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HOLLAND PARK: PHASE 2, SPALDING

Phase II Geo-Environmental Assessment - Revision A - Volume 1 of 2

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Phase II Geo-Environmental Assessment

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Phase II Geo-Environmental Assessment – Revision A

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HOLLAND PARK: PHASE 2, SPALDING
Phase II Geo-Environmental Assessment
Revision A

Contents

1.0 Introduction
2.0 Site Location and Description
3.0 Environmental Setting
4.0 Review of Existing Information
5.0 Ground Investigation
6.0 Ground Conditions
7.0 Contamination Assessment
8.0 Geotechnical Appraisal
9.0 Soakage Assessment
10.0 Conclusions & Recommendations
11.0 References

Figures

1.1 Existing Site Plan
1.2 Proposed Site Layout
2.1 Site Location Plan

Tables

Table 6.1: Summary of *in situ* hand shear vane geotechnical results
Table 6.2: Comparison of Geotechnical Laboratory CBR and *in situ* DCP Results
Table 6.3a: Summary of cohesive Tidal Flat geotechnical laboratory results
Table 6.3b: Summary of PSD (sieve) Tidal Flat geotechnical laboratory results
Table 6.3c: Summary of PSD (pipette) Tidal Flat geotechnical laboratory results
Table 6.4a: Summary of PSD (sieve) Glacial Till geotechnical laboratory results
Table 6.4b: Summary of cohesive Glacial Till geotechnical laboratory results
Table 8.1: Geotechnical design parameters
Table 9.1: Summary of soakage test results

Appendices

A Exploratory Hole Location Plan
B Exploratory Hole Logs, *in situ* DCP Testing and Soakage Test Results
C Chemical Laboratory Test Certificates & Comparison against Assessment Criteria
D Geotechnical Laboratory Test Certificates
E Geotechnical Plots
F Ground Gas Monitoring Results

Registration of Amendments

Revision and Date	Amendment Details	Revision Prepared By	Revision Approved By
Rev A 01/10/2020	Updated with results and foundation analysis from second phase of investigation	TB / AW	CB

1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd (CCE) were instructed by Broadgate Homes (the 'Client') to undertake a Phase II Geo-Environmental Assessment of land at Holland Park (the 'Site') for residential end-use.

Project Context

1.2 The Site currently comprises a plot of agricultural land, with a residential housing development to the east and agricultural land to the north, south and west.

1.3 The Site boundary is included as Figure 1.1, below:



Figure 1.1: Existing Site Plan (Google Earth, 2019)

1.4 A Phase I Contaminated Land Assessment was carried out by CCE in November 2019 (Ref: SG/CC/P13-501/05) and a summary of the findings of this assessment is provided in Section 4.

1.5 The proposed layout for the residential development will include approximately 150 units on the Site, presented in Figure 1.2, below:



Figure 1.2: Proposed Site Layout (Unreferenced Broadgate Homes Drawing)

Objectives

1.6 The objectives of the site investigation were as follows:

- To assess the potential contaminated land issues identified in the CCE Phase I Contaminated Land Assessment report;
- Provide geotechnical parameters for the proposed development of the Site; and
- Assess the suitability for using soakaways for surface water disposal.

1.7 The geo-environmental investigation work was carried out in accordance with best practice and planning guidance such as that set out in the National Planning Policy Framework, 2019, the Environment Agency's Model Procedures for the Management of Land Contamination, CLR 11 2004.

Scope of Work

1.8 The scope of works proposed for this assessment was as follows:

<u>Geo-Environmental Site Investigation</u>

- Drilling of 5No. cable percussion boreholes to a maximum depth of 15m bgl (or refusal) with inspection pits to 1.0m and hand-vane testing carried out at each location;

- Drilling of 13No. windowless sample boreholes to a maximum depth of 5.45m below ground level (bgl) (or refusal) with machine-dug inspection pits to 1.0m and hand-vane testing carried out at each location;
- During drilling of the boreholes, in situ strength tests (SPTs) undertaken and collection of disturbed / undisturbed samples for subsequent laboratory analysis;
- Monitoring wells installed with raised covers at 6No. windowless sampler borehole locations across the Site to enable subsequent monitoring of ground gas and groundwater levels;
- Excavation of 6No. trial pits to a maximum of 2m bgl to help determine the potential for sustainable drainage (SUDS) and permeable paving across the Site with hand-vane tests and sampling for both geotechnical and environmental laboratory testing;
- Trial pits backfilled with gravel and used to perform soakage test in accordance with BRE 365;
- Soil samples collected and submitted to UKAS accredited testing laboratory for geotechnical testing (including classification, strength and California Bearing Ratio);
- Soil samples collected and submitted to an M-CERTS accredited testing laboratory for chemical testing for a standard suite of organic and inorganic parameters and aggressiveness to concrete;
- 19No. Dynamic Cone Penetrometer tests undertaken across the site to establish a CBR value (California Bearing Ratio) for the soil profile up to a depth of 1m bgl;
- 6No. monitoring visit on completion of the site works to measure groundwater levels and confirm the potential for the presence of ground gas; and
- A summary interpretative report prepared on completion of the works and subsequent laboratory testing.

Constraints and Limitations

1.9 The copyright of this report is vested in Create Consulting Engineers Limited and the Client, Broadgate Homes. The Client, or their appointed representatives, may copy the report for purposes in connection with the development described herein. It shall not be copied by any other party or used for any other purposes without the written consent of Create Consulting Engineers Limited or the Client.

1.10 Create Consulting Engineers Limited accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.

1.11 Create Consulting Engineers Limited has endeavoured to assess all information provided to them during this appraisal. Should additional information become available which may affect the opinions expressed in this report, Create Consulting reserves the right to review this information and, if warranted, to modify the opinions presented in the report accordingly.

1.12 The report summarises information from a number of external sources and is unable to offer any guarantees or warranties for the completeness or accuracy of information relied upon. Information from third parties has not been verified by Create Consulting Engineers Limited unless otherwise stated in this report.

1.13 The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the Site.

2.0 SITE LOCATION AND DESCRIPTION

Site Location

2.1 The Site is located in Spalding, directly north of Little London Road/B1172 and east/north of The Raceground, approximately 630m to the west of Little London and centred at National Grid reference 523217E, 321137N. The nearest postcode is PE11 3AP.

2.2 An approximate Site location plan is provided as Figure 2.1, below:

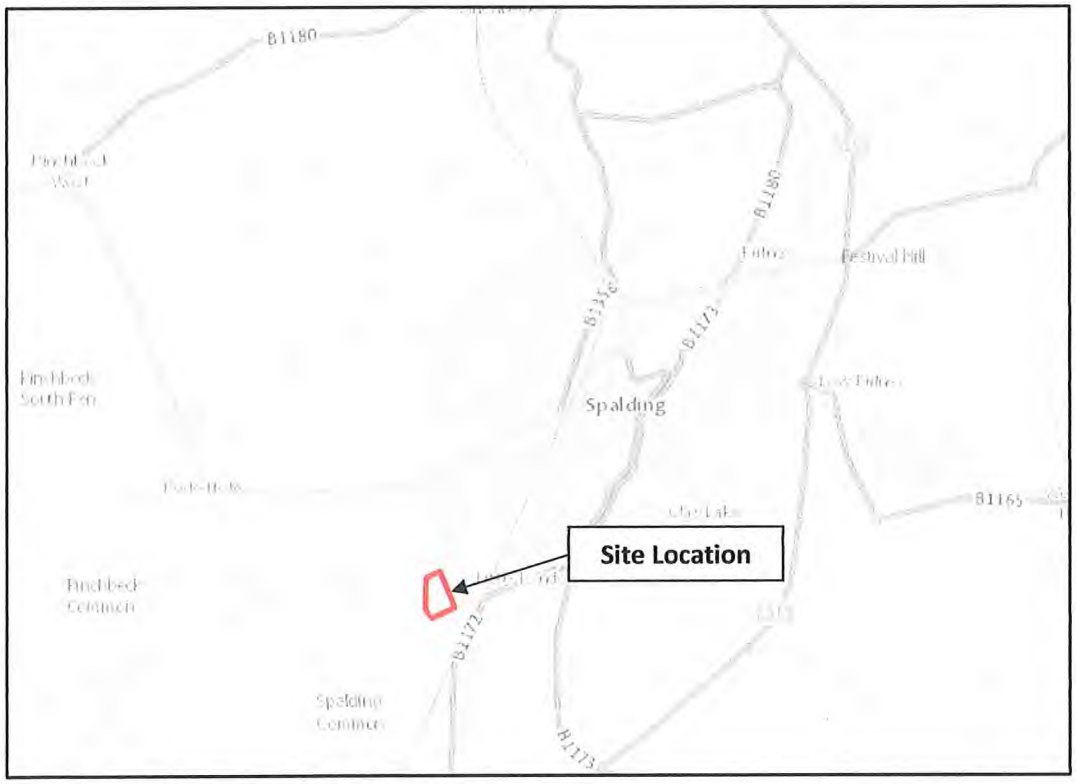


Figure 2.1: Site Location Plan (Geoindex, 2019)

Site Description

2.3 The Site was irregular in shape, covering an area of approximately 6.6 (source: Google Earth) and comprises a plot of agricultural land. An earth bund was located within the northern section of the Site. The Site was secured by Heras fencing along the eastern and northern boundaries, with a drainage ditch along the southern and western boundaries. Access to the Site was gained via Meadow Way and macadam roads through an under construction housing development.

2.4 The Site was bound to the south by The Raceground, with agricultural fields, semi-detached houses and Hill's Drain beyond; to the east by ongoing residential development, to the north

by a lake, with residential areas beyond (completed as part of a previous residential phase of development).

2.5 Semi-mature shrubs, bushes and small trees were present at various points along all boundaries of the Site. Established vegetation was found surrounding the lake, namely: long grass, brambles and semi-mature trees. This was bound by a line of semi-mature trees to the north and west.

3.0 ENVIRONMENTAL SETTING

Geology

3.1 Reference has been made to the BGS (British Geological Survey) 1:50,000 Solid and Drift map of the area (Sheet 144, Spalding, dated 1992), which indicates that the Site is underlain by superficial Tidal Flat Deposits (Clay and Silt). The bedrock geology underlying the Site is mapped as the Oxford Clay Formation.

Hydrogeology

3.2 The superficial Tidal Flat Deposits and bedrock of the Oxford Clay Formation (Mudstone) are classed *Unproductive* with low permeability and that have negligible significance for water supply or river base flow.

3.3 The Site does not fall within a Source Protection Zone and there are no groundwater or potable water abstraction licences within one kilometre of the Site.

Hydrology

3.4 There are multiple surface water features present within 250m of the Site belonging to the Lower Welland Catchment but none directly within the Site boundary. An artificial lake is present adjacent to the northern boundary of the Site. There is a drainage ditch running along the western boundary of the Site, joining Hill's Drain approximately 80m to the south. Additionally, two parallel drainage channels are present approximately 50m from the western Site boundary, running west and joining Broughton Drain.

3.5 There is one surface water abstraction licence within 1 kilometre of the Site, approximately 900m to the south.

Sensitivity

3.6 The sensitivity of each of the identified receptors is rated depending upon the environmental setting of the Site, the likelihood for pollutant linkages to be present and potential consequence of those potential pollutant linkages. The assessment approach adopted is based on guidance set out in the *Guidance for the Safe Development of Housing on Land Affected by Contamination R&D 66* document.

3.7 The Site sensitivity with regards to groundwater can be classified as **L2 (Very Low).** This designation is described as *'Not a recognised aquifer, but strata beneath site may retain a small amount of contaminated liquid but there is likely to be limited vertical penetration. High potential for surface runoff or ponding'*. This reflects the low permeability of the superficial

Tidal Flat Deposits and unproductive classification of both the superficial and bedrock deposits.

3.8 The Site sensitivity to surface water is designated as **M2 (Moderate)**, described as a *'Site within catchment of and relatively close (less than 1000m) to moderate or poor quality (GQA C to F) watercourse that may be subject to planned improvement by attainment of surface water'*. The Site is within the river catchment area of Vernatt's Drain, with drainage channels present adjacent to the Site.

4.0 REVIEW OF EXISTING INFORMATION

Phase I Contaminated Land Assessment, Create Consulting Engineers Ltd (Ref: SG/CC/P13-501/06) dated November 2019

4.1 CCE conducted a Phase I Contaminated Land Assessment to support a planning proposal for the redevelopment of the Site.

4.2 A potential pollutant linkage was identified associated with the proposed residential end-use:

- Potential herbicide and pesticide contamination from current and former agricultural usage.

4.3 In order to manage the uncertainty associated with these potential ground contamination sources, a site investigation was recommended to include contamination assessment of shallow soils and an initial ground gas monitoring visit to quantify the potential risks to end-users.

5.0 GROUND INVESTIGATION

5.1 Initial ground investigation works were undertaken at the Site between the 4th and 7th November 2019. Follow-on works comprising deeper boreholes were undertaken between 12th January and 18th January, and 1st to 2nd September 2020, as detailed in the following paragraphs.

Description of Fieldwork

5.2 The scope of works undertaken as part of the first phase of ground investigation works was as follows:

- Excavation of 13No. inspection trial pits at borehole locations to check for the presence of services and to allow for in situ geotechnical testing;
- Drilling of 13No. windowless sample boreholes (WS01 to WS13) to a maximum depth of 5.45m bgl (or refusal) to determine ground and groundwater conditions, *provide in situ* soil strength information (SPTs), enable the collection of soils samples for chemical and geotechnical testing and the installation of groundwater and ground gas monitoring standpipes;
- Excavation of 8No. trial pits (TP01 to TP06, TP01A and TP06A) to depths of between 0.5m and 2.0m bgl, with shallow soakage testing undertaken at 6No locations;
- Hand-vane testing of material at 19No. trial pit locations at suitable strata/intervals;
- Chemical laboratory testing of Site soil samples;
- Geotechnical laboratory testing of Site soil samples;
- 19No. Dynamic Cone Penetrometer tests to establish a California Bearing Ratio (CBR) value for the soil profile across the Site up to a depth of 1m bgl; and
- Ground gas and groundwater monitoring/sampling on 6No. occasions (using an infrared gas analyser GA5000) to establish the gassing regime across the site.

5.3 The foundation assessment from this phase of investigation concluded that a shallow foundation solution would not be suitable for the proposed development. It was, therefore, recommended that a second phase site investigation be carried out to target deeper ground conditions in order to provide piled foundation design parameters.

5.4 The second phase of works comprised the following:

- Drilling of 5No. cable percussive boreholes (BH01 to BH05) to depths of between 11.0m and 15.00m bgl to determine ground and groundwater conditions, provide *in situ* soil strength information (SPTs), enable the collection of soils samples for chemical and geotechnical testing;
- Installation of a groundwater and ground gas monitoring standpipe at one location given the deeper ground conditions included peat deposits, in order to enable subsequent ground gas monitoring;

- Geotechnical laboratory testing of Site soil samples; and
- Ground gas and groundwater monitoring/sampling on 3No. occasions (using an infrared gas analyser GA5000).

5.5 An exploratory hole location plan is presented in Appendix A.

5.6 The soil arisings from each borehole and trial pit were logged by a suitably qualified Engineer, in line with the relevant British Standard (BS 5930 and Eurocode 7). The exploratory hole logs are included within Appendix B.

5.7 All works were undertaken in accordance with the CCE Health and Safety Policy and within the framework of a Health and Safety plan.

Geo-Environmental Laboratory Testing

5.8 Soil samples were collected from various locations and depths across the site and submitted for chemical testing at a UKAS/MCERTS accredited laboratory.

5.9 All samples were transported under chain of custody documentation and tested for a range of inorganic and organic compounds. Cool boxes were kept cool (<4°C) with ice packs during sample collection and subsequent transportation by courier to the chemical testing laboratory.

5.10 The chemical testing comprised a range of organic and inorganic parameters including herbicides and pesticides and asbestos. Testing for aggressiveness to concrete was also carried out.

5.11 The laboratory test certificates are included as Appendix C.

Geotechnical Laboratory Testing

5.12 Selected soil samples were subjected to testing within a UKAS accredited geotechnical laboratory, including:

- Moisture content;
- Plasticity index;
- Particle size distribution (PSD) testing; and
- California Bearing Ratio (CBR).

5.13 The results of this testing, along with laboratory certificates are included as Appendix D.

Ground Gas Monitoring

5.14 On completion of the first phase of fieldwork, the Site was visited on 1No. occasion to measure ground gas concentrations and groundwater levels in the installed monitoring wells across the Site so as to provide an initial assessment of the ground gas regime. The existing wells were then monitored during the second phase of investigation works with a total of 6No. visits carried out and a total of 4No. visits to monitor the deeper well installed during the secondary investigation.

5.15 Measurements of methane, carbon dioxide and oxygen as well as gas flow were taken using a GA5000 infra-red gas analyser with flow pod.

5.16 Following measurement of ground gas concentration and flow levels, standing groundwater levels and the total depth of selected monitoring wells were recorded using a dipmeter.

5.17 The ground gas monitoring and groundwater level measurements are presented in Appendix F.

6.0 GROUND CONDITIONS

6.1 The encountered ground conditions are provided in detail within the exploratory hole logs (Appendix B), laboratory geotechnical test results (Appendix D) and geotechnical plots (Appendix E) and summarised in the following section.

General

6.2 The ground investigation included a total of 26No. exploratory holes formed across the Site (TP01 to TP06A, WS01 to WS13 and BH01 to BH05) to provide a general indication of ground conditions, carry out *in situ* strength testing of site soils, collect samples for geotechnical and chemical testing, install monitoring standpipes to enable ground gas and groundwater monitoring (boreholes) and undertake soakage testing.

6.3 The following paragraphs provide a summary of ground conditions encountered during the ground investigation undertaken at the Site.

Topsoil/Subsoil

6.4 Undifferentiated topsoil and subsoil was encountered at all exploratory hole locations across the Site, described as a *'brown silty fine to medium sand. With rootlets'* and recorded to depths of between 0.25m and 0.40m bgl.

6.5 No *in situ* geotechnical testing was undertaken on the Topsoil/subsoil material.

Superficial Deposits

6.6 The subsoil was underlain by superficial deposits of: Tidal Flat Deposits; Alluvium (southern half of Site only); underlain by granular Glacial Till, underlain cohesive Glacial Till, as outlined in the following paragraphs.

Tidal Flat Deposits

6.7 The Tidal Flat Deposits were found to comprise interbedded Clay, clayey Silt and a clayey Sand, including a thin band of peat. The interbedded layers were underlain by Tidal Flat Deposits of fine silty sand.

Interbedded – Clay / clayey Silt / clayey Sand

6.8 The Topsoil was underlain by highly variable layers of sandy clay/silt to silty/clayey sand, recorded to depths of between 1.50m and 3.50m bgl and were generally described as a *'light brown mottled orange brown variably sandy CLAY/SILT. Sand is fine'*, grading to a *'light brown mottled grey sandy clayey SILT. Sand is fine'*.

6.9 A thin band of peat, between 0.03m and 0.10m thick and encountered across the Site at depths of between 0.60m to 1.25m was generally described as a *'plastic dark brown to black amorphous PEAT'*.

6.10 A total of 17No. SPT tests were undertaken within the shallow variable Tidal Flat deposits, recording corrected N-values of N_{60}=1 to N_{60}=22, indicating that the material is of very low to moderate strength and corresponding to borehole strength descriptions of *'very soft'* to *'firm'*, as detailed in the SPT depth plot, Appendix E.

6.11 Laboratory geotechnical test results of the shallow site won Tidal Flat deposits are summarised in Table 6.1, below:

Laboratory Test	No. of Tests	Result Range		
Moisture Content	14	26% - 38%		
Plasticity Index	10	Clay: 16% – 57% (CI to CV) Silt: 8% – 19% (ML to MI)		
PSD (pipette)	4	Gravel (2mm-60mm)	0%	Cu = 0.00
		Sand (0.06mm-2mm)	32.7 – 53.4%	
		Silt (0.06mm-0.002mm)	41.3 – 56.7%	
		Clay (<0.002mm)	5.1 – 10.6%	
CBR	3	0.2% – 1.2%		

Table 6.1: Summary of cohesive Tidal Flat geotechnical laboratory results

The laboratory geotechnical test results indicate the interbedded layers comprise a clay and silt of low to intermediate plasticity (see Plasticity Chart, Appendix E) and, therefore, of moderate volume change potential. The 'Moisture Content Depth Plot', Appendix E indicates that moisture content increases with depth within the cohesive horizons.

6.12 During the site investigation, *in situ* hand shear vane testing was carried out on the cohesive shallow Tidal Flat Deposits, where possible. A total of 41No. depth intervals were tested, with an average from three separate tests used for the depth interval at each location. The results are summarised in Table 6.2, below:

Hand Shear Vane Tests	No. of Tests	Result Range
0.40m – 0.55m	13	43 – 75kPa
0.55m – 0.75m	9	49 – 93kPa
0.75m – 1.50m	19	34 – 75kPa

Table 6.2: Summary of *in situ* hand shear vane geotechnical results

6.13 The *in situ* hand shear vane testing proved a slight correlation between increasing strength and depth, as detailed in the *In Situ* Shear Strength depth plot, Appendix E.

6.14 A total of 3No. laboratory CBR tests were undertaken on samples of Site-won material, providing result of between 0.2% and 1.2%, with the laboratory test certificates presented in Appendix D.

6.15 A total of 19No. *in situ* Dynamic Cone Penetrometer (DCP) tests were carried within the top 1.00m of soil, carried out according to the methodology set out in the Design Manual for Roads and Bridges (2008), where a CBR value for the soil profile is calculated by:

$$CBR\ (\%) = 10^{(2.48-1.057 \times Log_{10}P)}$$

Where:

P = The penetration rate in mm per blow (average)

6.16 Where calculated CBR values are below 10%, the accuracy of this relationship is reduced. The interpreted DCP results are provided in Appendix B. A comparison between laboratory CBR testing with *in situ* CBR tests carried out is provided in Table 6.3, below. Where samples have been tested in the laboratory, the interpreted DCP value for the corresponding depth range has been given.

Hole Location	Sample Depth (m)	Laboratory Test Result (%)	DCP Test Result (%)
TP01 (DCP01)	-	-	4.5
TP02 (DCP02)	-	-	5.1
TP03 (DCP03)	-	-	4.5
TP04 (DCP04)	-	-	5.2
TP05 (DCP05)	-	-	6.4
TP06 (DCP06)	-	-	5.4
WS01 (DCP08)	0.70 – 1.00	0.2	2.2
WS02 (DCP09)	-	-	5.0
WS03 (DCP11)	-	-	6.2
WS04 (DCP19)	-	-	9.8
WS05 (DCP10)	-	-	11.3
WS06 (DCP07)	-	-	6.7
WS07 (DCP18)	-	-	6.8
WS08 (DCP14)	0.60 – 1.00	0.7	8.7
WS09 (DCP13)	-	-	7.3
WS10 (DCP17)	-	-	10.0
WS11 (DCP15)	-	-	6.6
WS12 (DCP16)	-	-	6.4
WS13 (DCP12)	0.70 – 1.00	1.2	3.1
	AVERAGE:	**0.7**	**6.4**

Table 6.3: Comparison of Geotechnical Laboratory CBR and *in situ* DCP Results

6.17 The *in situ* DCP results and interpreted CBR values gave an average of 6.4% across the Site. Site won samples subjected to CBR testing provided an average of 0.7%, an order of magnitude below that of interpreted CBR results.

Granular – Silty Sand

6.18 The interbedded Tidal Flat Deposits (clay, clayey silt, clayey sand) were underlain by Tidal Flat Deposits of a fine silty Sand, which was generally described as: '*loose to medium dense brown variably silty fine SAND. With traces of fine lignite*'. The silty Sand was recorded to depths of between 8.10m and 10.70m bgl. BH01 terminated at 11.0m bgl within the silty Sand.

