sigma_3)_f$	(kPa)	111	
MembraneCorrection	m_c	(kPa)	1.089	
Strain At Max Stress	$\epsilon_f\%$	(%)	7.10	
Shear Strength	c_u	(kPa)	56	
Final Moisture	$\omega_f\%$	(%)	15	
Final Dry Density	ρ_{df}	(Mg/m3)	1.50	
Final Voids Ratio	e_f	.	0.76	
Final Degree of Saturation	S_f	(%)	53.5	
Notes				
Triaxial at over burden				
				Failure Sketch (surface inclination)

	Test Method	BS1377-7 : 1990 Clause 8		Test Name	712424	
	Database:	.\SQLEXPRESS \ 6171-I2 Analytical		Test Date	13/03/2017	
	Site Reference	Southall		Borehole	TP3B	
	Jobfile	17-41710		Sample	1	
	Client	Card		Depth	1.50	
	Operator	palmowska	Checked	pytlikm	Approved	pytlikm

i2 Analytical Limited, 7 Woodshots Meadow, Croxley Green Business Park, Herts WD18 8YS

i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

APPENDIX C

Chemical Test Results

**Owen Flowers**

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4 Godalming Business Centre
Woolsack Way
Godalming
Surrey
GU7 1XW

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Analytical Report Number : 17-41233

Project / Site name:	Southall	Samples received on:	28/02/2017
Your job number:	CGN-3732D	Samples instructed on:	28/02/2017
Your order number:		Analysis completed by:	09/03/2017
Report Issue Number:	1	Report issued on:	09/03/2017
Samples Analysed:	17 soil samples		

Signed: _____

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

Analytical Report Number: 17-41233

Project / Site name: Southall

Lab Sample Number				709459	709460	709461	709462	709463
Sample Reference				TP1	TP2	TP3	HP1	TP4
Sample Number				ES1	ES1	ES2	ES1	ES2
Depth (m)				2.60	0.60	1.50	0.00	1.30
Date Sampled				24/02/2017	24/02/2017	24/02/2017	24/02/2017	24/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	23	25	36	16	19
Total mass of sample received	kg	0.001	NONE	0.44	0.42	0.40	0.44	0.45

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	7.5	7.4	8.1	8.4	8.0
Total Cyanide	mg/kg	1	MCERTS	3	3	2	6	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	7300	4900	2200	2500	2500
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	-	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	-	-
Total Sulphur	%	0.005	MCERTS	-	-	-	-	-
Organic Matter	%	0.1	MCERTS	3.3	5.7	4.5	2.9	0.7

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	0.23	0.24	0.20	< 0.05
Acenaphthylene	mg/kg	0.1	MCERTS	0.21	0.32	0.38	0.20	< 0.10
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	0.21	0.28	< 0.10	< 0.10
Fluorene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	0.24	0.39	< 0.10
Phenanthrene	mg/kg	0.1	MCERTS	1.7	2.8	1.8	2.9	< 0.10
Anthracene	mg/kg	0.1	MCERTS	0.38	0.64	0.63	0.60	< 0.10
Fluoranthene	mg/kg	0.1	MCERTS	4.6	7.0	7.9	3.5	< 0.10
Pyrene	mg/kg	0.1	MCERTS	3.7	6.0	6.3	2.7	< 0.10
Benzo(a)anthracene	mg/kg	0.1	MCERTS	2.2	4.3	4.1	1.9	< 0.10
Chrysene	mg/kg	0.05	MCERTS	2.1	2.9	3.3	1.4	< 0.05
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	2.9	5.3	4.7	1.7	< 0.10
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	1.7	2.1	2.0	0.74	< 0.10
Benzo(a)pyrene	mg/kg	0.1	MCERTS	2.0	4.2	3.5	1.3	< 0.10
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	2.5	3.9	2.7	0.85	< 0.10
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	0.42	0.88	0.61	0.27	< 0.10
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	3.0	4.8	3.1	1.0	< 0.05
Coronene	mg/kg	0.05	NONE	1.8	2.5	1.4	0.50	< 0.05

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	29	48	43	20	< 1.6
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	5.8	7.4	5.7	1.6	< 1.0
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	18	26	37	7.7	2.9
Barium (aqua regia extractable)	mg/kg	1	MCERTS	160	270	160	91	98
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.99	1.0	1.1	0.32	1.1
Boron (water soluble)	mg/kg	0.2	MCERTS	3.2	3.1	5.1	1.7	3.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	13	14	28	1.0	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (III)	mg/kg	1	NONE	78	110	120	17	34
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	78	110	120	17	34
Copper (aqua regia extractable)	mg/kg	1	MCERTS	160	260	300	37	24
Lead (aqua regia extractable)	mg/kg	1	MCERTS	280	480	290	110	16
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	1.9	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	52	73	98	17	24
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	61	64	69	18	42
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	420	670	660	410	56

Analytical Report Number: 17-41233

Project / Site name: Southall

Lab Sample Number				709459	709460	709461	709462	709463
Sample Reference				TP1	TP2	TP3	HP1	TP4
Sample Number				ES1	ES1	ES2	ES1	ES2
Depth (m)				2.60	0.60	1.50	0.00	1.30
Date Sampled				24/02/2017	24/02/2017	24/02/2017	24/02/2017	24/02/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Monoaromatics

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

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	1.4	4.6	7.5	2.7	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	14	12	58	3.1	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	110	81	180	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	690	690	960	28	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	810	790	1200	38	< 10

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	1.6	2.5	3.1	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	12	8.8	17	9.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	52	65	110	29	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	370	520	500	53	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	430	600	630	91	< 10



Analytical Report Number: 17-41233

Project / Site name: Southall

Lab Sample Number				709464	709465	709466	711441	711442
Sample Reference				TP2B	TP3B	TP4B	TP1	TP2
Sample Number				ES1	ES1	ES1	B2	D2
Depth (m)				0.20	0.20	0.50	2.60	2.50
Date Sampled				24/02/2017	24/02/2017	24/02/2017	Deviating	Deviating
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	21	18
Moisture Content	%	N/A	NONE	16	16	11	14	33
Total mass of sample received	kg	0.001	NONE	0.43	0.44	0.45	0.39	0.34

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

pH - Automated	pH Units	N/A	MCERTS	7.4	8.3	7.9	-	-
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	1	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	2200	1000	920	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	-	1.12	0.888
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	2.0	1.7
Total Sulphur	%	0.005	MCERTS	-	-	-	0.426	0.396
Organic Matter	%	0.1	MCERTS	5.7	3.7	4.6	-	-

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	0.1	MCERTS	0.21	< 0.10	< 0.10	-	-
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	-	-
Fluorene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	-	-
Phenanthrene	mg/kg	0.1	MCERTS	2.7	1.0	0.66	-	-
Anthracene	mg/kg	0.1	MCERTS	0.63	0.27	0.19	-	-
Fluoranthene	mg/kg	0.1	MCERTS	5.7	2.4	1.9	-	-
Pyrene	mg/kg	0.1	MCERTS	4.6	2.0	1.6	-	-
Benzo(a)anthracene	mg/kg	0.1	MCERTS	3.6	1.4	1.2	-	-
Chrysene	mg/kg	0.05	MCERTS	2.4	1.1	0.98	-	-
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	4.0	1.5	1.4	-	-
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	1.6	0.82	0.81	-	-
Benzo(a)pyrene	mg/kg	0.1	MCERTS	3.4	1.5	1.4	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	1.8	0.89	0.86	-	-
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	0.43	0.20	< 0.10	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	2.0	1.1	0.95	-	-
Coronene	mg/kg	0.05	NONE	0.94	0.58	0.43	-	-