6.19 A total of 69No. SPT tests were undertaken within the silty Sand, recording corrected N-values of between $(N_1)_{60}$ = 5 to $(N_1)_{60}$ = 63, indicating the material corresponds to borehole strength descriptions from 'loose' to 'very dense'. A correlation between increasing strength and depth is evident in the SPT depth plot (Appendix E).

6.20 Laboratory PSD (sieve and pipette) test results of Site won granular (silty Sand) Tidal Flat deposits are summarised in Table 6.4, below, with laboratory test certificates presented in Appendix D.

Laboratory Test	No. of Tests	Material	Result Range	Cu
PSD (sieve)	16	Cobbles (>60mm)	0.0%	1.80 – 3.66
		Gravel (2mm-60mm)	0.0 – 2.5%	
		Sand (0.06mm-2mm)	11.0 – 94.7%	
		Silt & Clay (<0.06mm)	5.3 – 89.0%	
PSD (pipette)	4	Gravel (2mm-60mm)	0%	0.00
		Sand (0.06mm-2mm)	32.7 – 53.4%	
		Silt (0.06mm-0.002mm)	41.3 – 56.7%	
		Clay (<0.002mm)	5.1 – 10.6%	

Table 6.4: Summary of silty Sand geotechnical laboratory test results

6.21 The particle size distribution tests confirm the granular Tidal Flat Deposits predominantly comprise sand, with little or no gravel present, with the exception of a sample from WS07 at 3.00m bgl, recording 11% sand and 89% fines. A test carried out on a sample from 3.00m bgl classified the material as a silt, however the remainder of the PSD tests confirmed the classification of 'silty SAND'. Coefficient of unity (Cu) values, where able to be calculated, provided values of between 1.80 and 3.66, indicating the material is uniform to moderately graded. The sedimentation by pipette analysis test results confirm the material descriptions of a silty Sand and indicate a negligible presence of clay within this material.

6.22 The particle size distribution sedimentation tests confirms the material predominantly comprises a sand with silt. Coefficient of unity (Cu) values of 0.00 were calculated, indicating the material is uniform.

Alluvium

6.23 Alluvium was recorded in the centre/south of the Site (BH03 and BH04), between depths of 8.10m and 10.10m bgl and with strata thicknesses of 1.40m and 2.00m respectively. This comprised a band of peat, approximately 15cm thick and described as '*soft to firm dark brown to black variably sandy spongy pseudofibrous to amorphous PEAT*' overlying a '*soft to firm becoming very soft blue grey silty CLAY. With occasional shelly fragments*'. The peat and top of the clay from BH04 were noted to have an odour of rotten eggs, indicating the presence of Hydrogen Sulphide (H_2S).

6.24 A total of 2No. SPT tests were undertaken within the Alluvial deposits, recording corrected N-values of N_{60}=1 to N_{60}=9, indicating that the material is of very low to low strength and corresponding to borehole strength descriptions of '*very soft*' to '*soft*', as detailed in the SPT depth plot, Appendix E.

Glacial Till

Granular Glacial Till

6.25 The Tidal Flat Deposits and Alluvium (southern section of Site), were underlain by granular Glacial Till deposits to depths of between 12.50m and 13.70m bgl. The granular Glacial Till was described as '*silty sandy fine to medium subangular to subrounded flint, chalk and very weak mudstone GRAVEL*'. Pockets of soft grey clay were recorded within these deposits.

6.26 A total of 8No. SPT tests were undertaken within the granular Glacial Till, recording corrected N-values of $(N_1)_{60}$ = 45 to $(N_1)_{60}$ = R , indicating that the material corresponds to borehole strength descriptions of '*dense*' to '*very dense*', as detailed in the SPT depth plot, Appendix E. During the formation of borehole BH05, 2No. SPT tests were undertaken within the granular Glacial Till, recording values of N=5 and N=7, indicating a '*loose*' classification. However, it is considered likely the borehole was overdrilled, artificially loosening the material prior to undertaking the tests and thus reducing the strength classification. Therefore, these test results have been discounted during analysis.

6.27 Laboratory PSD (wet sieve analysis) test results of Site won granular Glacial Till are summarised in Table 6.5, below, with laboratory test certificates presented in Appendix D.

Laboratory Test	No. of Tests	Material	Result Range	Cu
PSD (sieve)	4	Cobbles (>60mm)	0.0%	14.96 – 96.72
		Gravel (2mm-60mm)	22.8 – 71.5%	
		Sand (0.06mm-2mm)	28.3– 59.2%	
		Silt & Clay (<0.06mm)	0.2 – 18.0%	

Table 6.5: Summary of PSD (sieve) Glacial Till geotechnical laboratory results

6.28 The particle size distribution tests confirm the material is predominantly sand and gravel, with limited fines content present. Coefficient of unity (Cu) values were between 14.96 and 96.72, indicating the material is well graded.

Cohesive Glacial Till

6.29 The granular Glacial Till was underlain by cohesive Glacial Till to the maximum extent of the boreholes, 15.0m bgl. The cohesive Glacial Till was generally described as: '*very stiff dark grey silty gravelly CLAY. Gravel is subangular to subrounded fine to medium chalk and angular fine to medium flint*'.

6.30 A total of 3No. SPT tests were undertaken within the cohesive Glacial Till, recording corrected N-values of N_{60}=43 to N_{60}=R, indicating that the material is high strength and corresponding to borehole strength descriptions of '*very stiff*', as detailed in the SPT depth plot, Appendix E.

6.31 Laboratory geotechnical test results of the cohesive Glacial Till are summarised in Table 6.6, below:

Laboratory Test	No. of Tests	Result Range
Moisture Content	4	17 – 18%
Plasticity Index	3	Clay: 19 – 21% (CL to CI)

Table 6.6: Summary of cohesive Glacial Till geotechnical laboratory results

6.32 The laboratory geotechnical test results of the Tidal Flat deposits indicate the material is of very low to low plasticity (see Plasticity Chart, Appendix E) and therefore of low volume change potential. The 'Moisture Content Depth Plot', Appendix E indicates no significant change in moisture with depth.

Groundwater

6.33 During exploratory hole formation, groundwater strikes were recorded across the Site at depths of between 0.90m and 3.00m bgl. Subsequent monitoring of groundwater standpipes on 6No. occasions recorded groundwater at levels of between 1.0m and 2.09m bgl, but generally at 1.20m bgl, as summarised in Table 6.7 below. The groundwater monitoring results presented in full in Appendix F.

Monitoring Location	Minimum recorded Level (m bgl)	Maximum recorded Level (m bgl)
WS01	1.06	1.56
WS03	1.08	1.68
WS06	1.09	1.69
WS07	1.02	1.66
WS13	1.00	2.09
BH03	1.16	1.68

Table 6.7: Summary of groundwater monitoring results

Visual and Olfactory Observations of Contamination

6.34 No significant visual or olfactory evidence of contamination was identified during exploratory hole formation across the Site.

7.0 CONTAMINATION ASSESSMENT

Soil Contamination

7.1 The soil characteristics have been assessed with reference to Land Quality Management (LQM) / Chartered Institute of Environmental Health (CIEH) 'Suitable 4 Use Levels' (S4ULs) for human health risk assessment (2015). In the case of lead a DEFRA Category 4 Screening Level has been adopted.

7.2 A Tier 1 (semi-quantitative) risk assessment has been undertaking comparing soil chemical testing results against current and appropriate published guidelines for residential end use with home grown produce and using the organic matter results (average across Site of 1.8%).

7.3 This assessment along with the laboratory test certificates are provided in Appendix C.

Tier 1 Assessment

7.4 All potential contaminants of concern underlying the Site, were confirmed as being less than the assessment criteria in all the samples collected and tested.

7.5 There were no traces of asbestos found within any of the samples tested.

7.6 There were no elevated levels of herbicides or pesticides recorded within any of the samples tested.

Ground Gas Monitoring

7.7 A total of six rounds of ground gas monitoring were undertaken within the installed wells since completion of the fieldwork between 21 November 2019 and 22 April 2020, with two of the visits during low and falling barometric pressure conditions (<1005mbar).

7.8 Measurements of concentrations of methane, carbon dioxide and oxygen gases were taken within each monitoring well followed by the measurement of gas flow using a GA5000 infrared gas analyser with flow pod.

7.9 There was no detectable presence of methane above the analyser detection limit (0.1% by volume), with the exception of a brief spike concentration of 0.9% recorded in BH03 although monitoring over a 10 minute period this returned to a stable methane concentrations of 0.0% by volume.

7.10 There were no significantly elevated stable concentrations of carbon dioxide (CO_2) recorded across the Site, with concentrations ranging between 0.1 and 1.4% by volume with the highest recorded in borehole WS08 (centre of the Site).

7.11 No sample positions recorded significantly depleted Oxygen (O_2) concentration, with concentrations ranging from 19.0% to 22.0% by volume.

7.12 A low flow of ground gas was recorded across the with a maximum flow of 0.4l/hr at exploratory hole WS13. Negligible flows were recorded at the remaining positions of 0.0l/hr to 0.2l/hr.

7.13 Negative flows were recorded in BH03, with flow trends rising towards a zero flow value over a monitoring period of 2 minutes (assessed to be stabilising negative pressures within the standpipe). It should be noted that water levels in this installation standpipe was above the response zone, which tends to affect downhole pressures and the gas flows recorded.

7.14 The results of the ground gas monitoring are provided in Appendix F.

Gas Risk Assessment

7.15 The assessment of gas risk uses the gas concentrations present and the flow rate measured, which gives a gas screening value (GSV). Using this method and the worst-case measurements (Ref: BS 8485: 2015+A1:2019), the GSV for the areas identified across this Site have been established and a gas risk rating assigned in accordance with the 'traffic light' system outlined in the NHBC Guidance on Evaluation of Development Proposals on sites where Methane and Carbon Dioxide are present (March 2007).

7.16 The 'traffic light' system enables the assessment of derived GSVs against pre-determined gas screening values, as well as consideration to typical maximum concentrations, for methane and carbon dioxide. The screening values and typical maximum concentrations along with the gas protection measures required are outlined in Table F1 and F2 in Appendix F.

7.17 The worst case GSVs have been determined using the highest initial methane and stable carbon dioxide concentrations detected and the highest gas flow measured (0.4l/hr) on the site using the monitoring results and the worst case GSVs are:

- Methane (0.9%) x gas flow (0.4l/hr gives a GSV of 0.0036; and
- Carbon dioxide (1.4%) x gas flow (0.4l/hr) gives a GSV of 0.0056.

7.18 These GSVs indicate an NHBC 'green' classification for both methane and carbon dioxide with no ground gas protection measures considered necessary within the proposed future development.

8.0 GEOTECHNICAL APPRAISAL

General

8.1 This section of the report should be read in conjunction with Section 6.0 (Ground Conditions), which indicates the Site is underlain by Topsoil to a maximum depth of 0.40m, underlain by interbedded Tidal Flat deposits comprising silt, clay and a thin band of peat, overlying variably silty sand to approximately 8.00m in the centre/south and approximately 11.00m in the north of the Site. This was underlain by very soft Alluvium with a minor peat layer to approximately 9.60m, underlain by granular and cohesive Glacial Till to the extents of the boreholes. Alluvium was not encountered in the north of the Site. The bedrock of the Oxford Clay was not encountered.

8.2 Groundwater strikes were recorded across the Site at between 1.70m and 3.00m bgl, with minor perched water seepages encountered within the south of the Site at 0.90m bgl.

8.3 It is understood the Site is to be developed with residential properties up to three storeys in height.

Ground Model

8.4 Based on the material descriptions, *in situ* strength test results and geotechnical laboratory test results, Table 8.1 (below) details design parameters used for geotechnical design.

Material	Depth to base (m bgl)	Y (kN/m³)	SPT N-value	Cu (kPa)	Φ (°)
Topsoil	0.40	15[a]	-	-	-
Tidal Flat deposits: Clay, clayey Silt & clayey Sand	3.0	17[a]	N=5	-	4[a]
Tidal Flat deposits: Silty Sand	8.0	20[a]	N=30	-	34[a]
Alluvium	10 (southern section only)	15[a]	N=1	6	1
Glacial Till - Gravel	13.0	21[a]	N >50	-	43[a]
Glacial Till - Clay	>15.00	19[a]	N=42	180	25[a]
Groundwater	1.20m bgl				

Table 8.1: Geotechnical design parameters

[a] BS8002

[b] determined from *in situ* shear strength depth plot

Shallow Foundations

8.5 Shallow strip foundations were considered. However, due to the high water table, the variable nature of the underlying soils (cohesive and granular) and very soft / very loose strength properties of the near surface soils, the use of strip foundations as a foundation solution have been discounted.

8.6 Pad foundations taken to the granular Tidal Flat deposits at a depth of 2.0m bgl were considered. However, the weak soils will likely result in excavation collapse and blowing sands as a result of the shallow groundwater conditions.

8.7 It may be possible to utilise a raft foundation solution, utilising a cellular design to enable a thicker construction to increasing stiffness and reducing relative weight. Such a foundation will reduce settlement of proposed new structures. Soft spots, including the layer of peat encountered between 0.60m and 1.25m bgl, will need to be excavated out and backfilled to a suitable earthworks specification. At a nominal depth of 1.0m bgl, an allowable bearing capacity of 70kN/m^2 is calculated, as outlined below:

$$q_a = \frac{1}{F}\left(c.N_c.s_c + \sigma_0.N_q.s_q + \frac{1}{2}.B.\gamma.N_\gamma.s_\gamma\right)$$

where;

N_c, N_q and N_γ are bearing capacity factors
s_c, s_q and s_γ are shape factors
c' is the cohesive strength of the soil (kN/m^2)
B is the width of the foundation (m)
γ is the unit weight of the soil (kN/m^3)
σ_0 is the overburden pressure
F is a factor of safety against bearing capacity failure

8.8 Therefore, the allowable bearing capacity (q_a) for a 10m wide raft foundation (assumed width of a semi detached house) with a factor of safety of 3 is thus:

$$q_a = \frac{1}{3}\left(20 \times 5.14 \times 1 + 14.2 \times 1 \times 1 + \frac{1}{2} \times 10 \times 20 \times 1 \times 1\right)$$
$$q_a = \frac{1}{3}\left(102 + 14 + 100\right)$$
$$q_a = \mathbf{70kN/m^2}$$

Deep Foundations

8.9 On the basis strip and pad foundation solutions are not viable and a raft foundation solution would require the excavation of soft-spots and backfilling, it is recommended a piled

foundation solution be utilised to transfer the load of proposed new structures to deeper, more competent strata, as detailed in the following paragraphs.

Piled Foundations

8.10 The following paragraphs detail resistance calculations for a 300mm cross-section pre-cast concrete driven pile.

Design Factors

- $\Upsilon_{cu} = 1.25$
- $\Upsilon_{Rb} = 1.45$
- $\Upsilon_{Rs} = 1.30$

Pile Resistance

8.11 For the purposes of initial design and to allow for negative skin friction, the resistant properties from the interbedded Tidal Flat Deposits and Alluvium have been ignored.

- Pile resistance R = base resistance (Q_{bu}) + shaft resistance (Q_{su})

Base Resistance

8.12 The base resistance is calculated by: $Q_{bu} = (Ap.(N_q.\sigma'_q)/ \Upsilon_{Rb})$ where:

- Ap is the cross sectional area of the pile D_0^2
- σ'_q = effective vertical stress
- N_q is a bearing capacity factor

Shaft Resistance

8.13 The shaft resistance is determined by $Q_{su} = (\pi.D_0.\tau_{int}.dz)/ \Upsilon_{Rs}$

Where:

- $\tau_{int}=c_u.\alpha$ (cohesive soils): $\alpha = 0.5F_p\left(\frac{c_u}{\sigma'_{v0}}\right)^{-0.5}$
- $\tau_{int}=K\sigma'_{v0}\tan\delta'$ (drained conditions): δ is the interface friction angle; $K=1-\sin\emptyset'$
- D_0 is pile width
- dz is the layer thickness

Pile Resistances

8.14 For a 300mm square pre-cast concrete pile, the following resistances have been calculated.

	BaseResistance Q_{bu} (kN)	Shaft Resistance Q_{su} (kN)	Total Pile Resistance R (kN)
200mm	55	40	**95**
300mm	123	59	**182**

Table 8.2 Pre-cast pile design values

8.15 Ground conditions were seen to vary across the Site, with Alluvium (soft clay and Peat) recorded beneath the Tidal Flat Deposits within the southern section of the Site only. Therefore, calculated pile resistances are based on this worst-case scenario. Further, the above resistances are based on piles being driven into the very dense gravels by 1.0m. In the case of driven piles refusing on the top of the gravels, total resistances should be reduced by 18kN (200mm width) and 27kN (300mm).

Floor Slabs

8.16 Due to the ground conditions encountered, floor slabs should be suspended.

Pavements

8.17 Based on the guidance of Interim Advice Note 73-06 Revision 1, Design Guidance for Road Pavement Foundations (Chapter 3), the following sub-base values have been derived.

8.18 Laboratory testing of site soils gave an average CBR value of 0.7%.

8.19 Due to the low strength soils recorded at shallow depth, some form of ground improvement would be required prior to pavement construction.

8.20 A geogrid could be utilised to improve the ground stability for pavement design.

8.21 Following improvement in line with guidance of Interim Advice Note 73-06 Revision 1, Design Guidance for Road Pavement Foundations (Chapter 5.16), the new design CBR should be assumed to be equivalent to 2.5% in order to allow for effects of any softer underlying material and the potential reduction in the strength of the replacement material to its long-term CBR value. A 2.5% CBR for a Class 2 single foundation layer option (as per Figure 4.3, Interim Advice Note 73-06) of stiffness 150MPa would require a thickness of 350mm.

8.22 Formation level is to be inspected by a suitably qualified engineer and proof-rolled prior to sub-base placement. Any identified soft-spots are to be excavated out and backfilled with suitable engineered fill to an appropriate specification.

Excavations and Earthworks

8.23 In general, shallow cohesive soils should remain freestanding over the short to medium term. When excavating within granular soils (including silts), shoring should be used.

8.24 Where earthworks is required, targeted laboratory geotechnical testing is recommended and a detailed earthworks specification should be prepared. The earthworks specification should include an assessment of the typical parameters for the soil types anticipated and a programme of quality control.

8.25 Shallow groundwater was encountered during the site investigation and during subsequent monitoring. Therefore, some form of groundwater control should be anticipated.

Buried Concrete

8.26 Design/mix of buried concrete should be undertaken in accordance with the appropriate ACEC classification, of BRE Special Digest 1: 2005 (Concrete in Aggressive Ground. On the basis of the Site history, the geological setting, and observations during the formation of exploratory holes, the Site is considered to classify as "greenfield" and one that does not contain pyrite (i.e. sulphide).

8.27 A total of 21No. samples from within the shallow and deep site soils were subject to pH and SO_4 analysis. Results indicate soluble sulphate concentrations of between 4mg/l to 188mg/l. On the basis of these chemical test results, the Design Sulphate Class for the site is considered to be "DS-1".

8.28 Based on the shallow groundwater at the Site, the groundwater conditions can be described as 'mobile', with recorded soil pH values in the range of 7.77 to 8.65. On this basis, the "Aggressive Chemical Environment for Concrete (ACEC)" class for concrete in the ground is indicated to be AC-1^d. Design/mix of buried concrete should be undertaken in accordance with these classifications.

9.0 SOAKAGE ASSESSMENT

9.1 To assess the potential for sustainable drainage across the Site, 6Nø. soakaway tests were undertaken (TP01A – TP06A). These were undertaken in accordance with the guidance laid out in BRE365.

9.2 The soakage test results are presented in full along with the Trial Pit logs in Appendix B and the results summarised in Table 9.1, below.

Loc.	Pass / Fail	Lithology	Test Range (depth m)	Soil Infiltration rate (ms^{-1})
TP01A	Fail	Tidal Flat Deposits (Sandy CLAY and SILT with minor PEAT layer)	0.4 – 0.9	n/a
TP02	Fail	Tidal Flat Deposits (Sandy CLAY and SILT)	0.5 – 1.0	n/a
TP03	Pass	Tidal Flat Deposits (PEAT over clayey SILT)	0.5 – 1.0	Test No.1: 2.86E-06 Test No.2: 1.68E-06 Test No.3: 1.70E-06
TP04	Pass	Tidal Flat Deposits (PEAT over clayey SILT)	0.4 – 0.9	Test No.1: 2.88E-05 Test No.2: 2.66E-05 Test No.3: 2.31E-05
TP05	Pass	Tidal Flat Deposits (PEAT over clayey SILT)	0.5 – 1.0	Test No.1: 8.86E-07 Test No.2: 7.68E-07 Test No.3: 6.49E-07
TP06A	Pass	Tidal Flat Deposits (PEAT over clayey SILT)	0.4 – 0.9	Test No.1: 2.06E-05 Test No.2: 1.92E-05 Test No.3: 1.62E-05

Table 9.1: Summary of soakage test results

9.3 A general requirement for soakaway testing is that the excavation should drain half the volume over a period of 24 hours. The soakage tests carried out in the southwest, central and northern areas (TP03 to TP06A) were able to achieve this for three complete tests.

10.0 CONCLUSIONS & RECOMMENDATIONS

Conclusions

10.1 A Phase II Geo-Environmental Assessment of a Site at Holland Park, Spalding was undertaken for residential end-use.

10.2 The site investigation comprised a series of boreholes and trial pits across the Site to establish the ground conditions and determine the potential for ground, groundwater and ground gas contamination across the Site and assess the suitability for soakaways for surface water disposal.

10.3 The ground conditions across the Site generally comprised Topsoil to a depth of 0.40m, underlain by superficial Tidal Flat Deposits, comprising interbedded horizons of clay, clayey silt and clayey sand to a depth of 3.0m bgl, including a thin band of peat (up to 10cm thick) was recorded at depths of between 0.60m and 1.25m across the Site. The interbedded clays, silts and sands were underlain by further Tidal Flat deposits, comprising a silty Sand to a depth of 10.0m bgl. Within the southern section of the Site, the silty sand Tidal Flat Deposits were underlain by a layer of soft peaty Alluvium, being recorded at depths of between 8.10m and 10.10m bgl.

10.4 The Tidal Flat Deposits and Alluvium were underlain by Glacial sand and gravel to a depth of 13.0m bgl. The sand and gravel was underlain by cohesive Glacial Till (stiff clay) to the maximum extent of the boreholes (15.0m bgl).

10.5 Groundwater seepages were encountered 0.90m to 1.00m bgl, with moderate groundwater strikes across the Site at 1.70m and 2.10m bgl. Groundwater monitoring recorded groundwater at levels of between 1.0m and 2.09m bgl.

10.6 Laboratory chemical testing did not identify any concentrations of determinants, with respect to the assessment criteria of 'residential end use with home grown produce' above relevant screening levels no asbestos fibres were detected within tested samples. No traces of herbicides or pesticides were recorded above laboratory detection levels in the samples collected and tested.

10.7 Due to the highly variable and soft ground conditions, coupled with a high groundwater table, shallow strip and pad foundations are not recommended for proposed new structures at the Site. A cellular raft foundation solution should be feasible although a piled foundation option is recommended.

10.8 Driven pre-cast concrete square piles socketed into the dense gravels would provide resistances of 94kN (200mm width) and 182kN (300mm width) for an 11m pile.

10.9 Based on the ground conditions recorded and a piled foundation option adopted, slabs should be suspended.

10.10 Due to the low strength soils recorded at shallow depth ground improvement would be required prior to pavement construction, possibly in conjunction with the use of a geogrid. Following improvement, a 2.5% CBR for a Class 2 single foundation layer option of stiffness 150MPa would require a thickness of 350mm.

10.11 Buried concrete should be classified as DS-1, with an ACEC classification of AC-1[d].

10.12 Shallow excavations within cohesive soils may offer short to medium-term stability although excavations in granular soils will require shoring. Shallow groundwater was encountered during the site investigation and during subsequent monitoring. Therefore, some form of groundwater control should be anticipated.

Recommendations

10.13 Based on the findings of the site investigation works undertaken, no remedial works are considered necessary at the Site.