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	34	15	12	-	-
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	5.0	1.6	8.0	-	-
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	18	11	27	-	-
Barium (aqua regia extractable)	mg/kg	1	MCERTS	310	120	310	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.95	0.85	1.9	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	2.8	1.5	2.3	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	-	-
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	-	-
Chromium (III)	mg/kg	1	NONE	30	26	32	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	30	27	32	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	120	52	120	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	200	92	310	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	110	26	36	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	43	50	59	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	300	110	340	-	-



Analytical Report Number: 17-41233

Project / Site name: Southall

Lab Sample Number				709464	709465	709466	711441	711442
Sample Reference				TP2B	TP3B	TP4B	TP1	TP2
Sample Number				ES1	ES1	ES1	B2	D2
Depth (m)				0.20	0.20	0.50	2.60	2.50
Date Sampled				24/02/2017	24/02/2017	24/02/2017	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	1.8	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	2.3	4.1	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	40	52	40	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	46	61	53	-	-
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	5.0	< 1.0	< 1.0	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	6.6	< 2.0	5.4	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	33	10	15	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	150	81	64	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	190	92	86	-	-

Analytical Report Number: 17-41233

Project / Site name: Southall

Lab Sample Number				711443	711444	711445	711446	711447
Sample Reference				TP3B	TP3B	TP4B	TP2	TP3
Sample Number				B1	B2	B1	B4	B3
Depth (m)				1.50	2.70	1.50	3.60	1.70
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
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	52	58	44	24	< 0.1
Moisture Content	%	N/A	NONE	9.2	7.3	11	29	35
Total mass of sample received	kg	0.001	NONE	0.49	0.57	0.57	0.39	0.47

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

pH - Automated	pH Units	N/A	MCERTS	-	-	-	-	-
Total Cyanide	mg/kg	1	MCERTS	-	-	-	-	-
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	-	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	0.216	0.210	0.087	0.884	0.197
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.55	0.79	0.18	2.3	1.3
Total Sulphur	%	0.005	MCERTS	0.134	0.112	0.048	0.347	0.244
Organic Matter	%	0.1	MCERTS	-	-	-	-	-

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthylene	mg/kg	0.1	MCERTS	-	-	-	-	-
Acenaphthene	mg/kg	0.1	MCERTS	-	-	-	-	-
Fluorene	mg/kg	0.1	MCERTS	-	-	-	-	-
Phenanthrene	mg/kg	0.1	MCERTS	-	-	-	-	-
Anthracene	mg/kg	0.1	MCERTS	-	-	-	-	-
Fluoranthene	mg/kg	0.1	MCERTS	-	-	-	-	-
Pyrene	mg/kg	0.1	MCERTS	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.1	MCERTS	-	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.1	MCERTS	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Coronene	mg/kg	0.05	NONE	-	-	-	-	-

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	-	-	-	-	-
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	-	-	-	-	-
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 (III)	mg/kg	1	NONE	-	-	-	-	-
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	-	-	-	-	-



Analytical Report Number: 17-41233

Project / Site name: Southall

Lab Sample Number				711443	711444	711445	711446	711447
Sample Reference				TP3B	TP3B	TP4B	TP2	TP3
Sample Number				B1	B2	B1	B4	B3
Depth (m)				1.50	2.70	1.50	3.60	1.70
Date Sampled				Deviating	Deviating	Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
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-CWG - Aliphatic >EC5 - EC6	mg/kg	0.1	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.1	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.1	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	0.1	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.1	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.1	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: 17-41233

Project / Site name: Southall

Lab Sample Number				711448	711449			
Sample Reference				TP4	TP2B			
Sample Number				B2	D1			
Depth (m)				0.60	0.20			
Date Sampled				Deviating	Deviating			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	4.9	40			
Moisture Content	%	N/A	NONE	20	21			
Total mass of sample received	kg	0.001	NONE	0.61	0.28			