10.14 Prior to any earthworks, targeted laboratory geotechnical testing is recommended and a detailed earthworks specification prepared.

11.0 REFERENCES

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V. DEFRA / Environment Agency, Model Procedures for the Management of Land Contamination, CLR11, September 2004.

VI. DEFRA, Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance, April 2012

VII. Department for Communities and Local Government. National Planning Policy Framework. February 2019.

VIII. Department of the Environment, Transport and the Regions, Environment Agency and Institute of Environmental Health. Guidelines for Environmental Risk Assessment and Management. HMSO July 2000.

IX. ENVIRONMENT AGENCY. Guidance for the Safe Development of Housing on Land Affected by Contamination R&D Publication 66, 2008.

X. HIGHWAYS AGENCY. Design Manual for Roads and Bridges, Volume 7, Section 3 Part 2, 2008.

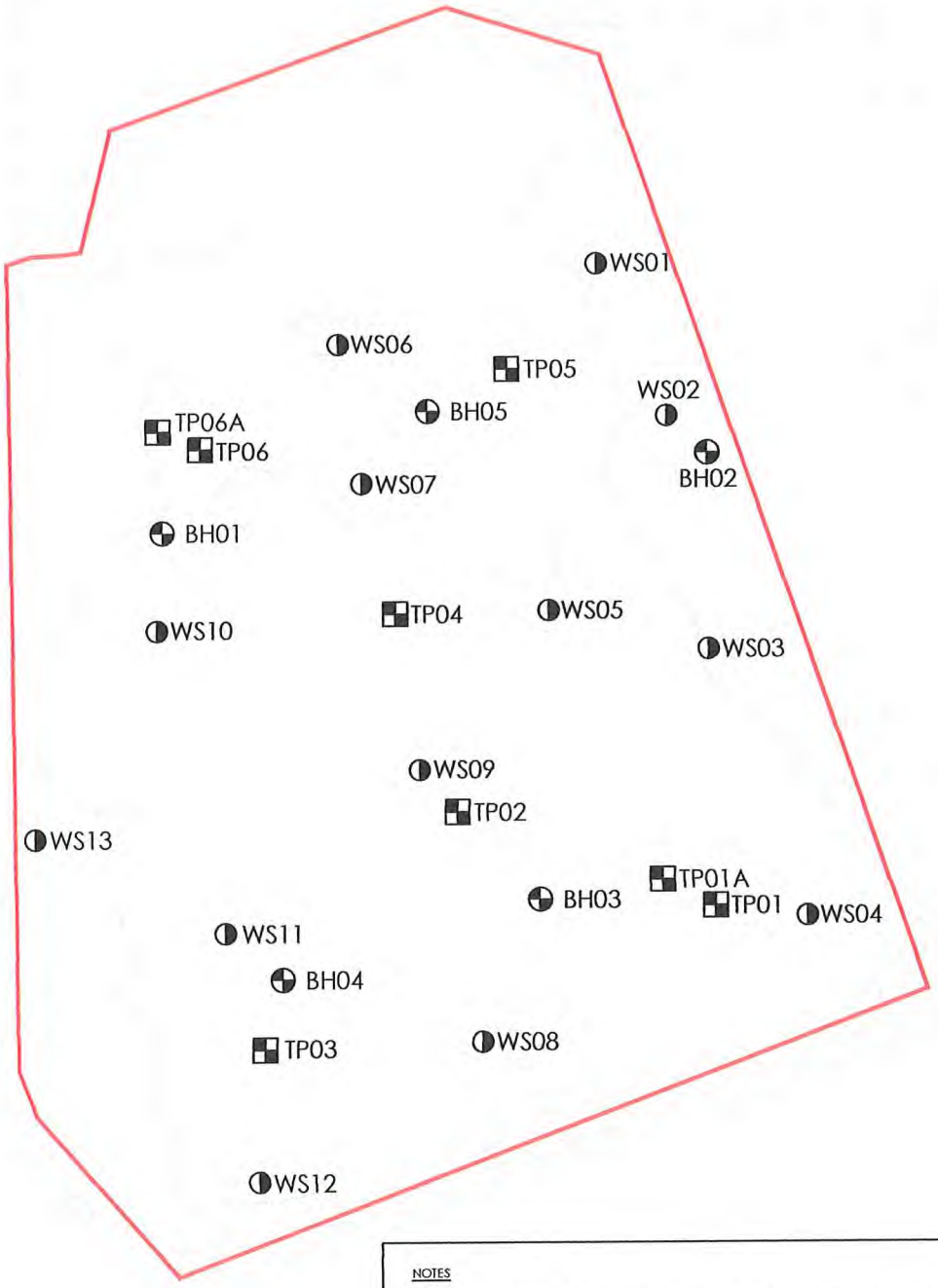
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XII. NHBC and Environment Agency. Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008 Volume 1.

APPENDICES

APPENDIX A

EXPLORATORY HOLE LOCATION PLAN



NOTES

1. THIS DRAWING IS BASED ON TOPOGRAPHIC SURVEY 18-184-01 REV A BY DANIEL CHARLES SURVEYS LTD DATED 02/10/2018.

KEY

WINDOW SAMPLER BOREHOLE LOCATION — WS01

MACHINE EXCAVATED TRIAL PIT LOCATION — TP01

CABLE PERCUSSIVE BOREHOLE LOCATION — BH01

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REV	DATE	AMENDMENT DETAILS	DRAWN	APPROVED
B	17.09.20	ADDED BH05 TO PLAN	TT	TB
A	28.02.20	Added Cable Percussive Borehole Locations	SG	TB

PROJECT: HOLLAND PARK, SPALDING	DATE: 11.11.19	DRAWING STATUS: INFORMATION	
	SCALE(S): 1:2000	DESIGNED: SG	DRAWN: SG
DRAWING TITLE: EXPLORATORY HOLE LOCATION PLAN		CHECKED: TB	APPROVED: TB
	JOB No: 501		
CLIENT: BROADGATE HOMES	DRAWING No: 10/001	REVISION: B	

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APPENDIX B

EXPLORATORY HOLE LOGS, *IN SITU* DCP TESTING AND SOAKAGE TEST RESULTS

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Trial Pit Log

Trialpit No **TP01** Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523292.50 - 321029.10 Level: 2.56	Date 04/11/2019
Location: Spalding		Dimensions (m): Depth 2.00, 1.5, 0.45	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	ES		0.40	2.16		Brown silty fine to medium sand. With rootlets. TOPSOIL.
			HVR=72	0.65	1.91		Light brown to orange brown slightly sandy CLAY/SILT. Sand is fine. TIDAL FLAT DEPOSITS.
				0.69	1.87		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
			HVR=50				Soft grey brown mottled orange brown slightly sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
			HVR=39				
▼				2.00	0.56		End of pit at 2.00 m

1
2
3
4

Remarks:
1. TP01 halted at 2.00m, target depth reached
2. Groundwater seepage encountered at 1.90m
3. Trial pit backfilled with arisings to surface
4. Location moved to TP01A to target shallow ground for soakage testing
5. HVR = In situ Hand Shear Vane test result

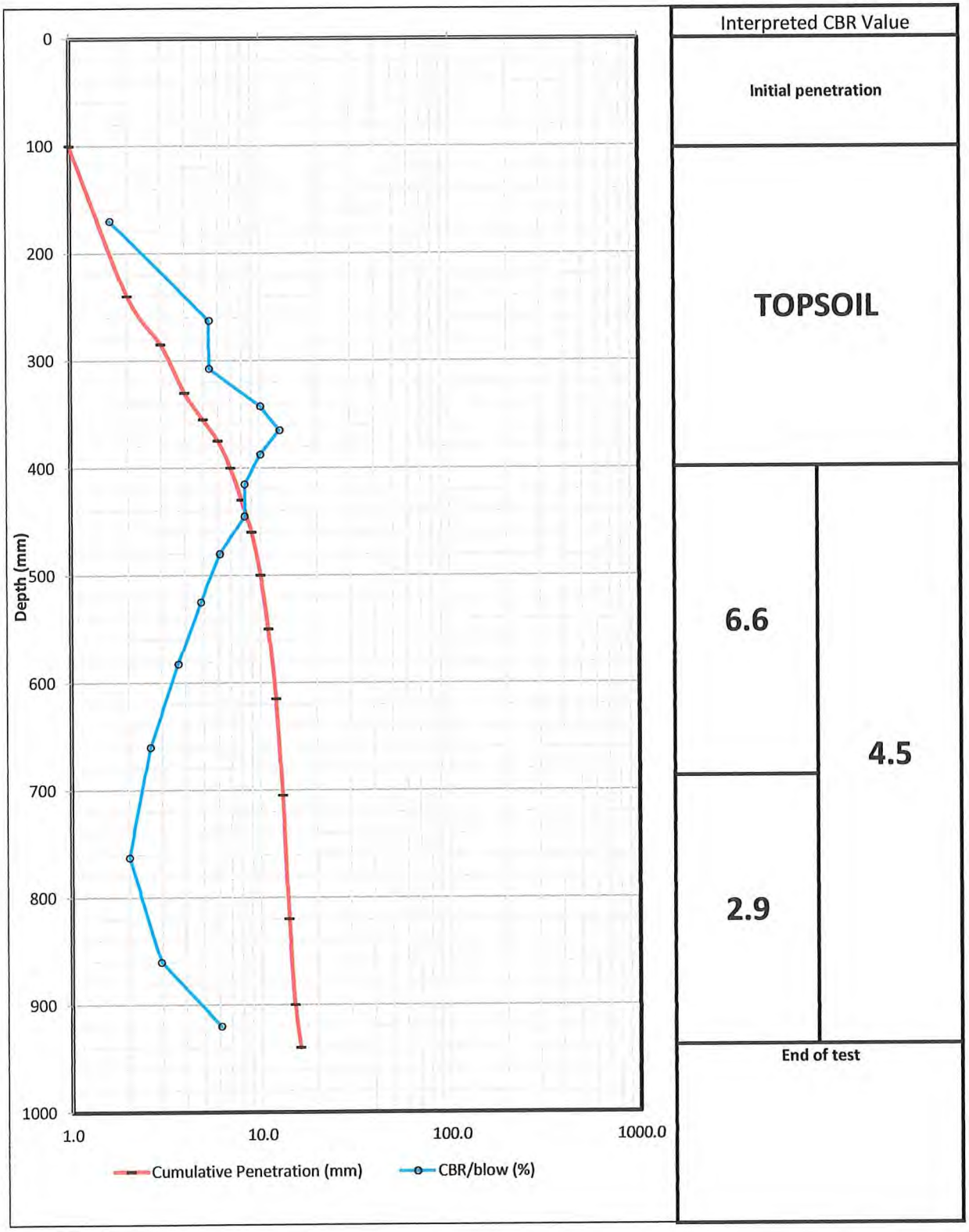
Stability: Stable

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	
	TP01
	DCP01



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
6.6	4.5
2.9	
End of test	

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Trial Pit Log

Trialpit No
TP01A
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523277.60 - 321036.40 Level: 2.63	Date 04/11/2019
Location: Spalding		Dimensions (m): 1.3 × 0.45 Depth 0.90	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Brown silty fine to medium sand. With rootlets. TOPSOIL.
				0.40	2.23		
	0.50	ES					Light brown to orange brown slightly sandy CLAY/SILT. Sand is fine. TIDAL FLAT DEPOSITS.
				0.65	1.98		
				0.69	1.94		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
				0.90	1.73		Soft grey brown mottled orange brown slightly sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
							End of pit at 0.90 m

Remarks:
1. TP01A halted at 0.90m, target depth reached
2. No groundwater encountered
3. Trial pit backfilled with gravel to 0.40m and arisings to surface
4. Soakage testing carried out between 0.40m and 0.90m

Stability: Stable

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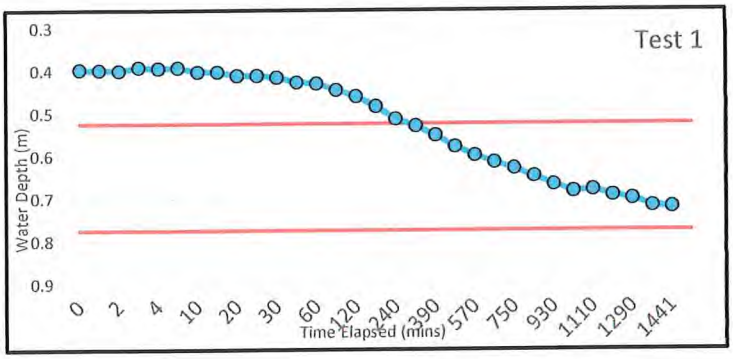
Location	TP01A

Site:	Holland Park, Spalding
Client:	Broadgate Homes
Job No:	P13-501

Location	523277.6 E 321036.4 N
Elevation	2.63 m
Date	04/11/2019

Trial Pit Dimensions (m)	
Length	1.30
Width	0.45
Depth	0.90
Test volume (m^3)	0.29
Effective Depth	0.50

Soil type at test level	Sandy CLAY and SILT with minor PEAT layer.		
Groundwater	Not encountered	**Stone Filled?**	Yes
Sidewall stability	Stable, vertical	**Voids Ratio (%)**	0.41



V_{p75-25} (m^3)	n/a
A_{S50} (m^2)	n/a
t_{p75-25} (mins)	n/a
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**Test Failed**

Time (mins)	Test 1	Test 2	Test 3
0	0.40	-	-
1	0.40	-	-
2	0.40	-	-
3	0.39	-	-
4	0.39	-	-
5	0.39	-	-
10	0.40	-	-
15	0.40	-	-
20	0.41	-	-
25	0.41	-	-
30	0.42	-	-
45	0.43	-	-
60	0.43	-	-
90	0.45	-	-
120	0.46	-	-
180	0.48	-	-
240	0.51	-	-
300	0.53	-	-
390	0.55	-	-
480	0.58	-	-
570	0.60	-	-
660	0.62	-	-
750	0.63	-	-
840	0.65	-	-
930	0.67	-	-
1020	0.68	-	-
1110	0.68	-	-
1200	0.69	-	-
1290	0.70	-	-
1380	0.72	-	-
1441	0.72	-	-
		-	-

Remarks

1 Soakage testing carried out between 0.5m and 1.0m
2 Datalogger number 580856
3 Test 1 carried out on 04/11/2019
4 Test failed due to insufficient drainage in 24 hour period

Analysis by: SG
Checked by: TB

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Trial Pit Log

Trialpit No
TP02
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523219.70 - 321055.40 Level: 2.79	Date 04/11/2019
Location: Spalding		Dimensions (m): 1.4 × 0.45 Depth 1.00	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES					Brown silty fine to medium sand. With rootlets. TOPSOIL.
				0.35	2.44		
				0.40	2.39		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
			HVR=75				Soft grey brown mottled orange brown slightly sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
			HVR=45	1.00	1.79		End of pit at 1.00 m

1
2
3
4

Remarks:
1. TP02 halted at 1.00m, target depth reached
2. No groundwater encountered
3. Trial pit backfilled with gravel to 0.50m and arisings to surface
4. Soakage testing carried out between 0.50m and 1.00m
5. HVR = In situ Hand Shear Vane test result

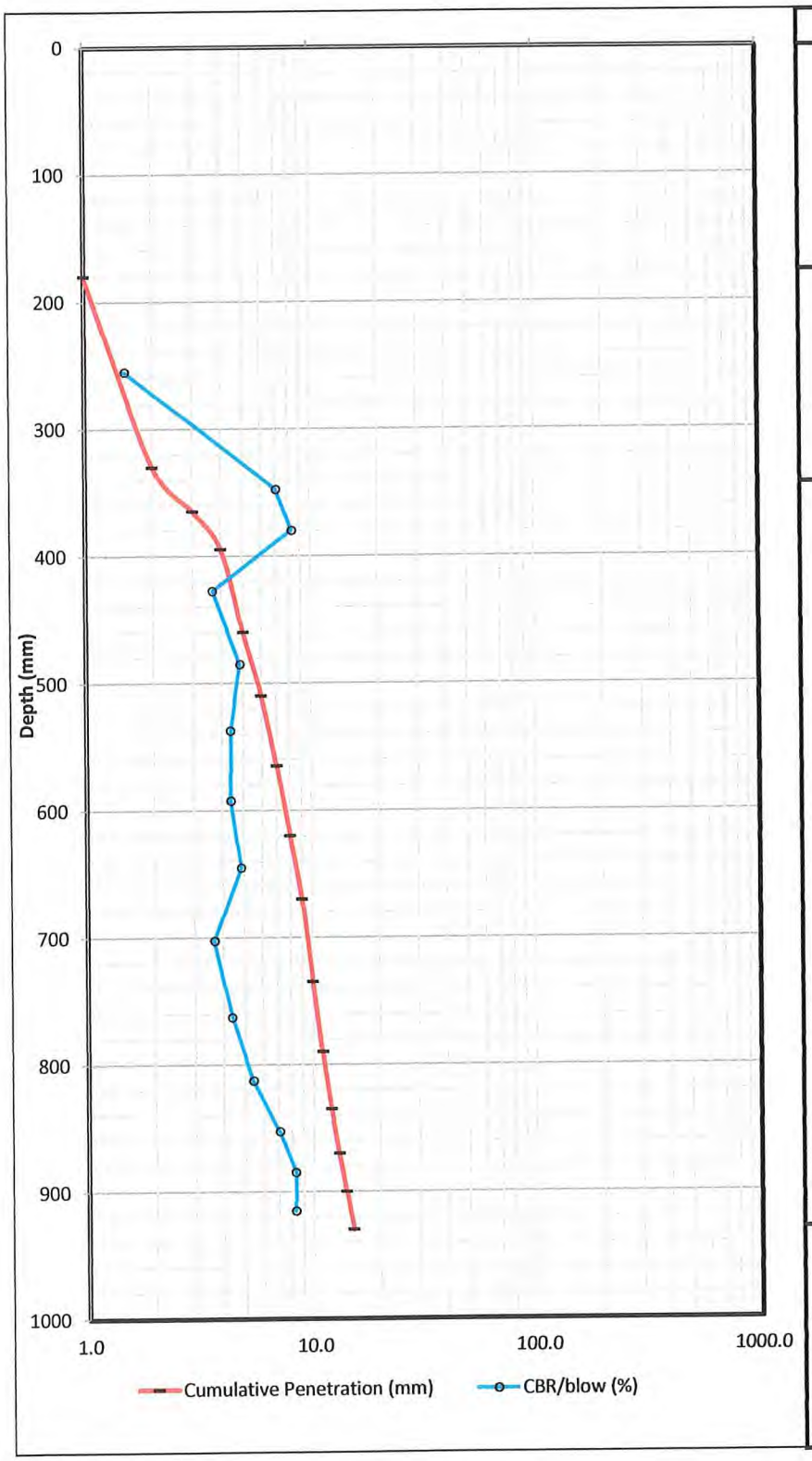
Stability: Stable

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	TP02
	DCP02



Interpreted CBR Value
Initial penetration
TOPSOIL
5.1
End of test

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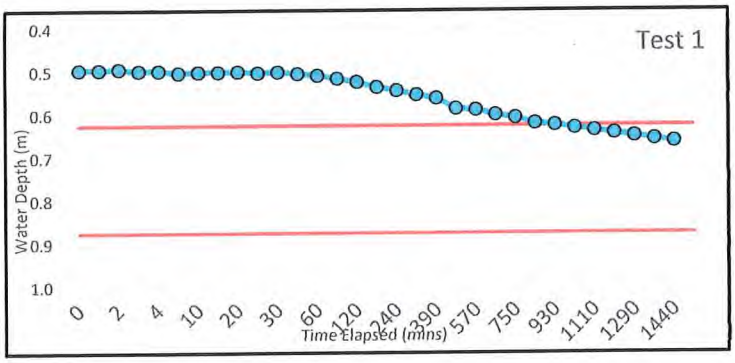
Location	TP02

Site:	Holland Park, Spalding
Client:	Broadgate Homes
Job No:	P13-501

Location	523219.7 E 321055.4 N
Elevation	2.79 m
Date	04/11/2019

Trial Pit Dimensions (m)	
Length	1.40
Width	0.45
Depth	1.00
Test volume (m^3)	0.32
Effective Depth	0.50

Soil type at test level	Sandy CLAY and SILT.		
Groundwater	Not encountered	**Stone Filled?**	Yes
Sidewall stability	Stable, vertical	**Voids Ratio (%)**	0.41



V_{p75-25} (m^3)	n/a
A_{S50} (m^2)	n/a
t_{p75-25} (mins)	n/a
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**Test Failed**

Time (mins)	Test 1	Test 2	Test 3
0	0.50	-	-
1	0.50	-	-
2	0.49	-	-
3	0.50	-	-
4	0.50	-	-
5	0.50	-	-
10	0.50	-	-
15	0.50	-	-
20	0.50	-	-
25	0.50	-	-
30	0.50	-	-
45	0.50	-	-
60	0.51	-	-
90	0.52	-	-
120	0.52	-	-
180	0.54	-	-
240	0.54	-	-
300	0.55	-	-
390	0.56	-	-
480	0.59	-	-
570	0.59	-	-
660	0.60	-	-
750	0.61	-	-
840	0.62	-	-
930	0.62	-	-
1020	0.63	-	-
1110	0.64	-	-
1200	0.64	-	-
1290	0.65	-	-
1380	0.66	-	-
1440	0.66	-	-
		-	-

Remarks

1 Soakage testing carried out between 0.5m and 1.0m
2 Datalogger number 581410
3 Test 1 carried out on 04/11/2019
4 Test failed due to insufficient drainage in 24 hour period

Analysis by: SG
Checked by: TB

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Trial Pit Log

Trialpit No
TP03
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523164.90 - 320989.10 Level: 2.87	Date 04/11/2019
Location: Spalding		Dimensions (m): 1.4 × 0.45, Depth 1.00	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	ES					Brown silty fine to medium sand. With rootlets. TOPSOIL.
	0.40	ES		0.35	2.52		Light brown to orange brown slightly sandy CLAY/SILT. Sand is fine. TIDAL FLAT DEPOSITS.
			HVR=72	0.55	2.32		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
				0.60	2.27		Soft to firm grey brown clayey SILT. TIDAL FLAT DEPOSITS.
			HVR=61	1.00	1.87		End of pit at 1.00 m

Remarks:
1. TP03 halted at 1.00m, target depth reached
2. No groundwater encountered
3. Trial pit backfilled with gravel to 0.50m and arisings to surface
4. Soakage testing carried out between 0.50m and 1.00m
5. HVR = In situ Hand Shear Vane test result