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

pH - Automated	pH Units	N/A	MCERTS	-	-			
Total Cyanide	mg/kg	1	MCERTS	-	-			
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-			
Total Sulphate as SO ₄	%	0.005	MCERTS	0.171	0.161			
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	1.0	0.51			
Total Sulphur	%	0.005	MCERTS	0.066	0.076			
Organic Matter	%	0.1	MCERTS	-	-			

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	-	-			
Acenaphthylene	mg/kg	0.1	MCERTS	-	-			
Acenaphthene	mg/kg	0.1	MCERTS	-	-			
Fluorene	mg/kg	0.1	MCERTS	-	-			
Phenanthrene	mg/kg	0.1	MCERTS	-	-			
Anthracene	mg/kg	0.1	MCERTS	-	-			
Fluoranthene	mg/kg	0.1	MCERTS	-	-			
Pyrene	mg/kg	0.1	MCERTS	-	-			
Benzo(a)anthracene	mg/kg	0.1	MCERTS	-	-			
Chrysene	mg/kg	0.05	MCERTS	-	-			
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	-	-			
Benzo(k)fluoranthene	mg/kg	0.1	MCERTS	-	-			
Benzo(a)pyrene	mg/kg	0.1	MCERTS	-	-			
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	MCERTS	-	-			
Dibenz(a,h)anthracene	mg/kg	0.1	MCERTS	-	-			
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-			
Coronene	mg/kg	0.05	NONE	-	-			

Total PAH

Total WAC-17 PAHs	mg/kg	1.6	NONE	-	-			
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Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	-	-			
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 (III)	mg/kg	1	NONE	-	-			
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	-	-			



Analytical Report Number: 17-41233

Project / Site name: Southall

Lab Sample Number				711448	711449			
Sample Reference				TP4	TP2B			
Sample Number				B2	D1			
Depth (m)				0.60	0.20			
Date Sampled				Deviating	Deviating			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		
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-CWG - Aliphatic >EC5 - EC6				mg/kg	0.1	MCERTS	-	-
TPH-CWG - Aliphatic >EC6 - EC8				mg/kg	0.1	MCERTS	-	-
TPH-CWG - Aliphatic >EC8 - EC10				mg/kg	0.1	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	0.1	MCERTS	-	-
TPH-CWG - Aromatic >EC7 - EC8				mg/kg	0.1	MCERTS	-	-
TPH-CWG - Aromatic >EC8 - EC10				mg/kg	0.1	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 : 17-41233

Project / Site name: Southall

* 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 *
709459	TP1	ES1	2.60	Brown loam and clay with gravel.
709460	TP2	ES1	0.60	Brown loam and clay with gravel.
709461	TP3	ES2	1.50	Brown clay and sand with gravel.
709462	HP1	ES1	0.00	Brown loam and sand with gravel and vegetation.
709463	TP4	ES2	1.30	Brown clay and sand with gravel.
709464	TP2B	ES1	0.20	Brown loam and clay with gravel.
709465	TP3B	ES1	0.20	Brown loam and sand with gravel.
709466	TP4B	ES1	0.50	Brown loam and clay with gravel.
711441	TP1	B2	2.60	Brown loam and clay with gravel.
711442	TP2	D2	2.50	Brown clay and loam with gravel.
711443	TP3B	B1	1.50	Brown loam and clay with gravel.
711444	TP3B	B2	2.70	Brown loam and clay with gravel.
711445	TP4B	B1	1.50	Brown loam and clay with gravel.
711446	TP2	B4	3.60	Brown clay and loam with gravel.
711447	TP3	B3	1.70	Brown clay and sand.
711448	TP4	B2	0.60	Brown clay and sand with gravel.
711449	TP2B	D1	0.20	Brown clay and loam with gravel and vegetation.

Analytical Report Number : 17-41233

Project / Site name: Southall

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
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
Organic matter in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L023-PL	D	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 WAC-17 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	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, 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
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 sulphate (as SO4 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

Iss No 17-41233-1 Southall CGN-3732D

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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 : 17-41233

Project / Site name: Southall

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

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 Deviation Report



Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP1	B2	S	17-41233	711441	a			
TP2	B4	S	17-41233	711446	a			
TP2	D2	S	17-41233	711442	a			
TP2B	D1	S	17-41233	711449	a			
TP3	B3	S	17-41233	711447	a			
TP3B	B1	S	17-41233	711443	a			
TP3B	B2	S	17-41233	711444	a			
TP4	B2	S	17-41233	711448	a			
TP4B	B1	S	17-41233	711445	a			

APPENDIX D

WAC Test Results

**Owen Flowers**

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WD18 8YS

t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 17-41236

Project / Site name:	Southall	Samples received on:	28/02/2017
Your job number:	CGN-3732D	Samples instructed on:	28/02/2017
Your order number:		Analysis completed by:	06/03/2017
Report Issue Number:	1	Report issued on:	06/03/2017
Samples Analysed:	3 10:1 WAC samples		

Signed:

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

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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Waste Acceptance Criteria Analytical Results

Report No:	17-41236						
					Client: CARDGEO		
Location	Southall						
Lab Reference (Sample Number)	709470 / 709471				Landfill Waste Acceptance Criteria		
Sampling Date	24/02/2017				Limits		
Sample ID	TP1 + TP2 + TP3				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Depth (m)	0.60-3.50						
Solid Waste Analysis							
TOC (%)**	3.8				3%	5%	6%
Loss on Ignition (%) **	14				--	--	10%
BTEX (µg/kg) **	< 10				6000	--	--
Sum of PCBs (mg/kg) **	0.28				1	--	--
Mineral Oil (mg/kg)	1100				500	--	--
Total PAH (WAC-17) (mg/kg)	100				100	--	--
pH (units)**	7.2				--	>6	--
Acid Neutralisation Capacity (mol / kg)	1.7				--	To be evaluated	To be evaluated
Eluate Analysis	10:1			10:01	Limit values for compliance leaching test		
	(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l		mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	< 0.0011			< 0.0110	0.5	2	25
Barium *	0.0348			0.261	20	100	300
Cadmium *	0.0024			0.0177	0.04	1	5
Chromium *	0.0011			0.0081	0.5	10	70
Copper *	0.025			0.19	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0013			0.0098	0.5	10	30
Nickel *	0.0056			0.042	0.4	10	40
Lead *	0.0025			0.019	0.5	10	50
Antimony *	< 0.0017			< 0.017	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.035			0.26	4	50	200
Chloride *	0.98			7.3	800	4000	25000
Fluoride	0.48			3.6	10	150	500
Sulphate *	480			3600	1000	20000	50000
TDS	560			4200	4000	60000	100000
Phenol Index (Monhydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	7.48			56.0	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	2.0						
Dry Matter (%)	72						
Moisture (%)	28						
Results are expressed on a dry weight basis, after correction for moisture content where applicable Stated limits are for our data only and I2 report be held responsible for any discrepancies with current legislation							

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation

* = UKAS accredited (liquid eluate analysis only)