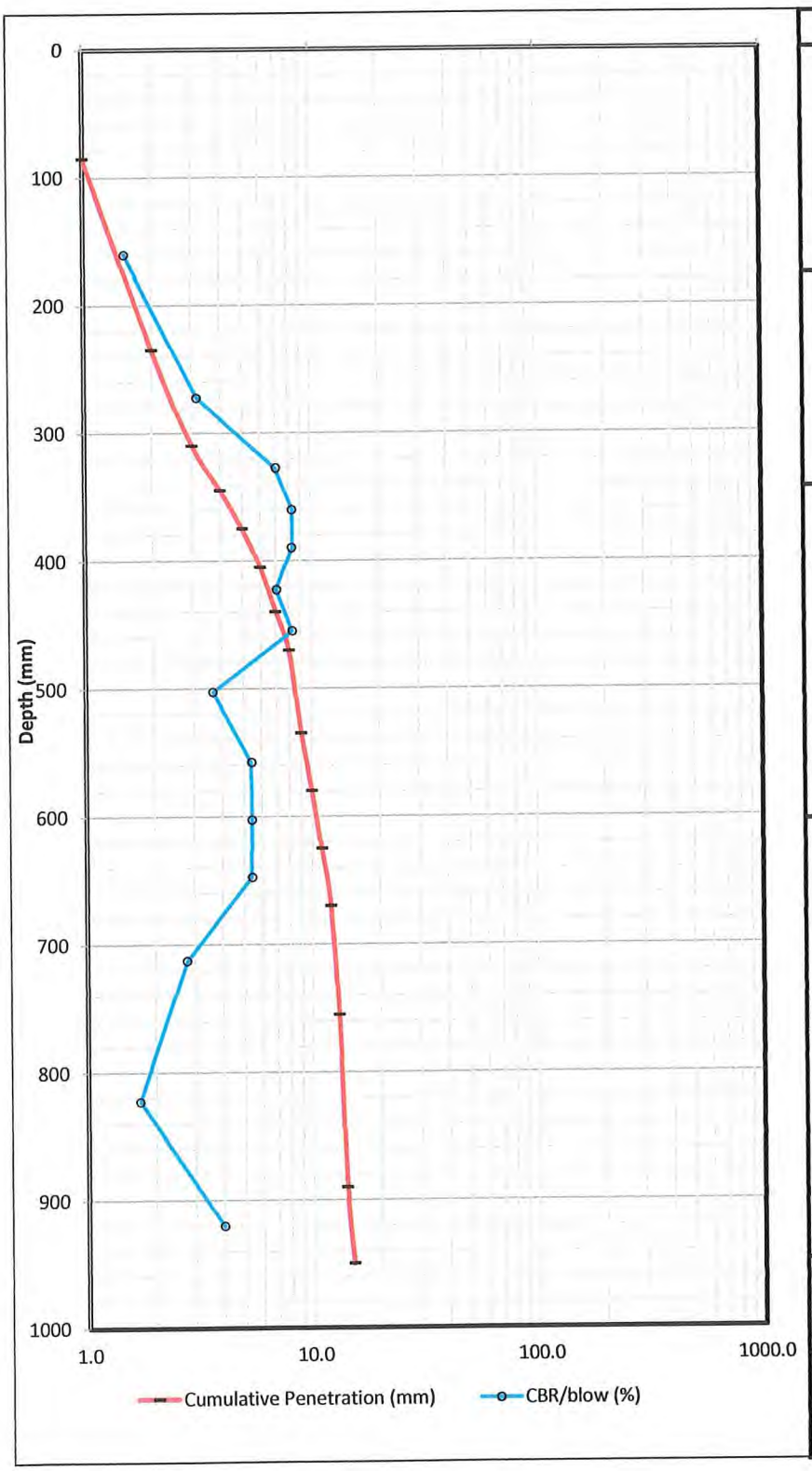
Stability: Stable

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	TP03
	DCP03



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
6.3	4.5
3.2	
End of test	

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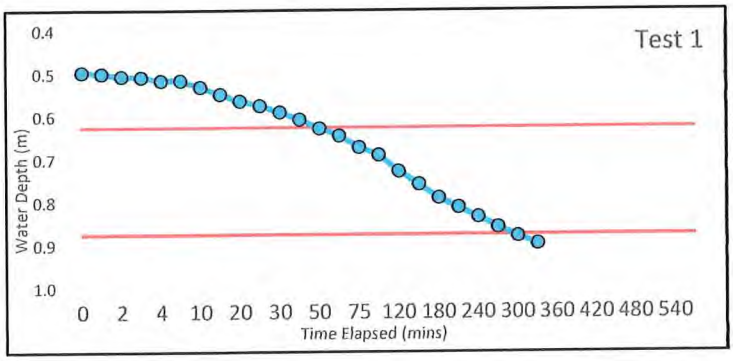
Location	TP03

Site:	Holland Park, Spalding
Client:	Broadgate Homes
Job No:	P13-501

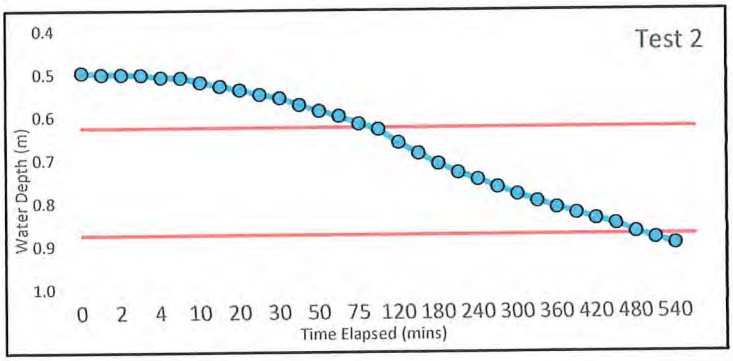
Location	523164.9 E 320989.1 N
Elevation	2.87 m
Date	04/11/2019

Trial Pit Dimensions (m)	
Length	1.40
Width	0.45
Depth	1.00
Test volume (m^3)	0.32
Effective Depth	0.50

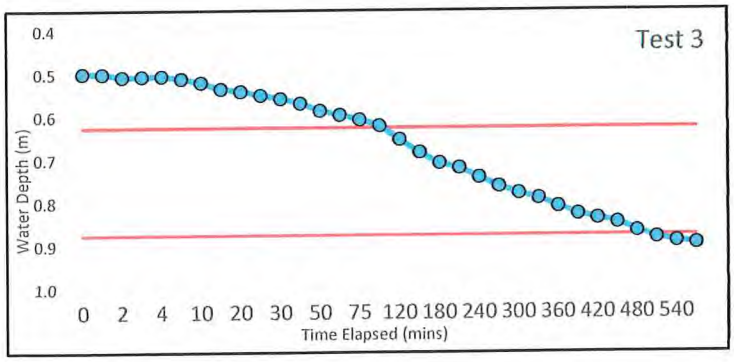
Soil type at test level	PEAT over clayey SILT.		
Groundwater	Not encountered	Stone Filled?	Yes
Sidewall stability	Stable, vertical	Voids Ratio (%)	0.41



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	241
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	2.86E-06



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	410
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	1.68E-06



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	405
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	1.70E-06

Time (mins)	Test 1	Test 2	Test 3
0	0.50	0.50	0.50
1	0.50	0.50	0.50
2	0.51	0.50	0.51
3	0.51	0.50	0.51
4	0.52	0.51	0.50
5	0.52	0.51	0.51
10	0.53	0.52	0.52
15	0.55	0.53	0.53
20	0.56	0.54	0.54
25	0.57	0.55	0.55
30	0.59	0.56	0.56
40	0.61	0.57	0.57
50	0.63	0.59	0.59
60	0.64	0.60	0.60
75	0.67	0.62	0.61
90	0.69	0.63	0.62
120	0.73	0.66	0.65
150	0.76	0.69	0.68
180	0.79	0.71	0.71
210	0.81	0.73	0.72
240	0.83	0.75	0.74
270	0.86	0.76	0.76
300	0.88	0.78	0.78
330	0.90	0.80	0.79
360		0.81	0.81
390		0.83	0.83
420		0.84	0.84
450		0.85	0.85
480		0.87	0.87
510		0.88	0.88
540		0.90	0.89
546			0.90

Remarks

1 Soakage testing carried out between 0.5m and 1.0m
2 Datalogger number 493231
3 Test 1 carried out on 04/11/2019
4 Test 2 carried out on 05/11/2019
5 Test 3 carried out on 06/11/2019

Analysis by: SG
Checked by: TB

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Trial Pit Log

Trialpit No
TP04
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523202.30 - 321110.80 Level: 2.84	Date 04/11/2019
Location: Spalding		Dimensions (m): 1.4 × 0.45, Depth 0.90	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	ES		0.30	2.54		Brown silty fine to medium sand. With rootlets. TOPSOIL.
				0.55	2.29		Light brown mottled orange brown sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
			HVR=64	0.60	2.24		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
				0.90	1.94		Soft grey mottled orange brown slightly slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
			HVR=58				End of pit at 0.90 m

Remarks:
1. TP04 halted at 0.90m, target depth reached
2. No groundwater encountered
3. Trial pit backfilled with gravel to 0.40m and arisings to surface
4. Soakage testing carried out between 0.40m and 0.90m
5. HVR = In situ Hand Shear Vane test result

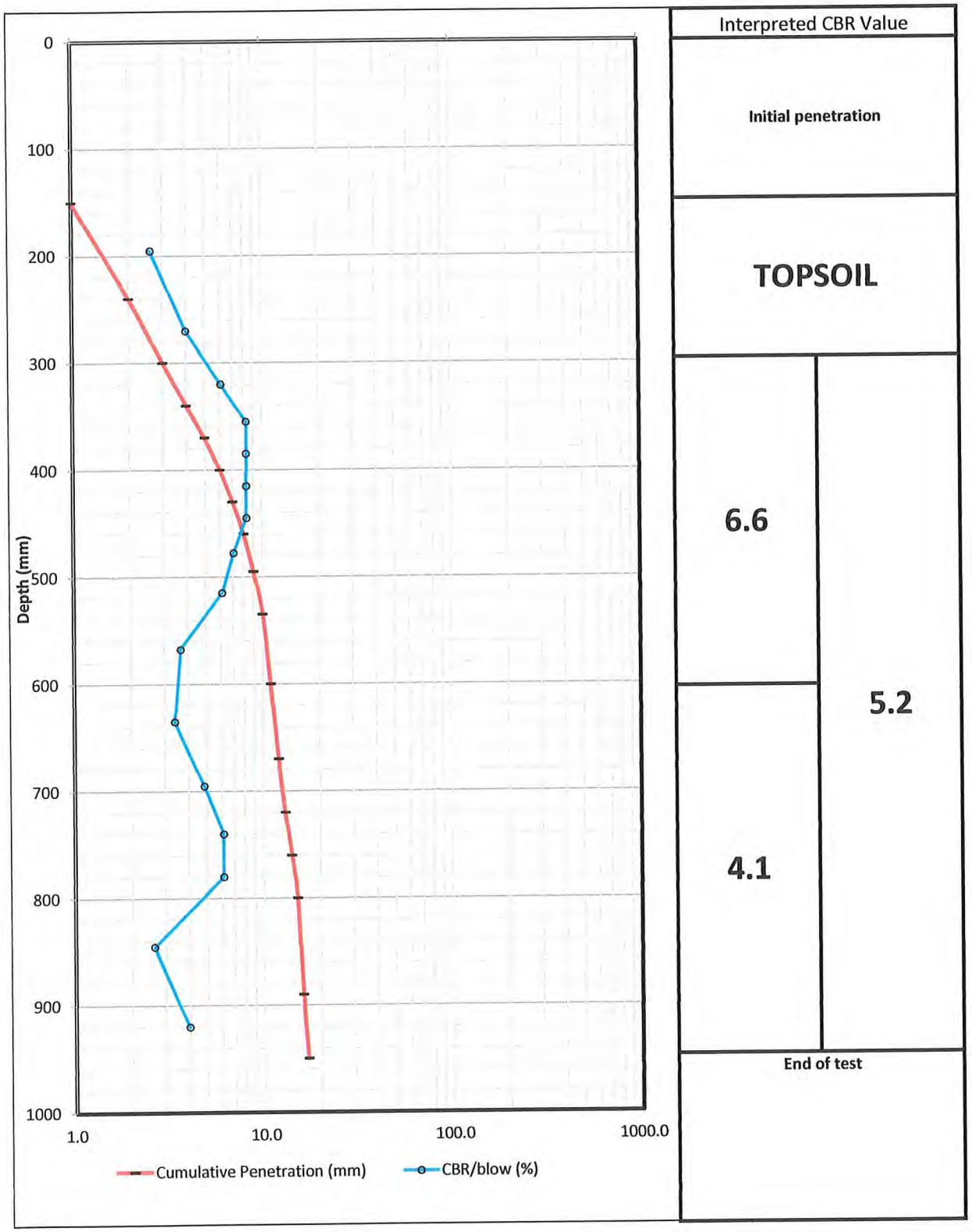
Stability: Stable

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	TP04
	DCP04



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
6.6	5.2
4.1	
End of test	

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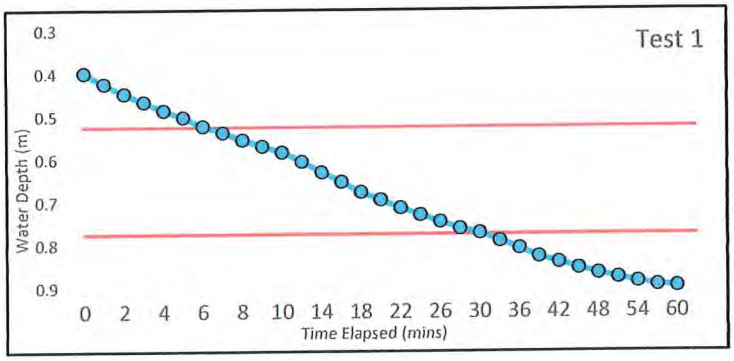
Location	TP04

Site:	Holland Park, Spalding
Client:	Broadgate Homes
Job No:	P13-501

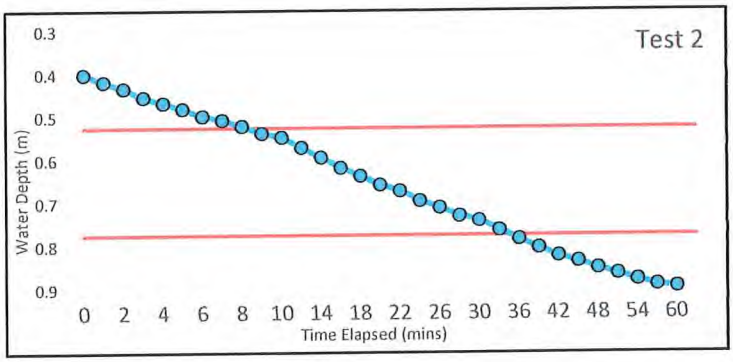
Location	523202.3 E 321110.8 N
Elevation	2.84 m
Date	04/11/2019

Trial Pit Dimensions (m)	
Length	1.40
Width	0.45
Depth	0.90
Test volume (m^3)	0.32
Effective Depth	0.50

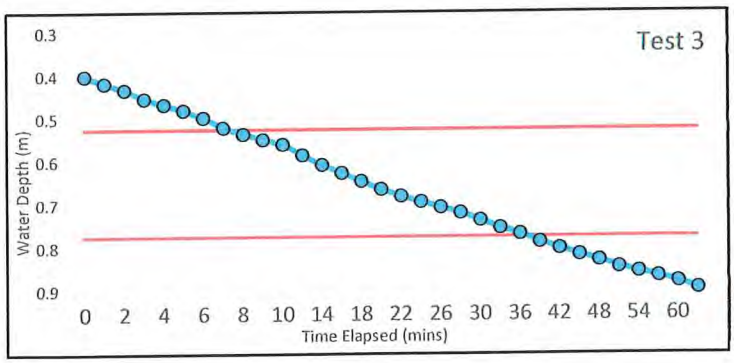
Soil type at test level	PEAT over clayey SILT.		
Groundwater	Not encountered	Stone Filled?	Yes
Sidewall stability	Stable, vertical	Voids Ratio (%)	0.41



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	24
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	2.88E-05



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	26
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	2.66E-05



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	30
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	2.31E-05

Time (mins)	Test 1	Test 2	Test 3
0	0.40	0.40	0.40
1	0.42	0.42	0.42
2	0.45	0.43	0.43
3	0.47	0.45	0.45
4	0.49	0.47	0.47
5	0.50	0.48	0.48
6	0.52	0.50	0.50
7	0.54	0.51	0.52
8	0.55	0.52	0.54
9	0.57	0.54	0.55
10	0.58	0.55	0.56
12	0.61	0.57	0.58
14	0.63	0.59	0.61
16	0.65	0.62	0.63
18	0.68	0.64	0.65
20	0.69	0.66	0.66
22	0.71	0.67	0.68
24	0.73	0.69	0.69
26	0.75	0.71	0.71
28	0.76	0.73	0.72
30	0.77	0.74	0.74
33	0.79	0.76	0.75
36	0.81	0.78	0.77
39	0.83	0.80	0.79
42	0.84	0.82	0.80
45	0.85	0.84	0.82
48	0.87	0.85	0.83
51	0.88	0.86	0.85
54	0.89	0.88	0.86
57	0.89	0.89	0.87
60	0.90	0.90	0.88
65			0.90

Remarks

1 Soakage testing carried out between 0.4m and 0.9m
2 Datalogger number 401493
3 Test 1 carried out on 04/11/2019
4 Test 2 carried out on 04/11/2019
5 Test 3 carried out on 05/11/2019

Analysis by: SG
Checked by: TB

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Trial Pit Log

Trialpit No **TP05** Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523234.30 - 321179.30 Level: 2.83	Date 04/11/2019
Location: Spalding		Dimensions (m): Depth 1.00 — 1.5 × 0.45	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	ES		0.40	2.43		Brown silty fine to medium sand. With rootlets. TOPSOIL.
	0.45	ES		0.55	2.28		Light brown mottled orange brown sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
			HVR=70	0.58	2.25		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
			HVR=36	1.00	1.83		Grey brown mottled orange brown slightly sandy clayey SILT. TIDAL FLAT DEPOSITS.
							End of pit at 1.00 m

Remarks:
1. TP05 halted at 1.00m, target depth reached
2. No groundwater encountered
3. Trial pit backfilled with gravel to 0.50m and arisings to surface
4. Soakage testing carried out between 0.50m and 1.00m
5. HVR = In situ Hand Shear Vane test result

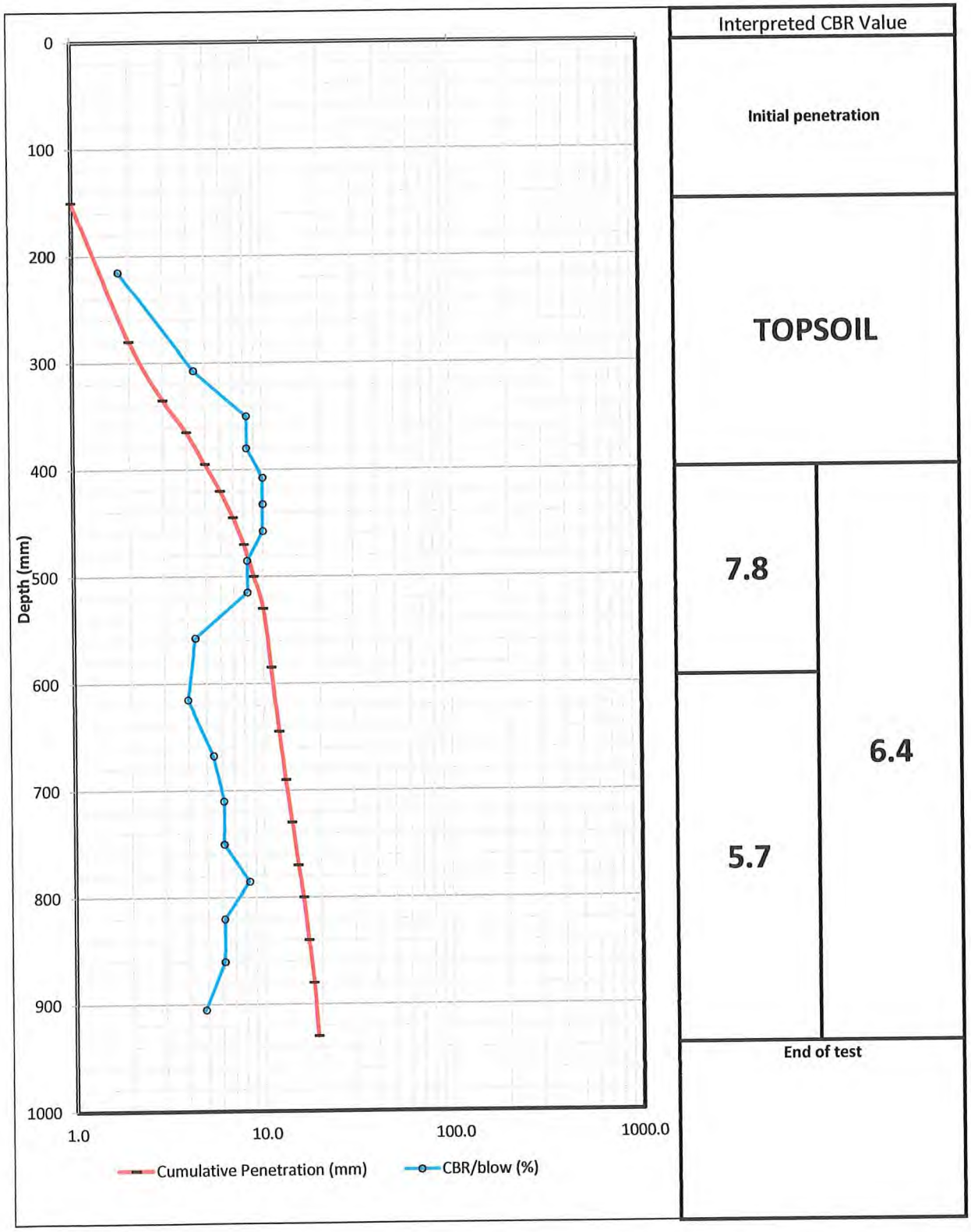
Stability: Stable

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	TP05
	DCP05



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
7.8	6.4
5.7	
End of test	

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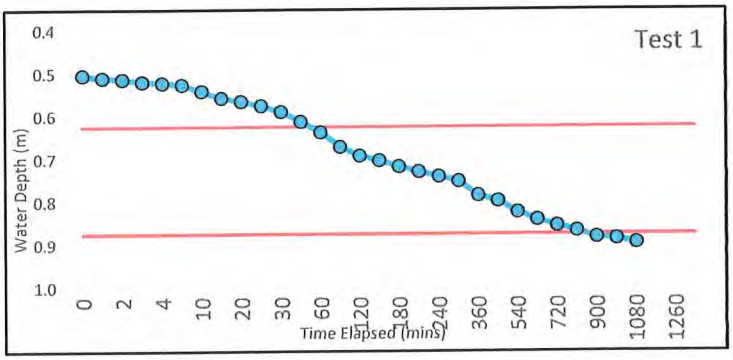
Location	TP05

Site:	Holland Park, Spalding
Client:	Broadgate Homes
Job No:	P13-501

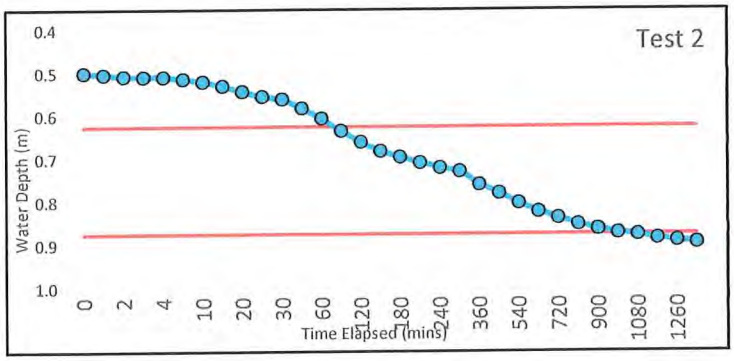
Location	523234.3 E 321179.3 N
Elevation	2.83 m
Date	04/11/2019

Trial Pit Dimensions (m)	
Length	1.50
Width	0.45
Depth	1.00
Test volume (m^3)	0.34
Effective Depth	0.50

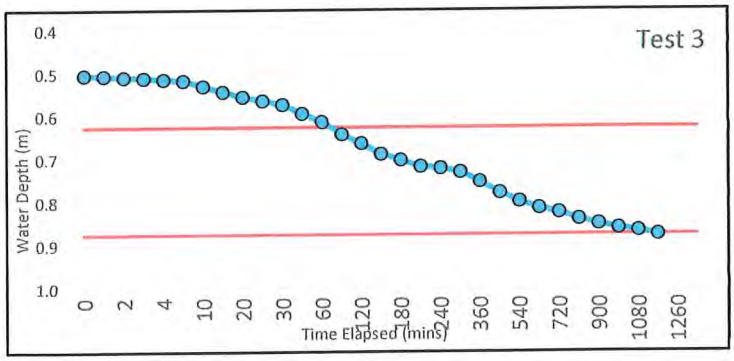
Soil type at test level	PEAT over clayey SILT.		
Groundwater	Not encountered	**Stone Filled?**	Yes
Sidewall stability	Stable, vertical	**Voids Ratio (%)**	0.41



V_{p75-25} (m^3)	0.07
A_{S50} (m^2)	1.64
t_{p75-25} (mins)	793
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**8.86E-07**



V_{p75-25} (m^3)	0.07
A_{S50} (m^2)	1.65
t_{p75-25} (mins)	909
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**7.68E-07**



V_{p75-25} (m^3)	0.07
A_{S50} (m^2)	1.64
t_{p75-25} (mins)	1080
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**6.49E-07**

Time (mins)	Test 1	Test 2	Test 3
0	0.50	0.50	0.50
1	0.51	0.50	0.51
2	0.51	0.51	0.51
3	0.52	0.51	0.51
4	0.52	0.51	0.51
5	0.53	0.51	0.52
10	0.54	0.52	0.53
15	0.56	0.53	0.54
20	0.57	0.54	0.55
25	0.58	0.55	0.56
30	0.59	0.56	0.57
45	0.61	0.58	0.59
60	0.64	0.61	0.61
90	0.67	0.63	0.64
120	0.69	0.66	0.66
150	0.70	0.68	0.69
180	0.72	0.70	0.70
210	0.73	0.71	0.72
240	0.74	0.72	0.72
270	0.75	0.73	0.73
360	0.78	0.76	0.75
450	0.80	0.78	0.78
540	0.82	0.80	0.80
630	0.84	0.82	0.81
720	0.86	0.84	0.82
810	0.87	0.85	0.84
900	0.88	0.86	0.85
990	0.89	0.87	0.86
1080	0.90	0.88	0.87
1170		0.89	0.88
1260		0.89	
1325		0.90	

Remarks

1 Soakage testing carried out between 0.4m and 0.9m
2 Datalogger number 364682
3 Test 1 carried out on 04/11/2019
4 Test 2 carried out on 05/11/2019
5 Test 3 carried out on 06/11/2019

Analysis by: SG
Checked by: TB

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Trial Pit Log

Trialpit No
TP06
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523135.50 - 321162.10 Level: 2.97	Date 04/11/2019
Location: Spalding		Dimensions (m): 1.7 × 0.45, Depth 2.00	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25	2.72		Brown silty fine to medium sand. With rootlets. TOPSOIL.
	0.20	ES					
	0.40	ES					Light brown mottled orange brown sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
	0.60	D		0.55	2.42		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
			HVR=75	0.65	2.32		Soft grey brown mottled orange brown slightly sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
			HVR=50				
▼				2.00	0.97		End of pit at 2.00 m

1
2
3
4

Remarks:
1. TP06 halted at 2.00m, target depth reached
2. Groundwater seepage encountered at 1.90m
3. Trial pit backfilled with arisings to surface
4. Location moved to TP06A to target shallow ground for soakage testing
5. HVR = In situ Hand Shear Vane test result

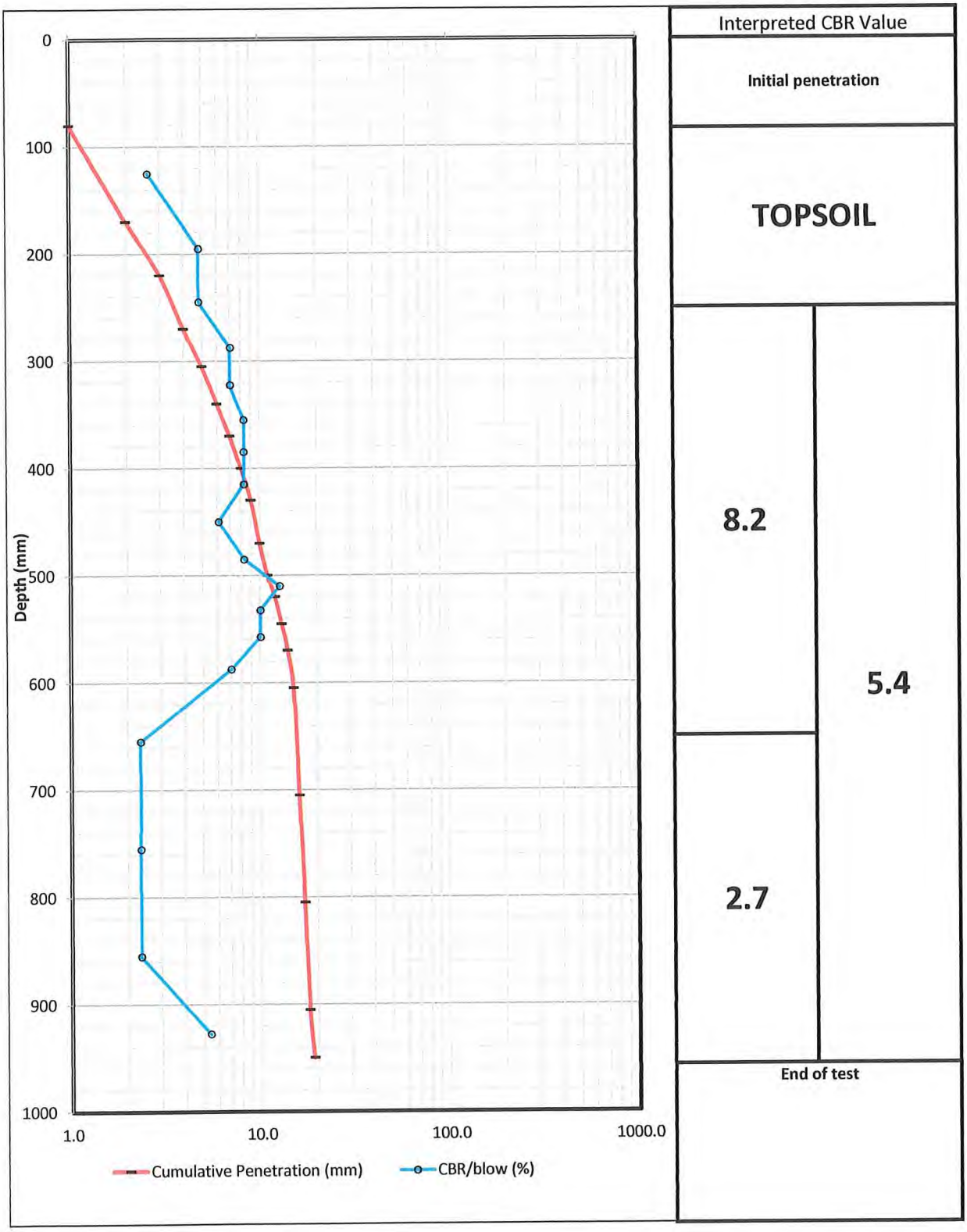
Stability: Stable

AGS

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	TP06
	DCP06



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
8.2	5.4
2.7	
End of test	

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Trial Pit Log

Trialpit No
TP06A
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523147.40 - 321157.10 Level: 2.97	Date 04/11/2019
Location: Spalding		Dimensions (m): 1.4 × 0.45 Depth 0.90	Scale 1:20
Client: Broadgate Homes			Logged TB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Brown silty fine to medium sand. With rootlets. TOPSOIL.
				0.25	2.72		Light brown mottled orange brown sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
				0.55	2.42		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
				0.65	2.32		Soft grey brown mottled orange brown slightly sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
	0.90	D		0.90	2.07		End of pit at 0.90 m

1
2
3
4

Remarks:
1. TP06A halted at 0.90m, target depth reached
2. No groundwater encountered
3. Trial pit backfilled with gravel to 0.40m and arisings to surface
4. Soakage testing carried out between 0.40m and 0.90m

Stability: Stable

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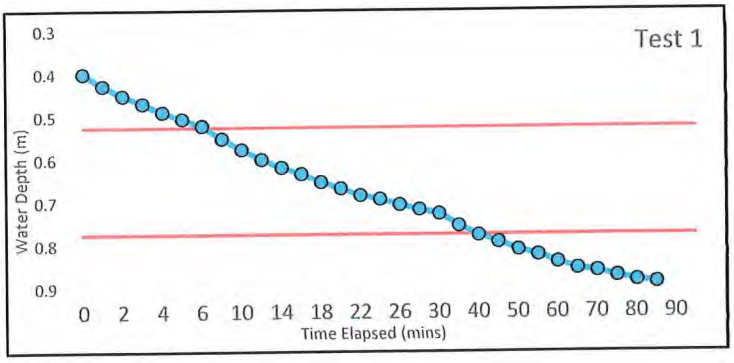
Location	TP06A

Site:	Holland Park, Spalding
Client:	Broadgate Homes
Job No:	P13-501

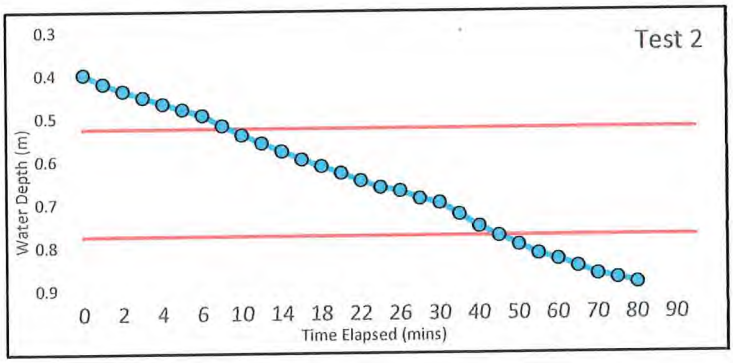
Location	523147.4 E 321157.1 N
Elevation	2.97 m
Date	04/11/2019

Trial Pit Dimensions (m)	
Length	1.40
Width	0.45
Depth	0.90
Test volume (m^3)	0.32
Effective Depth	0.50

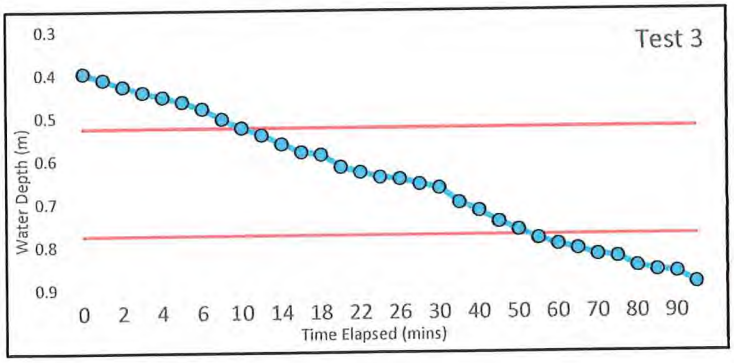
Soil type at test level	PEAT over clayey SILT.		
Groundwater	Not encountered	**Stone Filled?**	Yes
Sidewall stability	Stable, vertical	**Voids Ratio (%)**	0.41



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	34
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**2.06E-05**



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	36
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**1.92E-05**



V_{p75-25} (m^3)	0.06
A_{S50} (m^2)	1.56
t_{p75-25} (mins)	43
Soil infiltration rate $f = \frac{V_{p75-25}}{a_{S50} \times t_{p75-25}}$	**1.62E-05**

Time (mins)	Test 1	Test 2	Test 3
0	0.40	0.40	0.40
1	0.43	0.42	0.41
2	0.45	0.44	0.43
3	0.47	0.45	0.44
4	0.49	0.47	0.45
5	0.50	0.48	0.46
6	0.52	0.49	0.48
8	0.55	0.52	0.50
10	0.58	0.54	0.52
12	0.60	0.56	0.54
14	0.62	0.58	0.56
16	0.63	0.60	0.58
18	0.65	0.61	0.59
20	0.67	0.63	0.62
22	0.68	0.65	0.63
24	0.69	0.66	0.64
26	0.71	0.67	0.64
28	0.72	0.69	0.66
30	0.73	0.70	0.67
35	0.75	0.73	0.70
40	0.78	0.75	0.72
45	0.79	0.78	0.74
50	0.81	0.80	0.76
55	0.82	0.82	0.78
60	0.84	0.83	0.80
65	0.85	0.85	0.81
70	0.86	0.87	0.82
75	0.87	0.87	0.83
80	0.88	0.89	0.85
85	0.89		0.86
90			0.86
99			0.89

Remarks

1 Soakage testing carried out between 0.4 and 0.9m
2 Datalogger number 492948
3 Test 1 carried out on 04/11/2019
4 Test 2 carried out on 05/11/2019
5 Test 3 carried out on 05/11/2019

Analysis by: SG
Checked by: TB

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Borehole Log

Borehole No.
WS01
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523261.30 - 321208.70	Hole Type WS
Location: Spalding		Level: 3.05	Scale 1:40
Client: Broadgate Homes		Dates: 06/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.35	2.70		Brown silty fine to medium sand. With rootlets. TOPSOIL.
					0.60	2.45		Light brown mottled orange brown sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
				HVR=64	0.65	2.40		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		0.70 - 1.00	B					Soft grey brown mottled orange brown slightly sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00		N=7 (1,0/1,1,2,3) HVR=58				
		1.00 - 1.45	D					..becoming brown
		1.60 - 2.00	D		1.60	1.45		Medium dense brown silty fine SAND. Slightly clayey in places. TIDAL FLAT DEPOSITS.
	▼	2.00		N=12 (1,2/2,3,3,4)				
								..becoming grey
								..becoming loose
		3.00		N=5 (1,0/1,0,2,2)				
		3.30 - 4.00	D					..becoming medium dense
		4.00		N=12 (2,2/2,2,4,4)				
		5.00		N=14 (2,3/2,3,4,5)				
					5.45	-2.40		End of borehole at 5.45 m

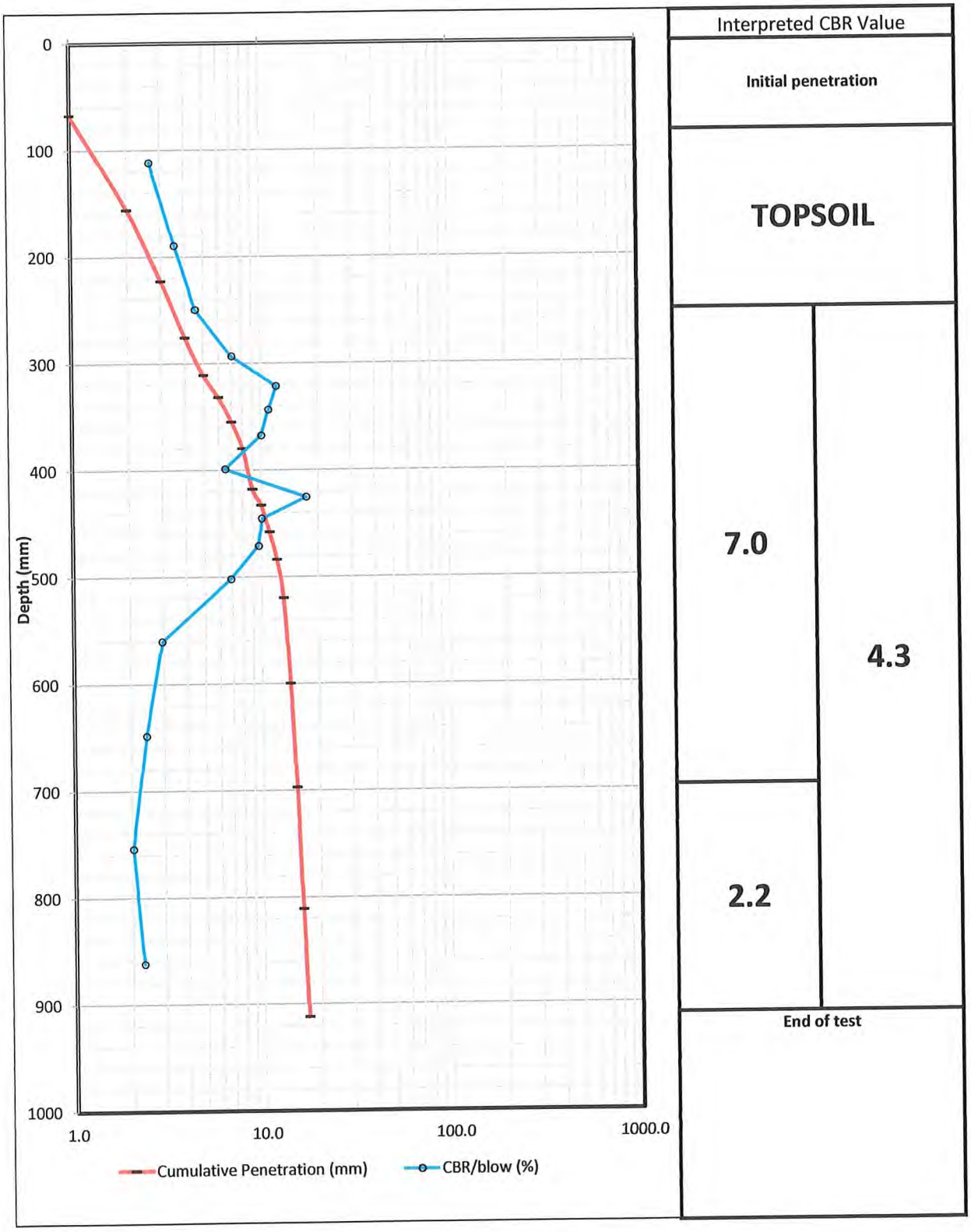
Remarks
1. WS01 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 2.00m
3. Hole collapsed to 2.50m upon liner removal
4. Monitoring standpipe installed to 2.50m
5. HVR = In situ Hand Shear Vane test result

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS01
	DCP08



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
7.0	4.3
2.2	
End of test	

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Borehole Log

Borehole No.
WS02
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523279.50 - 321166.00	Hole Type WS
Location: Spalding		Level: 3.22	Scale 1:40
Client: Broadgate Homes		Dates: 06/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
				HVR=64	0.35	2.87		Brown silty fine to medium sand. With rootlets. TOPSOIL.
								Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00		N=4 (0,0/0,0,2,2) HVR=39	0.98	2.24		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.00 - 1.45	D		1.05	2.17		Very soft grey brown mottled orange brown slightly sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
	▼	1.60	D					*..becoming slightly sandy silty CLAY in places*
					1.80	1.42		Medium dense grey brown silty fine SAND. TIDAL FLAT DEPOSITS.
		2.00		N=8 (1,2/2,2,2,2)				
		2.70 - 3.00	D					*..becoming loose and grey with black speckling*
		3.00		N=2 (1,1/1,1,0,0)				
		4.00		N=6 (1,1/2,2,1,1)				*..becoming loose to medium dense*
		5.00		N=8 (2,2/2,2,2,2)				*..becoming medium dense*
					5.45	-2.23		End of borehole at 5.45 m

1 2 3 4 5 6 7 8

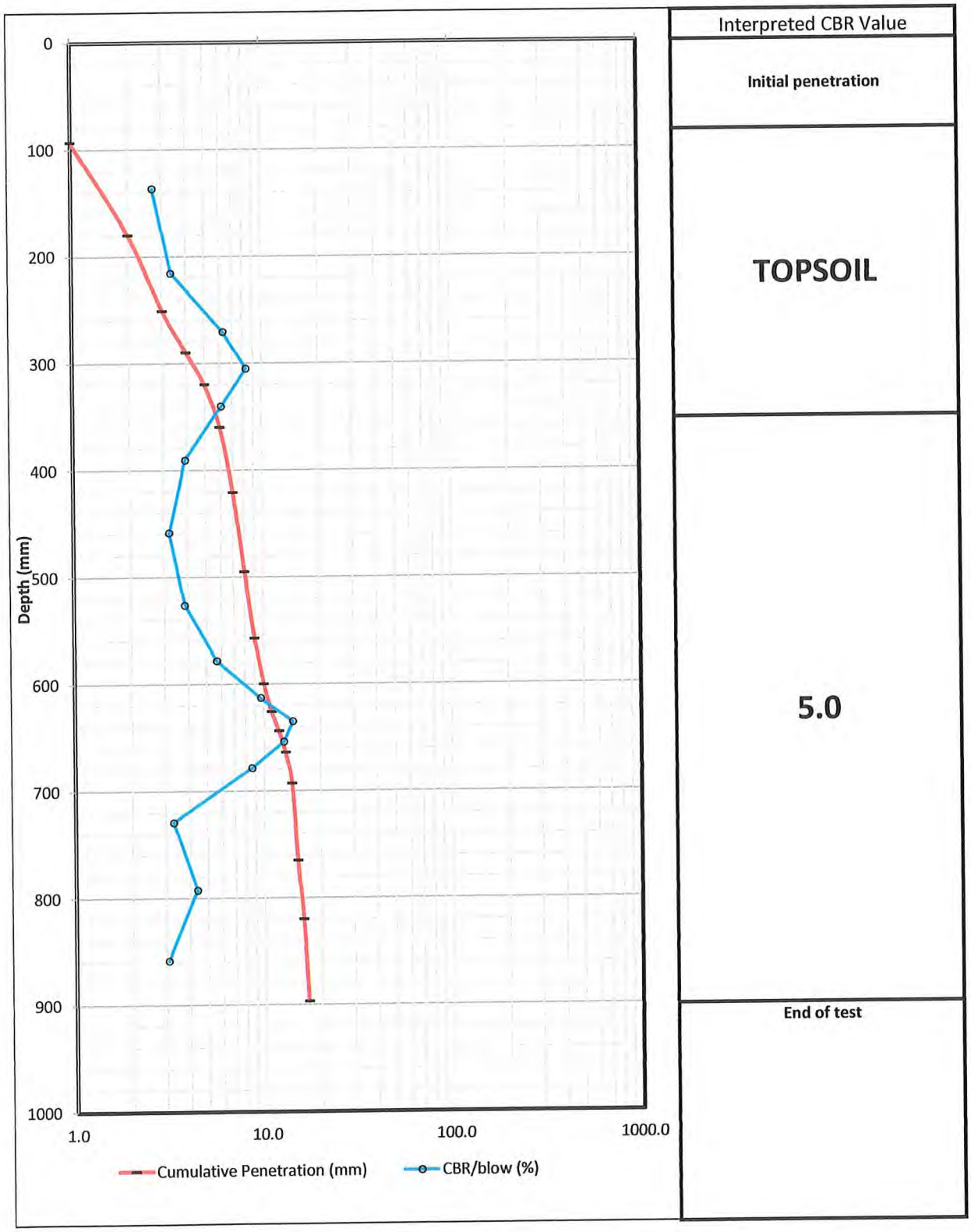
Remarks
1. WS02 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 1.70m
3. Exploratory hole backfilled with arisings upon completion
4. HVR = In situ Hand Shear Vane test result

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS02
	DCP09



Interpreted CBR Value
Initial penetration
TOPSOIL
5.0
End of test

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Borehole Log

Borehole No.
WS03
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523291.00 - 321100.70	Hole Type WS
Location: Spalding		Level: 3.01	Scale 1:40
Client: Broadgate Homes		Dates: 06/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
				HVR=42	0.40	2.61		Brown silty fine to medium sand. With rootlets. TOPSOIL.
								Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00		N=7 (1,0/1,2,2,2) HVR=61	0.87	2.14		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.00 - 1.45	D		0.92	2.09		Soft grey brown mottled orange brown silty very clayey fine SAND. TIDAL FLAT DEPOSITS.
								..becoming slightly sandy silty CLAY in places
		1.70 - 1.80	D					
		2.00		N=8 (1,1/2,2,2,2)	2.00	1.01		Loose to medium dense grey brown silty fine SAND. TIDAL FLAT DEPOSITS.
		2.00 - 2.45	D					*..becoming brown*
		3.00		N=7 (1,2/1,2,2,2)				
		3.00 - 3.45	D					
		3.50 - 4.00	D					*..becoming medium dense*
		4.00		N=10 (2,2/2,2,3,3)				
		4.50 - 5.45	D					*..becoming grey*
		5.00		N=12 (2,2/2,3,3,4)				
					5.45	-2.44		End of borehole at 5.45 m