** = MCERTS accredited

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Waste Acceptance Criteria Analytical Results								
Report No:	17-41236							
					Client: CARDGEO			
Location	Southall							
Lab Reference (Sample Number)	709472 / 709473				Landfill Waste Acceptance Criteria			
					Limits			
Sampling Date	24/02/2017				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill	
Sample ID	TP3							
Depth (m)	1.50							
Solid Waste Analysis								
TOC (%)**	1.4				3%	5%	6%	
Loss on Ignition (%) **	6.3				--	--	10%	
BTEX (µg/kg) **	< 10				6000	--	--	
Sum of PCBs (mg/kg) **	< 0.007				1	--	--	
Mineral Oil (mg/kg)	330				500	--	--	
Total PAH (WAC-17) (mg/kg)	30				100	--	--	
pH (units)**	7.8				--	>6	--	
Acid Neutralisation Capacity (mol / kg)	6.4				--	To be evaluated	To be evaluated	
Eluate Analysis	10:1			10:01	Limit values for compliance leaching test			
	(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l		mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)			
Arsenic *	0.0047			0.0364	0.5	2	25	
Barium *	0.0207			0.161	20	100	300	
Cadmium *	0.0003			0.0020	0.04	1	5	
Chromium *	0.0010			0.0075	0.5	10	70	
Copper *	0.018			0.14	2	50	100	
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2	
Molybdenum *	0.0042			0.0325	0.5	10	30	
Nickel *	0.0020			0.016	0.4	10	40	
Lead *	0.0048			0.038	0.5	10	50	
Antimony *	0.037			0.29	0.06	0.7	5	
Selenium *	< 0.0040			< 0.040	0.1	0.5	7	
Zinc *	0.015			0.11	4	50	200	
Chloride *	2.7			21	800	4000	25000	
Fluoride	0.70			5.4	10	150	500	
Sulphate *	33			260	1000	20000	50000	
TDS	100			820	4000	60000	100000	
Phenol Index (Monhydric Phenols) *	< 0.010			< 0.10	1	-	-	
DOC	7.04			54.9	500	800	1000	
Leach Test Information								
Stone Content (%)	< 0.1							
Sample Mass (kg)	2.0							
Dry Matter (%)	81							
Moisture (%)	19							
Results are expressed on a dry weight basis, after correction for moisture content where applicable								

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Waste Acceptance Criteria Analytical Results								
Report No:	17-41236							
					Client: CARDGEO			
Location	Southall							
Lab Reference (Sample Number)	709474 / 709475				Landfill Waste Acceptance Criteria			
Sampling Date	24/02/2017				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill	
Sample ID	TP2B + TP3B + TP4B							
Depth (m)	0.20-2.70							
Solid Waste Analysis								
TOC (%)**	1.8				3%	5%	6%	
Loss on Ignition (%) **	6.2				--	--	10%	
BTEX (µg/kg) **	< 10				6000	--	--	
Sum of PCBs (mg/kg) **	< 0.007				1	--	--	
Mineral Oil (mg/kg)	64				500	--	--	
Total PAH (WAC-17) (mg/kg)	7.4				100	--	--	
pH (units)**	7.5				--	>6	--	
Acid Neutralisation Capacity (mol / kg)	3.3				--	To be evaluated	To be evaluated	
Eluate Analysis	10:1			10:01	Limit values for compliance leaching test			
	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)			
Arsenic *	0.0050			0.0410	0.5	2	25	
Barium *	0.0136			0.110	20	100	300	
Cadmium *	< 0.0001			< 0.0008	0.04	1	5	
Chromium *	0.0011			0.0090	0.5	10	70	
Copper *	0.014			0.12	2	50	100	
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2	
Molybdenum *	< 0.0004			< 0.0040	0.5	10	30	
Nickel *	0.0003			< 0.0030	0.4	10	40	
Lead *	0.0042			0.034	0.5	10	50	
Antimony *	< 0.0017			< 0.017	0.06	0.7	5	
Selenium *	< 0.0040			< 0.040	0.1	0.5	7	
Zinc *	0.0093			0.076	4	50	200	
Chloride *	2.6			21	800	4000	25000	
Fluoride	0.58			4.7	10	150	500	
Sulphate *	16			130	1000	20000	50000	
TDS	69			560	4000	60000	100000	
Phenol Index (Monhydric Phenols) *	< 0.010			< 0.10	1	-	-	
DOC	4.98			40.5	500	800	1000	
Leach Test Information								
Stone Content (%)	< 0.1							
Sample Mass (kg)	2.0							
Dry Matter (%)	91							
Moisture (%)	9.0							
Results are expressed on a dry weight basis, after correction for moisture content where applicable Stated limits are for guidance only and I2 cannot be held responsible for any discrepancies with current legislation								