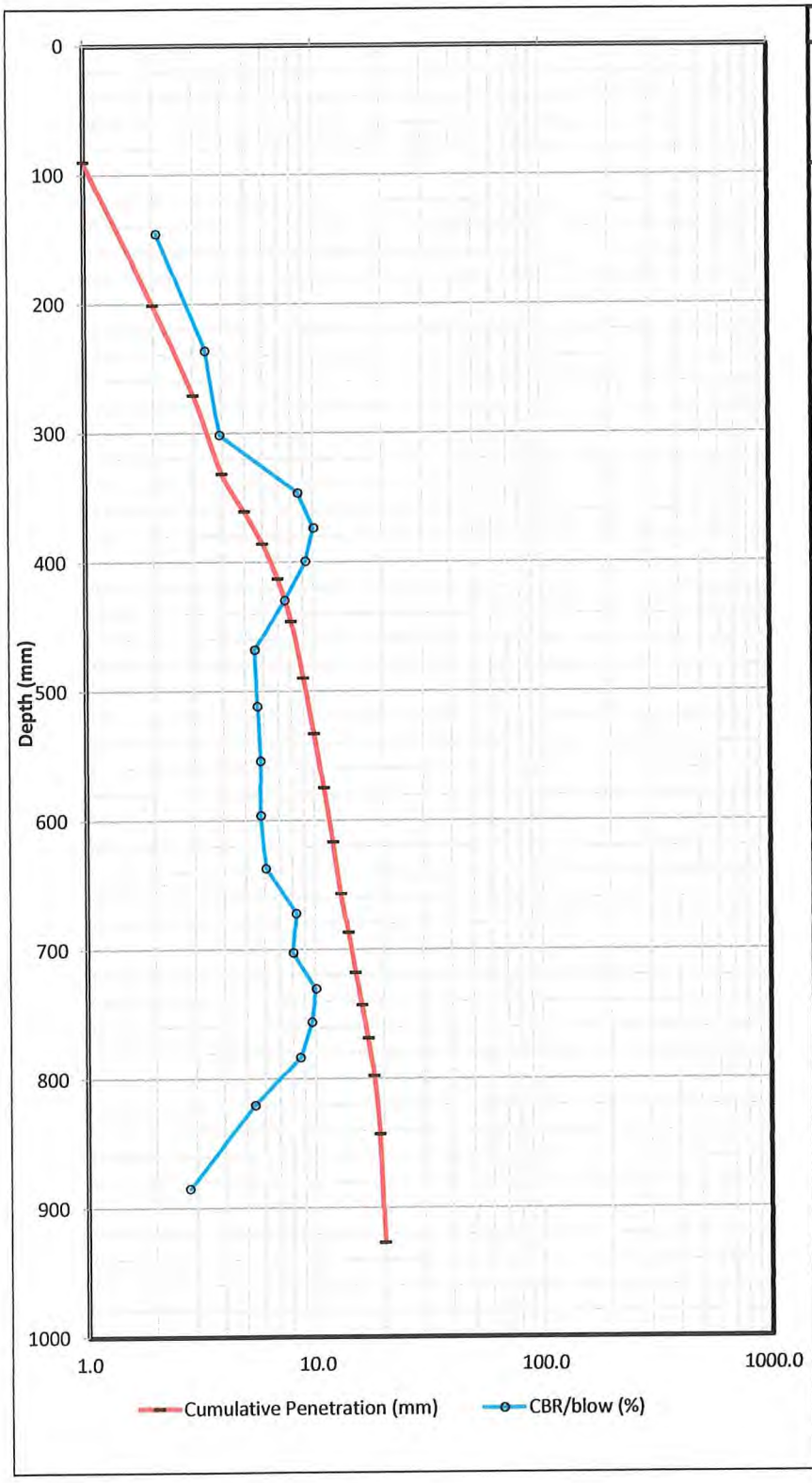
Remarks
1. WS03 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 1.90m
3. Hole collapsed to 3.00m upon liner removal
4. Monitoring standpipe installed to 3.00m
5. HVR = In situ Hand Shear Vane test result

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS03
	DCP11



Interpreted CBR Value
Initial penetration
TOPSOIL
6.2
End of test

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Borehole Log

Borehole No.
WS04
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523318.70 - 321026.10	Hole Type WS
Location: Spalding		Level: 2.75	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.35	2.40		Brown silty fine to medium sand. With rootlets. TOPSOIL.
				HVR=50				Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		0.60	D					
	▼	0.76 - 0.80	D		0.76	1.99		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.00		N=1 (0,0/0,0,0,1) HVR=33	0.80	1.95		Very soft grey brown mottled orange brown sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
		1.30	D					
		1.60	D		1.50	1.25		Soft brown slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
	▼	2.00		N=3 (1,0/1,1,1,0)	2.10	0.65		Loose brown very silty fine SAND. TIDAL FLAT DEPOSITS.
		3.00		N=5 (1,1/1,1,1,2)				
								..becoming grey
		4.00		N=8 (1,2/2,2,2,2)				
					4.45	-1.70		End of borehole at 4.45 m

1 2 3 4 5 6 7 8

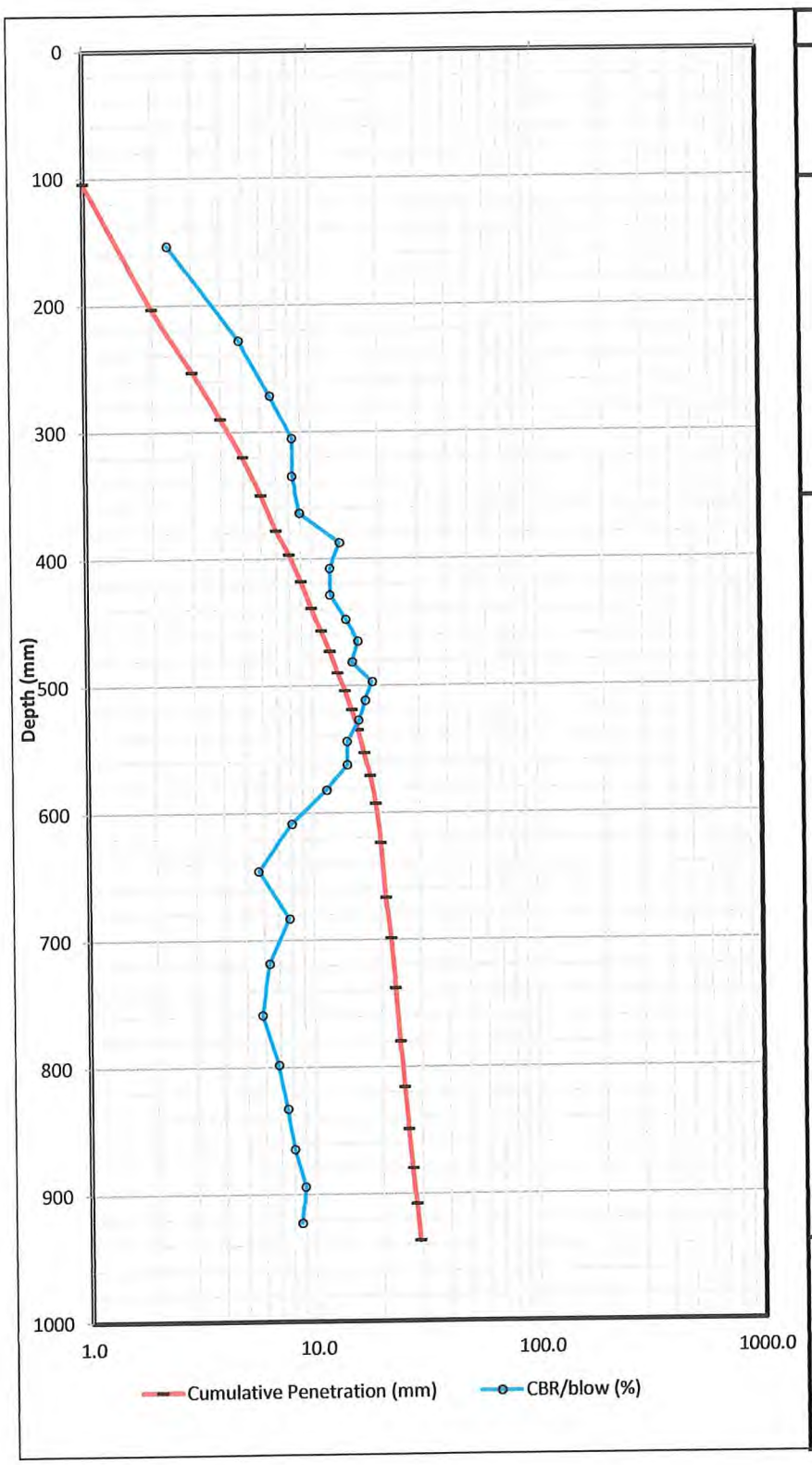
Remarks
1. WS04 complete at 4.45m, target depth reached
2. Slight groundwater seepage at 0.90m
3. Moderate groundwater seepage at 1.90m
4. Exploratory hole backfilled with arisings upon completion
5. HVR = In situ Hand Shear Vane test result

AGS

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS04
	DCP19



Interpreted CBR Value
Initial penetration
TOPSOIL
9.8
End of test

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Borehole Log

Borehole No.
WS05
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523246.00 - 321111.60	Hole Type WS
Location: Spalding		Level: 2.85	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.35	2.50		Brown silty fine to medium sand. With rootlets. TOPSOIL.
				HVR=70	0.70	2.15		Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
	▼			HVR=47	1.60	1.25		Soft grey brown mottled orange brown sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
	▼				3.50	-0.65		Medium dense brown silty fine SAND. TIDAL FLAT DEPOSITS.
								..becoming grey
								End of borehole at 3.50 m

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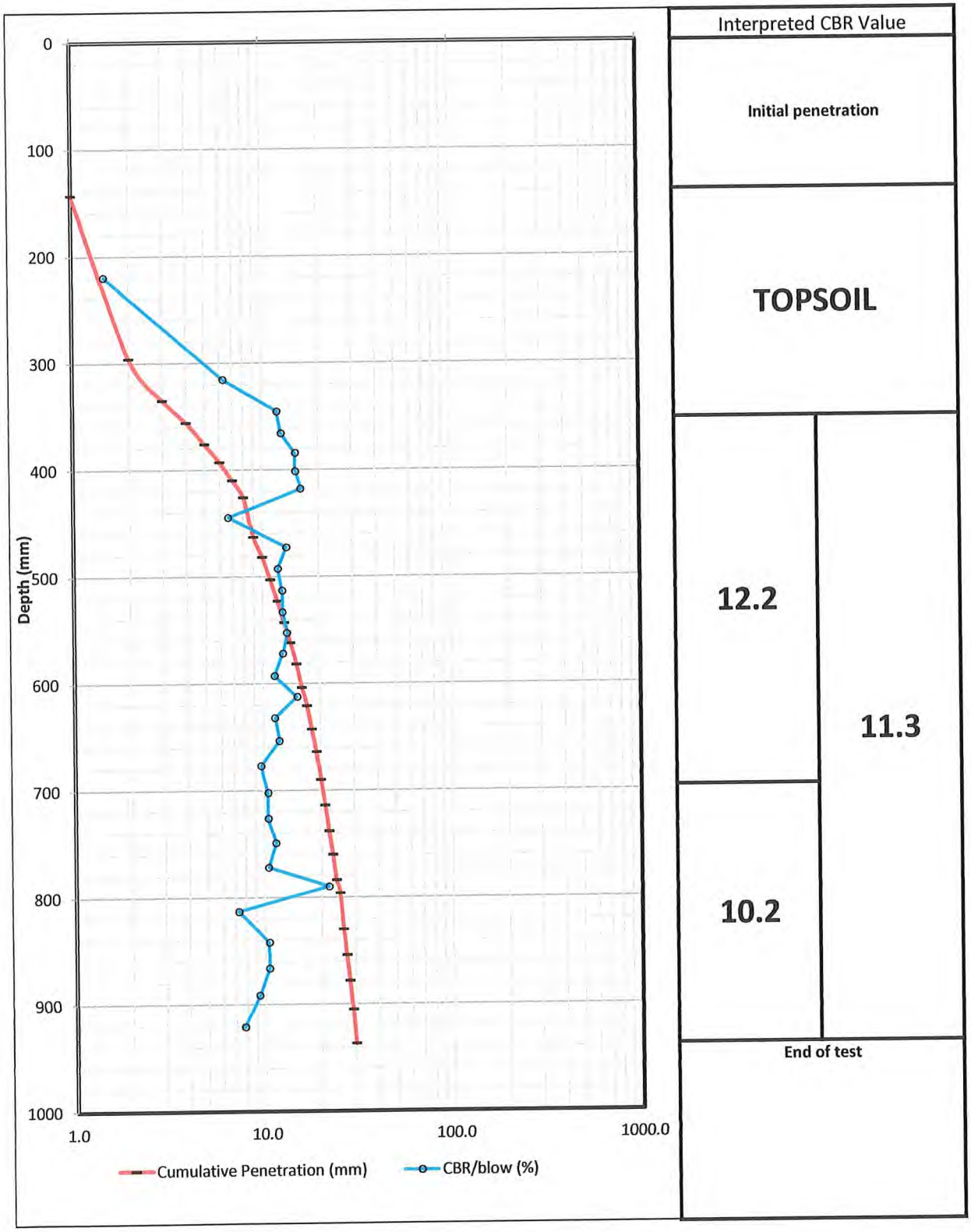
Remarks
1. WS05 terminated at 3.50m, due to rig breaking down. Consequently, SPTs were not possible.
2. Slight groundwater seepage at 1.00m
3. Moderate groundwater seepage at 2.00m
4. Exploratory hole backfilled with arisings upon completion
5. HVR = In situ Hand Shear Vane test result

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS05
	DCP10



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
12.2	11.3
10.2	
End of test	

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Borehole Log

Borehole No.
WS06
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523186.70 - 321186.10	Hole Type WS
Location: Spalding		Level: 3.00	Scale 1:40
Client: Broadgate Homes		Dates: 06/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	2.70		Brown silty fine to medium sand. With rootlets. TOPSOIL.
				HVR=58				Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
				HVR=47	0.80	2.20		
		1.00	D		0.90	2.10		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.00		N=6 (1,0/1,1,2,2)				Soft grey brown mottled orange brown sandy silty CLAY. Sand is fine. With relic roots. TIDAL FLAT DEPOSITS.
		1.50 - 2.00	D		1.50	1.50		Medium dense brown silty fine SAND. TIDAL FLAT DEPOSITS.
	▼	2.00		N=8 (1,2/2,2,2,2)				
		3.00		N=10 (0,0/2,2,3,3)				*..becoming grey to grey brown*
		3.50 - 4.00	D					
		4.00		N=8 (2,2/2,2,2,2)				*..becoming grey*
		5.00		N=15 (2,2/2,4,4,5)				
					5.45	-2.45		End of borehole at 5.45 m

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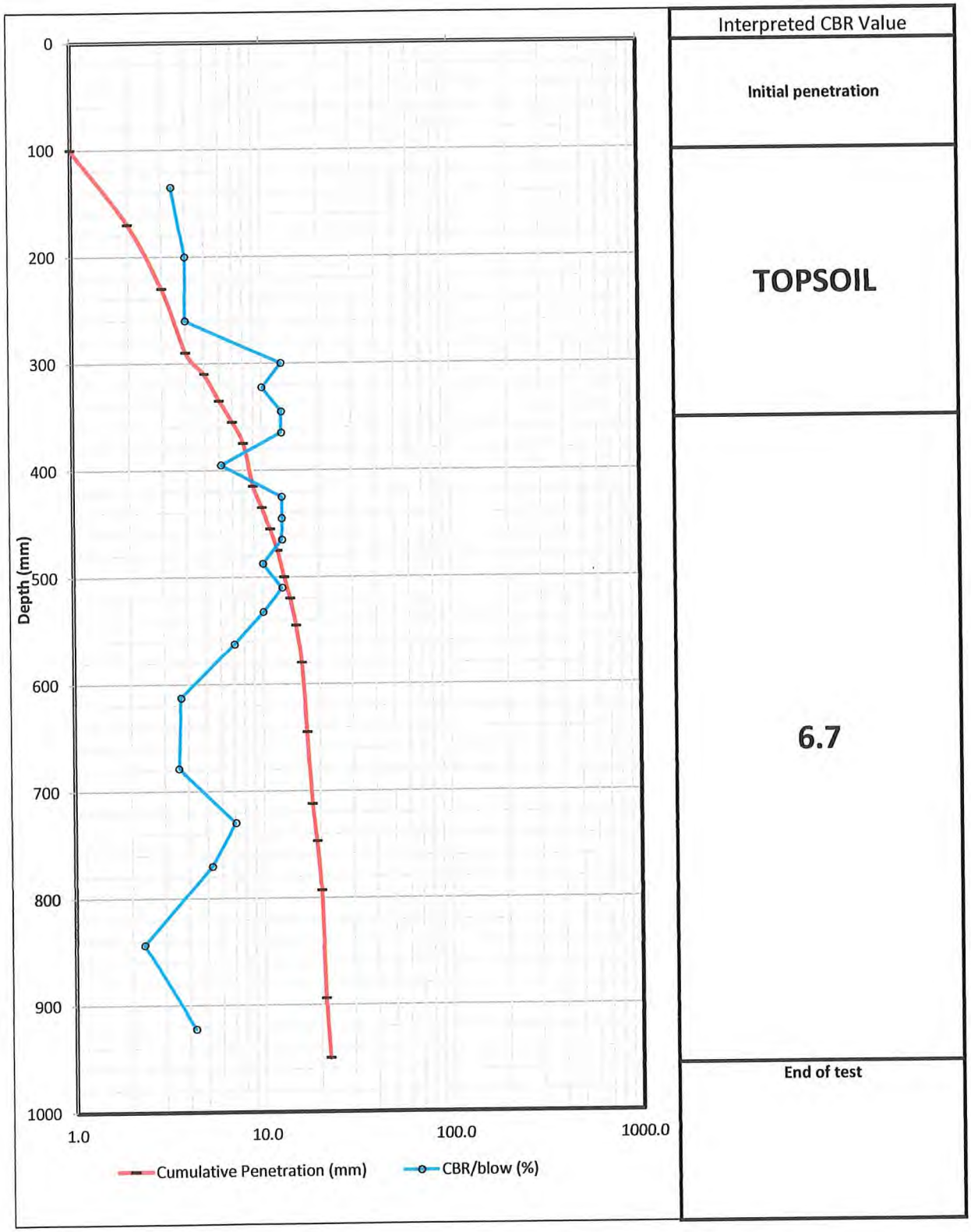
Remarks
1. WS06 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 2.10m
3. Hole collapsed to 2.40m upon liner removal
4. Monitoring standpipe installed to 2.40m
5. HVR = In situ Hand Shear Vane test result

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS06
	DCP07



Interpreted CBR Value
Initial penetration
TOPSOIL
6.7
End of test

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Borehole Log

Borehole No.
WS07
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523193.10 - 321147.10	Hole Type WS
Location: Spalding		Level: 2.79	Scale 1:40
Client: Broadgate Homes		Dates: 06/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
				HVR=47	0.35	2.44		Brown silty fine to medium sand. With rootlets. TOPSOIL.
					0.75	2.04		Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00		N=3 (1,0/1,0,1,1) HVR=56	0.82	1.97		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.50 - 1.60	D					Very soft grey brown mottled brown sandy silty CLAY. Sand is fine. With relic roots. TIDAL FLAT DEPOSITS.
	▼	2.00		N=8 (1,1/2,2,2,2)	1.70	1.09		*..becoming slightly clayey silty SAND in places*
		2.60 - 3.00	D					Medium dense grey brown silty fine SAND. TIDAL FLAT DEPOSITS.
		3.00		N=2 (1,0/1,0,0,1)				*..becoming loose and grey*
		3.50 - 4.00	D					
		4.00		N=10 (2,2/3,3,2,2)				*..becoming medium dense*
		4.40 - 5.00	D					
		5.00		N=15 (2,2/3,4,4,4)				
					5.45	-2.66		End of borehole at 5.45 m

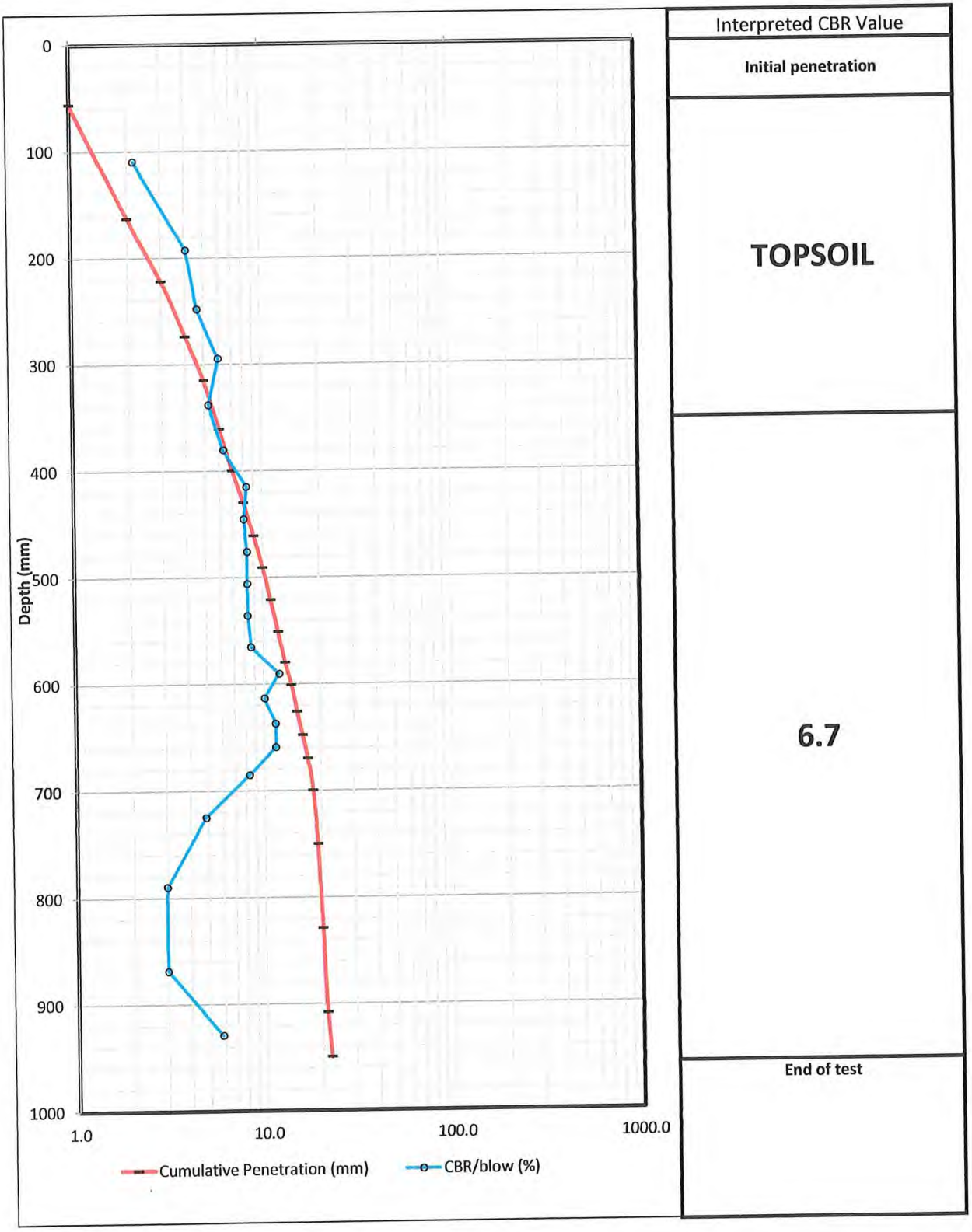
Remarks
1. WS07 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 1.90m
3. Hole collapsed to 3.40m upon liner removal
4. Monitoring standpipe installed to 3.40m
5. HVR = In situ Hand Shear Vane test result

AGS

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS07
	DCP18



Interpreted CBR Value
Initial penetration
TOPSOIL
6.7
End of test

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Borehole Log

Borehole No.
WS08
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523209.20 - 321067.00	Hole Type WS
Location: Spalding		Level: 2.89	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.40	2.49		Brown silty fine to medium sand. With rootlets. TOPSOIL.
		0.60 - 1.00	B	HVR=81	0.60 0.65	2.29 2.24		Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS. Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.00 1.00 - 1.45	D	N=6 (1,0/1,1,2,2) HVR=75				Soft grey brown mottled brown clayey very sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
	▼	2.00 2.00	D	N=9 (1,2/2,2,2,3)	1.90 2.20	0.99 0.69		Soft to firm brown slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS. Loost to medium dense grey brown silty fine SAND. TIDAL FLAT DEPOSITS.
								..becoming grey
		3.00 3.00 - 4.00	D	N=7 (1,2/2,1,2,2)				
		4.00		N=8 (2,3/3,2,1,2)				
		5.00		N=11 (2,1/2,3,3,3)				
					5.45	-2.56		End of borehole at 5.45 m

1 2 3 4 5 6 7 8

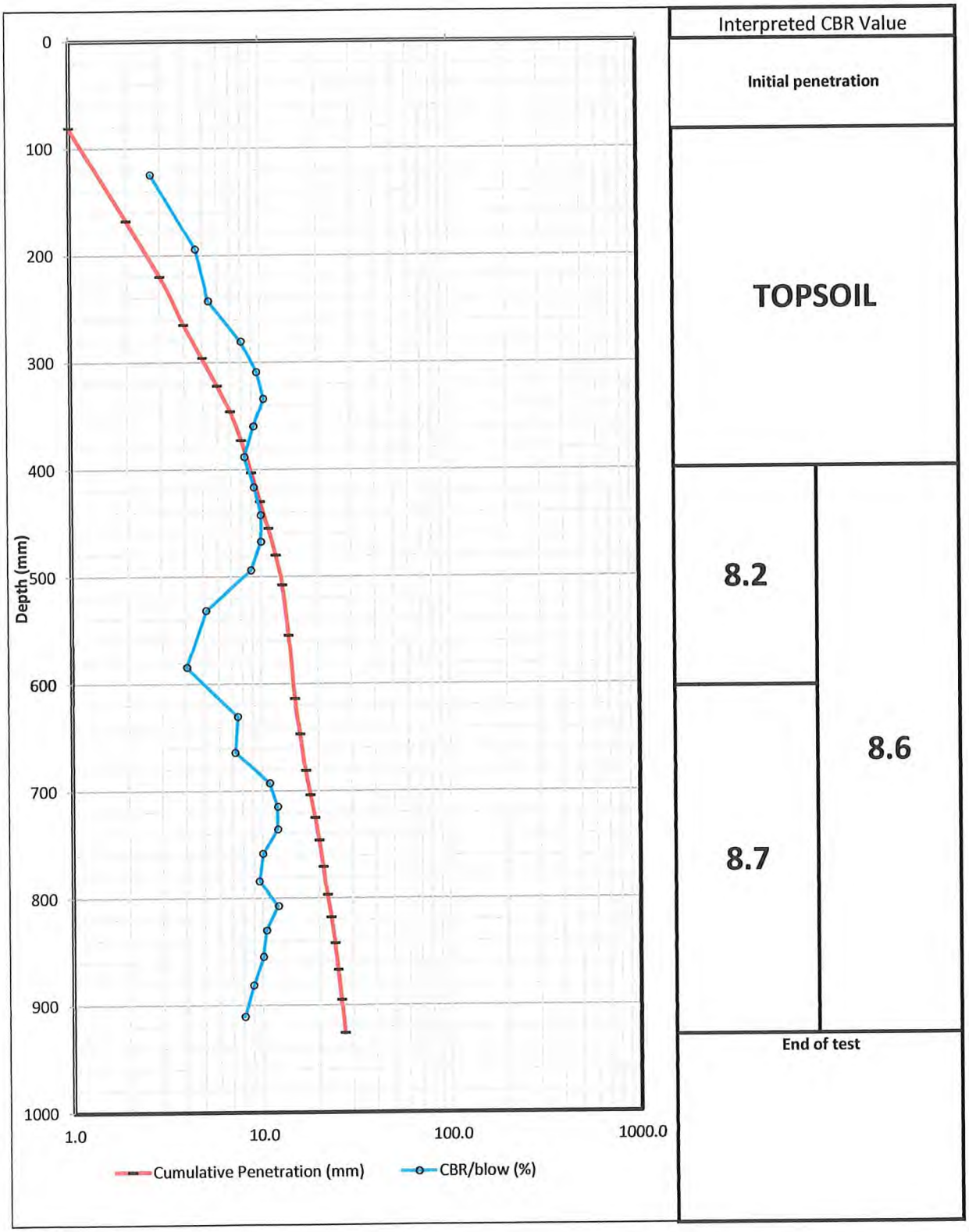
Remarks
1. WS08 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 1.90m
3. Hole collapsed to 3.40m upon liner removal
4. Monitoring standpipe installed to 3.40m
5. HVR = In situ Hand Shear Vane test result

AGS

create
CONSULTING ENGINEERS LTD

Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS08
	DCP14



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
8.2	8.6
8.7	
End of test	

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Borehole Log

Borehole No.
WS09
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523226.70 - 320990.90	Hole Type WS
Location: Spalding		Level: 2.67	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	2.37		Brown silty fine to medium sand. With rootlets. TOPSOIL.
					0.50	2.17		Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
					0.55	2.12		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
	▼	1.00		HVR=50 N=2 (1,1/1,0,0,1) HVR=61	1.00	1.67		Soft grey brown mottled brown sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
								Very soft brown slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
	▼				1.90	0.77		Medium dense grey brown silty fine SAND. TIDAL FLAT DEPOSITS.
		3.00		N=12 (1,2/3,3,3,3)				
								..becoming grey and loose sandy SILT in places
		4.00		N=6 (2,1/1,1,2,2)				
					4.45	-1.78		End of borehole at 4.45 m

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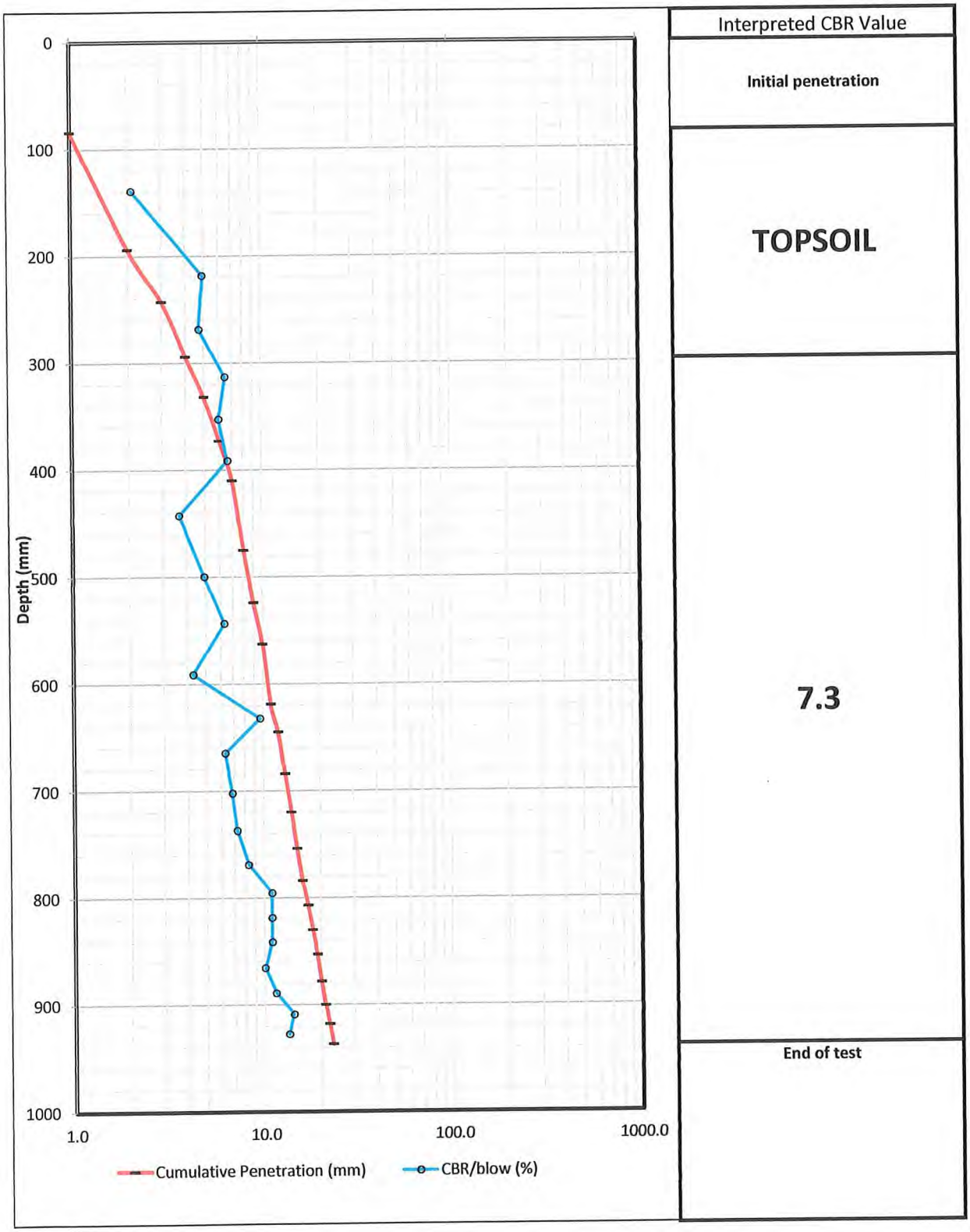
Remarks
1. WS09 complete at 4.45m, target depth reached
2. Slight groundwater seepage at 1.00m
3. Moderate groundwater seepage at 2.00m
4. Exploratory hole backfilled with arisings upon completion
5. HVR = In situ Hand Shear Vane test result

AGS

create
CONSULTING ENGINEERS LTD

Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	
	WS09
	DCP13



Interpreted CBR Value
Initial penetration
TOPSOIL
7.3
End of test

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Borehole Log

Borehole No.
WS10
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523136.70 - 321108.50	Hole Type WS
Location: Spalding		Level: 2.97	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	2.67		Brown silty fine to medium sand. With rootlets. TOPSOIL.
				HVR=45				Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
					0.67	2.30		
					0.70	2.27		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		0.90	D	HVR=53	1.00	1.97		Soft grey brown mottled brown sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00		N=9 (1,1/1,2,3,3)				
		1.30	D					Soft to firm grey brown mottled orange brown slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
					1.50	1.47		Medium dense brown to grey brown silty fine SAND. TIDAL FLAT DEPOSITS.
	▼	2.00		N=10 (1,1/2,3,2,3)				
		3.00		N=11 (1,1/2,2,3,4)				
								..becoming grey
		4.00		N=11 (1,2/2,2,3,4)				
		4.40 - 5.00	D					
		5.00		N=16 (2,2/3,4,4,5)				
					5.45	-2.48		End of borehole at 5.45 m

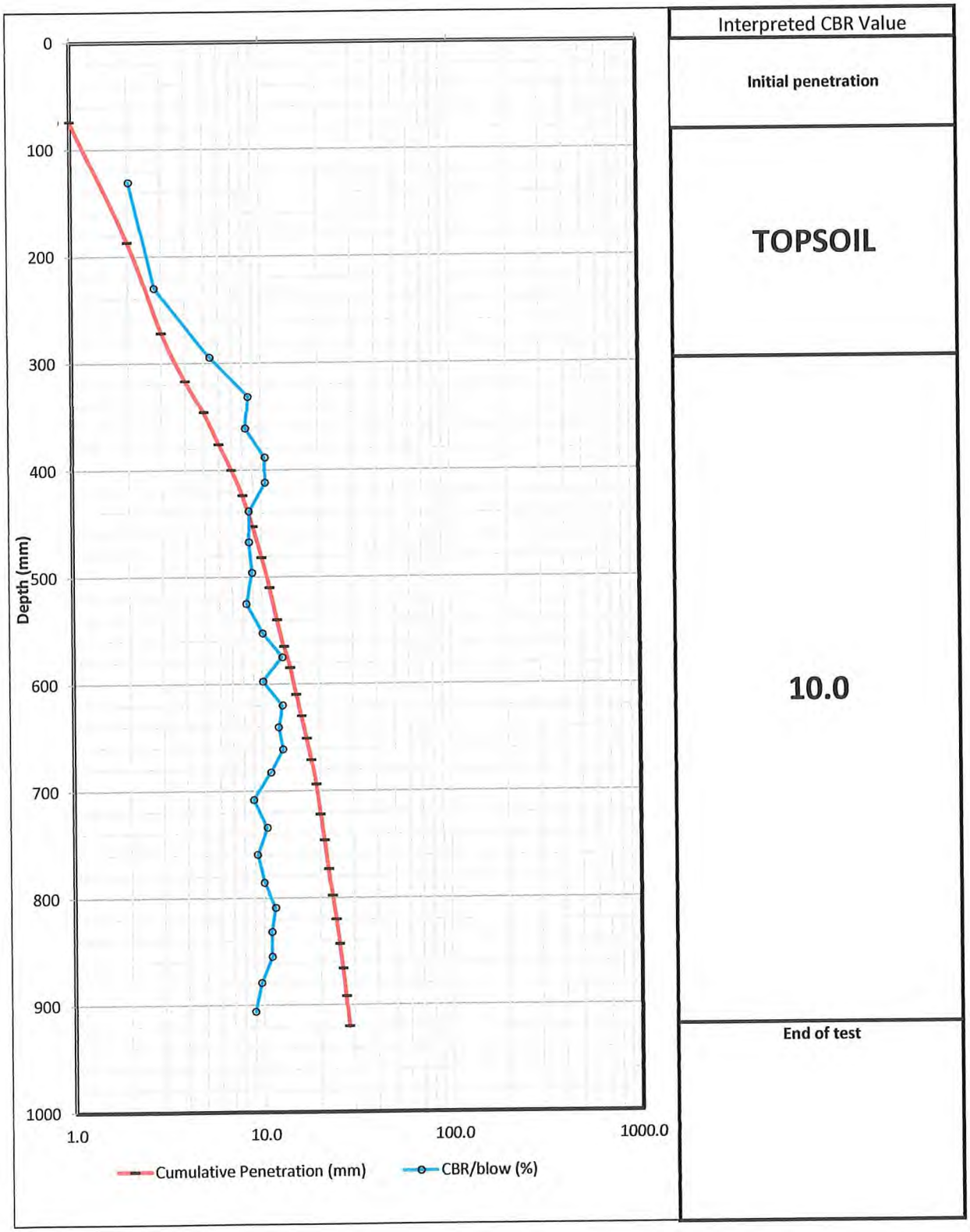
Remarks
1. WS10 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 1.90m
3. Exploratory hole backfilled with arisings upon completion
4. HVR = In situ Hand Shear Vane test result

AGS

create
CONSULTING ENGINEERS LTD

Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS10
	DCP17



Interpreted CBR Value
Initial penetration
TOPSOIL
10.0
End of test

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Borehole Log

Borehole No.
WS11
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523154.20 - 321021.50	Hole Type WS
Location: Spalding		Level: 2.91	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
				HVR=50	0.30	2.61		Brown silty fine to medium sand. With rootlets. TOPSOIL.
				HVR=81	0.60 0.65	2.31 2.26		Light brown mottled orange brown sandy CLAY/ SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00 1.00	D	N=9 (1,2/2,2,2,3) HVR=67	1.20	1.71		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.50 - 1.60	D		1.80	1.11		Soft to firm grey brown slightly sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
	▼	2.00 2.00 - 2.60	D	N=10 (1,2/2,3,2,3)				Soft to firm brown slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		3.00		N=10 (1,1/2,2,3,3)				Medium dense grey brown silty fine SAND. TIDAL FLAT DEPOSITS.
		3.30 - 3.80	D					*..becoming grey*
		4.00 4.00 - 5.00	D	N=13 (2,3/4,3,3,3)				
		5.00		N=10 (1,1/2,2,3,3)				
					5.45	-2.54		End of borehole at 5.45 m

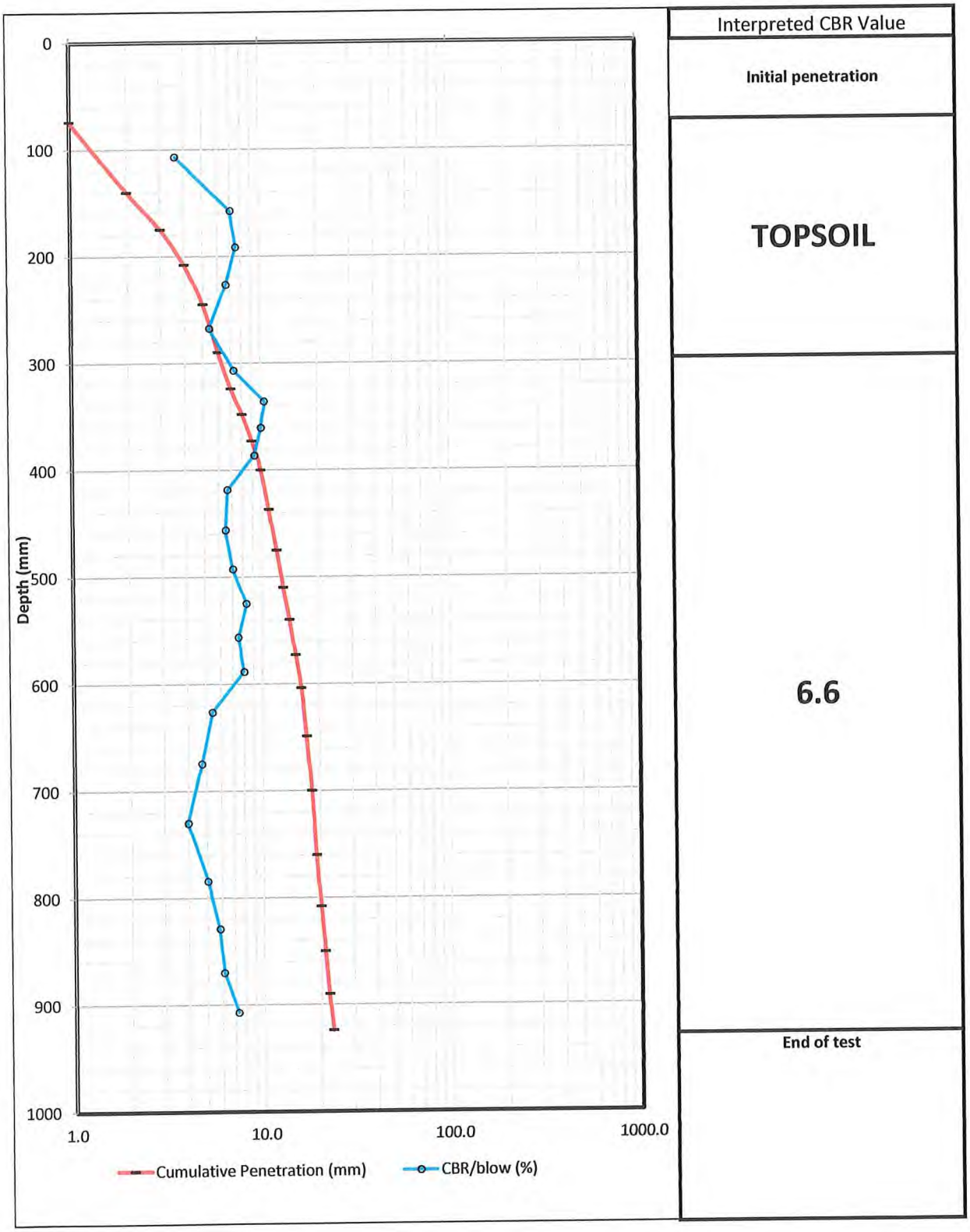
Remarks
1. WS11 complete at 5.45m, target depth reached
2. Moderate groundwater seepage at 1.90m
3. Exploratory hole backfilled with arisings upon completion
4. HVR = In situ Hand Shear Vane test result

AGS

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CONSULTING ENGINEERS LTD

Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS11
	DCP15



Interpreted CBR Value
Initial penetration
TOPSOIL
6.6
End of test

create
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Borehole Log

Borehole No.
WS12
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523163.50 - 320951.90	Hole Type WS
Location: Spalding		Level: 2.95	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.40	2.55		Brown silty fine to medium sand. With rootlets. TOPSOIL.
		0.60 - 0.80	D	HVR=47				Light brown mottled grey clayey silty fine SAND. TIDAL FLAT DEPOSITS.
		1.00		N=5 (1,1/1,1,1,2) HVR=58	1.00 1.05	1.95 1.90		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.30 - 1.50	D					Soft grey brown slightly sandy silty CLAY. Sand is fine. With relic roots. TIDAL FLAT DEPOSITS.
		1.70	D		1.60	1.35		Loose becoming medium dense grey brown to brown slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
	▼	2.00		N=16 (2,3/4,4,4,4)	2.00	0.95		Medium dense grey brown to orange brown silty fine SAND. TIDAL FLAT DEPOSITS.
		3.00		N=8 (2,2/2,2,2,2)				*..becoming loose to medium dense*
								..becoming loose and grey
		4.00		N=2 (1,1/1,0,0,1)				
					4.45	-1.50		End of borehole at 4.45 m

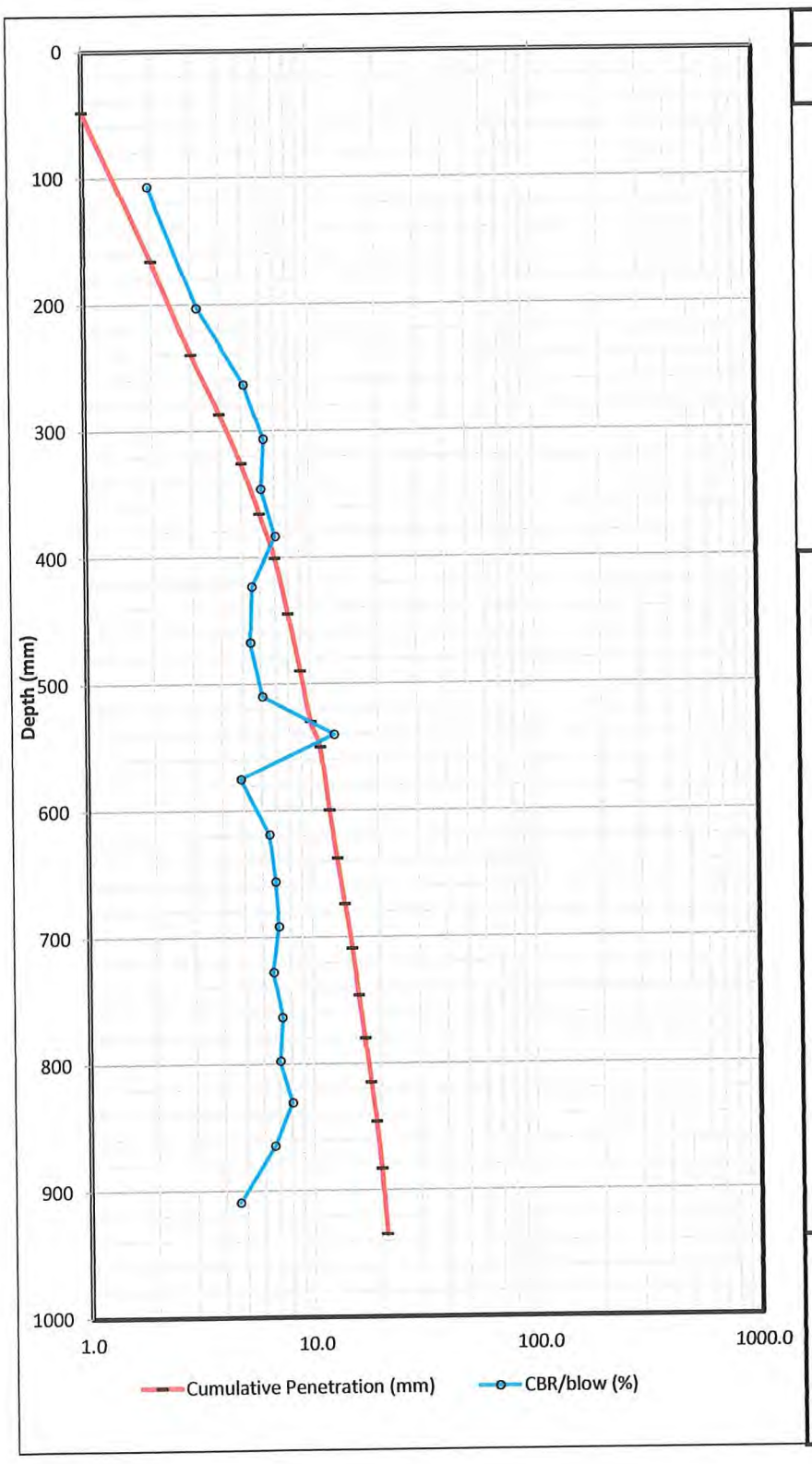
Remarks
1. WS12 complete at 4.45m, target depth reached
2. Moderate groundwater seepage at 1.90m
3. Exploratory hole backfilled with arisings upon completion
4. HVR = In situ Hand Shear Vane test result

AGS

create
CONSULTING ENGINEERS LTD

Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS12
	DCP16



Interpreted CBR Value
Initial penetration
TOPSOIL
6.4
End of test

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Borehole Log

Borehole No.
WS13
Sheet 1 of 1

Project Name: Holland Park	Project No. P13-501	Co-ords: 523100.50 - 321048.10	Hole Type WS
Location: Spalding		Level: 3.19	Scale 1:40
Client: Broadgate Homes		Dates: 07/11/2019 -	Logged By TB

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
				HVR=45	0.35	2.84		Brown silty fine to medium sand. With rootlets. TOPSOIL.
		0.70 - 1.00	B	HVR=92				Light brown mottled grey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00		N=3 (1,0/1,0,1,1) HVP=75 HVR=75	1.20	1.99		
		1.40 - 1.50	D		1.25	1.94		Plastic dark brown to black amorphous PEAT. TIDAL FLAT DEPOSITS.
		1.60	D		1.50	1.69		Soft grey mottled orange brown sandy silty CLAY. Sand is fine. With relic roots. TIDAL FLAT DEPOSITS.
	▼	2.00		N=13 (2,2/2,3,4,4)	1.80	1.39		Soft becoming firm grey brown mottled orange brown slightly clayey sandy SILT. Sand is fine. TIDAL FLAT DEPOSITS.
								Medium dense grey brown to orange brown silty fine SAND. TIDAL FLAT DEPOSITS.
								..becoming grey
		3.00		N=7 (1,1/1,2,2,2)				
		4.00		N=14 (2,2/3,3,4,4)				
					4.45	-1.26		End of borehole at 4.45 m

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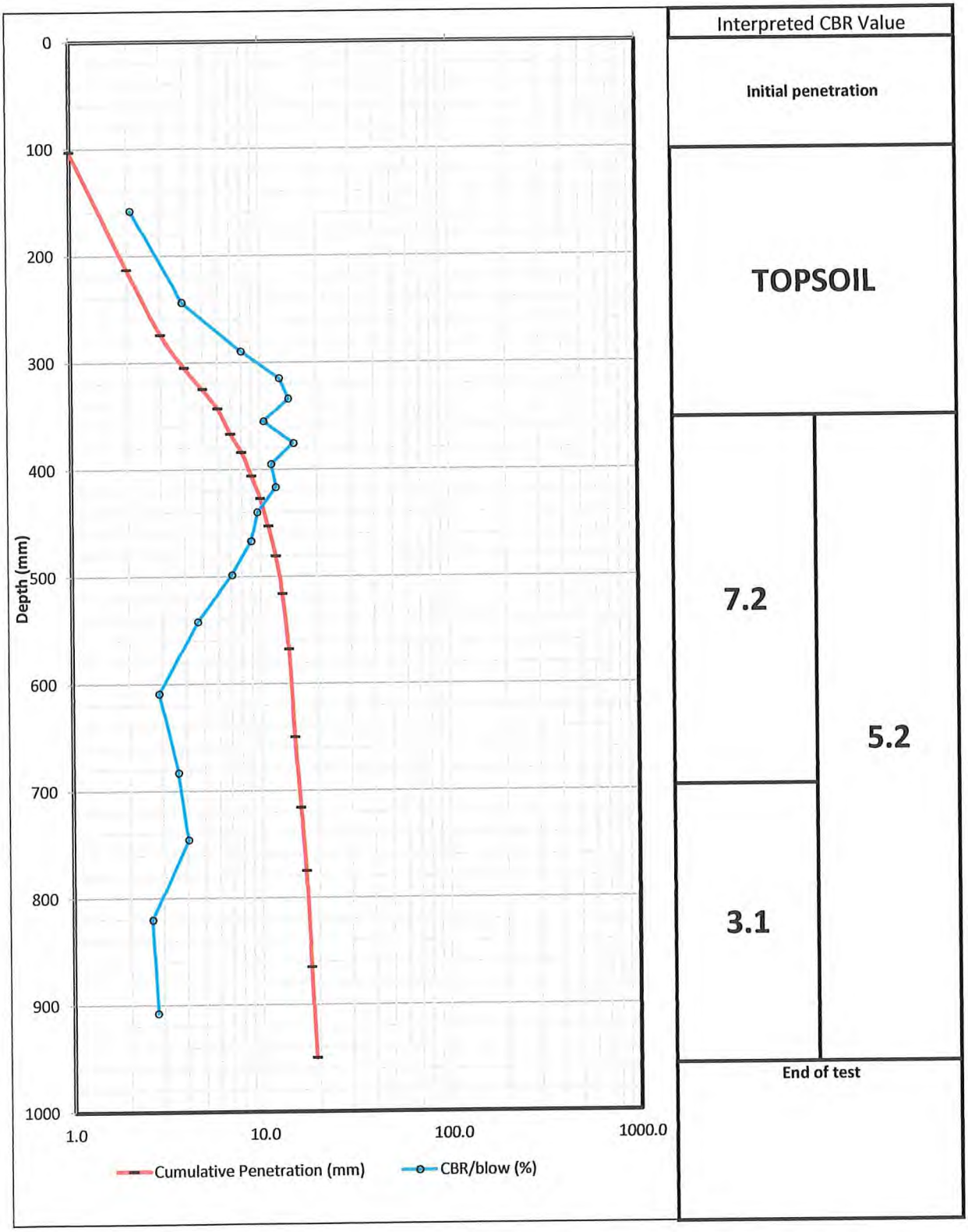
Remarks
1. WS13 complete at 4.45m, target depth reached
2. Moderate groundwater seepage at 1.90m
3. Hole collapsed to 3.40m upon liner removal
4. Monitoring standpipe installed to 3.40m
5. HVR = In situ Hand Shear Vane test result

AGS

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Date	04/11/2019
Job Number	P13-501
Site	Holland Park, Spalding
Engineer	TB

Location	WS13
	DCP12



Interpreted CBR Value	
Initial penetration	
TOPSOIL	
7.2	5.2
3.1	
End of test	

Borehole Log

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Borehole Number: BH01

Project Name	Holland Park	Date	12/02/2020 - 13/02/2020
Location	Spalding	Co-ords	E523134.97 N321131.60
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level: 3.00m AoD; Logged By: AW; Scale: 1:50	Page Number: Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.50	B		0.40	2.60		Brown slightly sandy SILT. Trace clay. Sand is fine. SUBSOIL.
		1.00	B					Very soft brown silty CLAY. With buff-brown partings of fine sand. With pockets of soft grey low plasticity silty clay. TIDAL FLAT DEPOSITS.
		1.50 - 1.95	U	Ublow=15	1.50	1.50		
		1.95 - 2.00	D					Brown slightly sandy slightly clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
	▼	2.50 - 2.95 2.50	D SPT	N=22 (1,1/4,5,6,7)	2.90	0.10		
		3.50 - 3.95 3.50	D SPT	N=7 (1,1/1,2,2,2)				Grey slightly silty fine SAND. Trace clay. With trace fine sand sized lignite. TIDAL FLAT DEPOSITS.
		4.50 - 4.95 4.50	D SPT	N=11 (1,2/2,3,3,3)				
		5.50 - 5.95 5.50	D SPT	N=18 (1,3/3,4,4,7)				
		6.00 - 6.50	B		6.00	-3.00		Brown grey slightly silty fine SAND. Trace fine sand sized lignite. TIDAL FLAT DEPOSITS.
		7.00 - 7.45 7.00	D SPT	N=31 (1,2/3,4,9,15)				
		8.50 - 8.95 8.50	D SPT	N=51 (7,9/11,11,13,16)				
		10.00 - 10.50	B		10.00	-7.00		

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
		11.00	152								

Remarks

1. BH01 halted at 11.00m, due to slow progress - casing advanced to 12.0m but could not progress hole due to blowing sands.
2. CPT at 11.0 abandoned due to not being able to advance SPT hammer down hole - blowing sands.
3. Groundwater seepage at 2.90m.
4. Blowing sands from 7.0m.

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Borehole Log

Borehole Number BH01

Project Name	Holland Park	Date	12/02/2020 - 13/02/2020
Location	Spalding	Co-ords	E523134.97 N321131.60
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level 3.00m AoD / Logged By AW / Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		10.00 - 10.95 10.00	D SPT	N=51 (9,11/51 for 245mm)				Brown grey silty fine SAND. Trace fine sand sized lignite. Trace fine sand sized shell fragments. TIDAL FLAT DEPOSITS.
					11.00	-8.00		End of Borehole at 11.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
		11.00	152								

Remarks

1. BH01 halted at 11.00m, due to slow progress - casing advanced to 12.0m but could not progress hole due to blowing sands.
2. CPT at 11.0 abandoned due to not being able to advance SPT hammer down hole - blowing sands.
3. Groundwater seepage at 2.90m.
4. Blowing sands from 7.0m.

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Borehole Log

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Borehole Number: BH02

Project Name	Holland Park	Date	14/02/2020 - 15/02/2020
Location	Spalding	Co-ords	E523288.97 N321153.57
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level: 3.30m AoD	Logged By: AW / Scale: 1:50 / Page Number: Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.50	B		0.70	2.60		Very soft grey orange-brown silty high plasticity CLAY. SUBSOIL
		1.00	B		1.00	2.30		Very soft brown clayey SILT. TIDAL FLAT DEPOSITS.
		1.20 - 1.65 1.20	D SPT	N=5 (1,1/1,1,1,2)	1.50	1.80		Very soft grey silty high plasticity CLAY. TIDAL FLAT DEPOSITS.
		2.00 - 2.45 2.00	D SPT	N=7 (1,1/1,2,2,2)				Loose buff brown slightly clayey slightly silty subangular to subrounded fine SAND. TIDAL FLAT DEPOSITS.
	▼	3.00 - 3.45 3.00	D SPT	N=10 (1,2/2,2,3,3)	3.50	-0.20		Loose brown grey subangular to subrounded fine SAND. Trace fine sand sized lignite. TIDAL FLAT DEPOSITS.
		4.00 - 4.45 4.00	D SPT	N=9 (1,2/2,3,2,2)				
		5.00 - 5.45 5.00	D SPT	N=11 (2,2/2,3,3,3)				*..becoming medium dense*
		6.50 - 6.95 6.50	D SPT	N=21 (2,3/4,5,5,7)				
		8.00 - 8.45 8.00	D SPT	N=41 (3,7/7,9,11,14)				
		9.00 - 10.00	B					
		9.50 - 9.95 9.50	D SPT	N=50 (3,7/9,11,11,19)				

Hole Diameter: Depth Base	Hole Diameter: Diameter	Casing Diameter: Depth Base	Casing Diameter: Diameter
		6.00 12.00	203 152

Chiselling: Depth Top	Depth Base	Duration	Tool	Inclination and Orientation: Depth Top	Depth Base	Inclination	Orientation

Remarks

1. BH02 halted at 12.45m, unable to progress borehole
2. BH02 advanced to 6.00m with 8" casing, then 6" to depth
3. Bentonite seal 5.00m to 6.00m
4. Blowing sands from 7.00m

AGS

Borehole Log

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Borehole Number: **BH02**

Project Name	Holland Park	Date	14/02/2020 - 15/02/2020
Location	Spalding	Co-ords	E523288.97 N321153.57
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level: 3.30m AoD; Logged By: AW; Scale: 1:50	Page Number: Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		10.40 - 10.85 10.40	B SPT	N=42 (3,5/9,9,11,13)	10.40	-7.10		Loose brown grey subangular to subrounded fine SAND. Trace fine sand sized lignite. TIDAL FLAT DEPOSITS.
		12.00 - 12.45 12.00	B SPT	N=34 (3,5/7,7,9,11)	12.00	-8.70		Dense gun metal grey silty sandy angular to subrounded fine flint chalk and very weak mudstone GRAVEL. With pockets of very soft grey brown mottled orange silty clay. GLACIAL TILL.
					12.45	-9.15		Dense brown sandy angular to subrounded fine to medium flint, very weak limestone and very weak mudstone GRAVEL. Trace coarse gravel. GLACIAL TILL.
								End of Borehole at 12.450m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
		6.00 12.00	203 152								

Remarks

1. BH02 halted at 12.45m, unable to progress borehole
2. BH02 advanced to 6.00m with 8" casing, then 6" to depth
3. Bentonite seal 5.00m to 6.00m
4. Blowing sands from 7.00m

AGS

Borehole Log

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Borehole Number: BH03

Project Name	Holland Park	Date	17/02/2020 - 18/02/2020
Location	Spalding	Co-ords	E523241.40 N321028.70
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level: 2.69m AoD; Logged By: TB; Scale: 1:50	Page Number: Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.40	2.29		Brown silty fine to medium sand. With rootlets. SUBSOIL.
					0.80	1.89		Very soft brown mottled grey sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.20 - 1.65 1.20	D SPT	N=10 (1,2/2,3,2,3)	1.30	1.39		Soft brown slightly sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS. *..becoming very soft and grey*
		2.00 - 2.45 2.00	D SPT	N=8 (1,1/2,2,2,2)				Medium dense brown slightly clayey silty fine SAND. TIDAL FLAT DEPOSITS.
								..becoming grey
					2.90	-0.21		*..becoming brown with occasional orange brown mottling*
	▼	3.00 - 3.45 3.00	D SPT	N=6 (0,0/1,1,2,2)				Loose becoming medium dense grey brown to grey silty fine SAND. With fine lignite and occasional fine shelly fragments. TIDAL FLAT DEPOSITS.
		3.50 - 4.00	B					
		4.00 - 4.45 4.00	D SPT	N=14 (1,2/2,3,4,5)				
		5.00 - 5.45 5.00	D SPT	N=9 (1,1/1,2,3,3)				
		5.50 - 6.00	B					
		6.00 - 6.45 6.00	D SPT	N=20 (4,7/4,4,6,6)				*..becoming medium dense to dense*
		7.50 - 8.00	B					
		8.00 - 8.45 8.00	D SPT	N=9 (1,2/2,3,2,2)	8.20 8.35 8.50	-5.51 -5.66 -5.81		Soft to firm dark blue grey silty CLAY. With shelly fragments and odour or rotten eggs. ALLUVIUM. Firm dark brown slightly sandy spongy pseudofibrous PEAT. With odour of rotten eggs. ALLUVIUM. Soft to firm becoming very soft blue grey silty CLAY. With occasional shelly fragments. ALLUVIUM.
		9.50 - 9.95 9.50	D SPT	N=50 (8,11/50 for 285mm)	9.60	-6.91		Dense to very dense blue grey becoming brown to grey brown slightly silty sandy subangular to

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
6.00 15.00	203 152	6.00 14.50	203 152								

Remarks

1. BH03 halted at 15.00m, target depth reached
2. Moderate groundwater ingress at 3.20m
3. BH02 advanced to 6.00m with 8" casing, then 6" to depth. Bentonite seal 5.00m to 6.00m
4. Standpipe installed to 15.00m

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Borehole Log

Borehole Number **BH03**

Project Name	Holland Park	Date	17/02/2020 - 18/02/2020
Location	Spalding	Co-ords	E523241.40 N321028.70
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level 2.69m AoD / Logged By TB / Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		11.00 - 11.45 11.00	D SPT	N=50 (75 for 100mm/50 for 0mm)				Dense to very dense blue grey becoming brown to grey brown slightly silty sandy subangular to angular fine to medium flint, limestone and mudstone GRAVEL. GLACIAL TILL. *..with occasional pockets of soft grey clay*
		12.50	SPT	N=49 (6,6/6,9,13,21)				
					13.70	-11.01		
		14.00	D					Very stiff dark grey silty gravelly CLAY. Gravel is subangular to subronded fine to medium chalk and angular fine to medium flint. GLACIAL TILL.
		14.50 - 14.95 14.50	D SPT	N=46 (4,7/9,11,13,13)				
					15.00	-12.31		End of Borehole at 15.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
6.00 15.00	203 152	6.00 14.50	203 152								

Remarks

1. BH03 halted at 15.00m, target depth reached
2. Moderate groundwater ingress at 3.20m
3. BH02 advanced to 6.00m with 8" casing, then 6" to depth. Bentonite seal 5.00m to 6.00m
4. Standpipe installed to 15.00m

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Borehole Log

Borehole Number BH04

Project Name	Holland Park	Date	18/02/2020
Location	Spalding	Co-ords	E523168.40 N321006.50
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level 2.88m AoD / Logged By TB / Scale 1:50	Page Number Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.40	2.48		Brown silty fine to medium sand. With rootlets. SUBSOIL.
					0.80	2.08		Very soft brown mottled grey sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
					1.30	1.58		Soft brown slightly sandy silty CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
								Medium dense brown slightly clayey silty fine SAND. TIDAL FLAT DEPOSITS.
								..becoming grey
	▼				3.00	-0.12		*..becoming brown with occasional orange brown mottling*
								Loose becoming medium dense grey brown to grey silty fine SAND. With fine lignite and occasional fine shelly fragments. TIDAL FLAT DEPOSITS.
		7.00	SPT	N=13 (2,3/3,4,3,3)				
					8.10	-5.22		Soft to firm dark brown to black spongy pseudofibrous to amorphous PEAT. With odour of rotten eggs. ALLUVIUM.
					8.25	-5.37		Soft to firm becoming very soft blue grey silty CLAY. With occasional shelly fragments. ALLUVIUM.
		8.50	SPT	N=1 (0,1/0,0,0,1)				
		10.00 - 10.10	D					

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
6.00	203	6.00 14.50	203 152								

Remarks

1. BH04 halted at 15.00m, target depth reached
2. Moderate groundwater ingress at 3.10m
3. BH02 advanced to 6.00m with 8" casing, then 6" to depth. Bentonite seal 5.00m to 6.00m
4. Borehole backfilled with arisings to surface

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Borehole Log

Borehole Number BH04

Project Name	Holland Park	Date	18/02/2020
Location	Spalding	Co-ords	E523168.40 N321006.50
Client	Broadgate Homes	Equipment	DANDO 2000
Project No.	P13-501	Level 2.88m AoD / Logged By TB / Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		10.00	SPT	N=50 (3,10/50 for 285mm)	10.10	-7.22		Soft to firm becoming very soft blue grey silty CLAY. With occasional shelly fragments. ALLUVIUM.
		10.50 - 11.00	B					Dense to very dense blue grey becoming brown to grey brown slightly silty sandy subangular to angular fine to medium flint, limestone and mudstone GRAVEL. GLACIAL TILL.
		11.50	SPT	N=50 (3,13/50 for 160mm)				*..becoming slightly sandy*
		12.00 - 12.50	D					
					12.50	-9.62		Very stiff dark grey silty gravelly CLAY. Gravel is subangular to subronded fine to medium chalk and angular fine to medium flint. GLACIAL TILL.
		13.00 - 13.45	D					
		13.00	SPT	N=50 (3,9/50 for 280mm)				
		14.50 - 14.95	D					
		14.50	SPT	N=44 (5,6/10,11,11,12)				
					15.00	-12.12		End of Borehole at 15.000m

11 12 13 14 15 16 17 18 19 20

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
6.00	203	6.00 14.50	203 152								

Remarks

1. BH04 halted at 15.00m, target depth reached
2. Moderate groundwater ingress at 3.10m
3. BH02 advanced to 6.00m with 8" casing, then 6" to depth. Bentonite seal 5.00m to 6.00m
4. Borehole backfilled with arisings to surface

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Borehole Log

Borehole Number BH05

Project Name	Holland Park	Date	01/09/2020 - 02/09/2020
Location	Spalding	Co-ords	E523213.40 N321169.60
Client	Broadgate Homes	Equipment	
Project No.	P13-501	Level 2.85m AoD / Logged By TB / Scale 1:50	Page Number Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.40	2.45		Brown silty fine to medium sand. With rootlets. TOPSOIL.
					0.60	2.25		Very soft light brown mottled grey brown sandy clayey SILT. Sand is fine. TIDAL FLAT DEPOSITS.
		1.00	SPT	N=6 (1,0/1,1,2,2)				Soft to firm grey mottled brown silty sandy CLAY. Sand is fine. TIDAL FLAT DEPOSITS.
					1.20	1.65		Loose to medium dense buff brown slightly clayey silty fine SAND. TIDAL FLAT DEPOSITS.
	▼	2.00	SPT	N=5 (1,0/1,1,1,2)				
					2.60	0.25		Loose grey brown fine SAND. With fine lignite. TIDAL FLAT DEPOSITS.
		3.00	SPT	N=5 (1,2/2,1,1,1)				
		4.00 - 6.00	B					
		4.00	SPT	N=6 (3,2/2,1,1,2)				
								..with shelly fragments
		5.00	SPT	N=9 (7,5/3,2,2,2)				
								..shelly fragments absent
		6.00	SPT	N=20 (3,3/3,4,5,8)				*..becoming medium dense*
		7.50	SPT	N=19 (1,3/4,5,5,5)				
		9.00	SPT	N=6 (2,3/3,1,1,1)				

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
6.00 14.00	203 152	6.00 14.00	203 152								

Remarks

1. BH05 terminated at 14.45m, groundwater ingress from bentonite seal failure
2. Moderate groundwater ingress at 2.40m
3. Borehole backfilled with arisings upon completion

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Borehole Log

Borehole Number **BH05**

Project Name	Holland Park	Date	01/09/2020 - 02/09/2020
Location	Spalding	Co-ords	E523213.40 N321169.60
Client	Broadgate Homes	Equipment	
Project No.	P13-501	Level 2.85m AoD / Logged By TB / Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		10.50 - 11.00 10.50	B SPT	N=7 (1,1/3,2,1,1)	10.70	-7.85		Loose grey brown fine SAND. With fine lignite. TIDAL FLAT DEPOSITS.
		12.00 - 12.50 12.00	B SPT	N=5 (2,2/2,1,1,1)				Medium dense grey slightly silty very sandy angular to subrounded fine to coarse flint, limestone and mudstone GRAVEL. Sand is fine to medium. GLACIAL TILL.
								..becoming very dense and trending to SAND & GRAVEL
					12.80	-9.95		Very stiff dark grey silty gravelly CLAY. Gravel is subangular to subrounded fine to medium chalk and angular fine to medium flint. With occasional fossil coral fragments. BOULDER CLAY.
		13.50 13.50 - 13.95	D U	Ublow=100				
		14.00 - 14.45 14.00	D SPT	N=41 (4,7/7,10,12,12)				
					14.45	-11.60		End of Borehole at 14.450m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
6.00 14.00	203 152	6.00 14.00	203 152								

Remarks

1. BH05 terminated at 14.45m, groundwater ingress from bentonite seal failure
2. Moderate groundwater ingress at 2.40m
3. Borehole backfilled with arisings upon completion

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