A REPORT ON A GROUND INVESTIGATION FOR AN ANAEROBIC DIGESTION PLANT, OFF WEBB'S ROAD, STREETLY END, NEAR CAMBRIDGE, CB21 4RP

CLIENT: Streetly Hall Estate

ENGINEER Plandescil Limited

Date: 5 September 2023

Reference: AFH/22.348/Rev01

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1. INTRODUCTION

It is proposed to construct an anaerobic digestion plant on land to the south of Webb's Road, to the east of Dean Road, and immediately west of Streetly Hall in Cambridgeshire (Drawing 22.348/01).

At the instruction of Streetly Hall Estate, an investigation was carried out to provide information on the subsoil conditions and relevant geotechnical parameters relating to foundation design.

This revised report provides the factual details of the fieldwork and laboratory testing undertaken during the investigation, and discusses the findings with respect to an amended scheme layout for the proposed development from that previously considered (AFHA, 2023.

The report was prepared for the use of the Client and its advisors. Other parties using the contained information do so at their own risk and any duty of care to those parties is specifically excluded as covered by copyright.

2. FIELDWORK

Fieldwork was carried out from 9 to 13 January 2023 and comprised five cable percussion boreholes, six trial pits, two trial pits for soakage testing, and eight dynamic cone penetrometer tests.

The positions were set out in general accordance with the requirements of the Client and Consulting Engineer for the project, Plandescil Limited, to target the expected construction proposals at the time of the investigation, and as shown approximately on Drawing 22.348/02/Rev01. The National Grid reference, and the elevation of the positions relative to Ordnance Datum, were obtained using a Hemisphere S320 VRS GPS (RTK) system.

A cable avoidance tool (CAT) was used to sweep the location of the exploratory holes and their immediate surrounding area to locate any potential services and the location adjusted as necessary. A starter pit was also excavated by hand to a depth of 1.20 m at the borehole positions to provide direct inspection for services.

During advance, sampling, soil descriptions and *in situ* tests were carried out in general accordance with BS EN1997-2:2007 Eurocode 7 and its UK National Annex supported by BS 5930:2015+A1:2020. Chalk descriptions followed the guidance presented in CIRIA C574 (Lord *et al*, 2002), where feasible.

Details of the strata encountered, the sampling, and *in situ* and subsequent laboratory testing are shown on records appended to this report.

The **boreholes**, referenced BH01 to BH05, were each taken to 15 m between 9 and 12 January 2023 and were spread throughout the site to confirm the deeper ground conditions. This utilised conventional cable percussive techniques ('shell and auger') in 150 mm diameter casing.

Disturbed samples were taken for laboratory testing and to allow later inspection of the materials encountered and facilitate accurate logging. Standard penetration tests (SPT) were carried out at regular intervals throughout, using a solid cone, mainly in the chalk but with a single test within clay strata. The N-value was taken as the number of blows for 300 mm of penetration, following a seating drive of 150 mm or 25 blows. Occasional open drive samples (U100) were taken to allow laboratory testing of the undisturbed materials.

The **trial pits**, referenced TP01 to TP06, were excavated by an 8 tonne tracked excavator and were taken to a depth of approximately 3 m below ground level on 12 January 2023. This was primarily to confirm variations in the shallow ground conditions and to enable the *in situ* chalk to be described according to the CIRIA guidelines. Throughout, disturbed samples were also obtained for possible laboratory testing.

A further two trial pits were excavated specifically in order to facilitate **soakage testing**, at locations referenced SA01 and SA02 on 12 and 13 January 2023, with test sections established from 1.1 to about 2.0 m. The lower sections were filled with 20 mm diameter gravel to maintain sidewall integrity. The soakage testing was carried out in accordance with Building Research Establishment report 365 (BRE, 2016) by filling the test section with water and recording the time taken for it to drain away, with three fillings undertaken at each. At SA01, insufficient drainage took place during the allocated time period despite a data logger installed to extend monitoring for a second day, which classifies as a test failure. At SA02, sufficient drainage took place during manual dipping.

The **dynamic cone penetrometer tests**, referenced DCP01 to DCP08 were carried out on 13 January 2023 in selected parts of the site associated with the proposed access road and silage clamps. The tests were performed with hand held equipment that utilised an 8 kg hammer dropped through a height of 575 mm to drive a 60° angled 20 mm diameter cone into the ground to enable determination of the *in situ* California Bearing Ratio (CBR). Readings were taken of the penetration rate per blow and extended to depths ranging from 1.2 to 1.4 m. The CBR value was calculated based on the following:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{penetration rate})$

Following completion of the DCP tests the soil was excavated to depth limit of testing and described using the CIRIA chalk grades where feasible. They were taken through the chalk and the overlying clay, sand and silt, with representative small disturbed samples obtained.

The exploratory holes were monitored for **groundwater** ingress during advance. In this instance, none was encountered, and there was no requirement for long-term water monitoring.

3. LABORATORY TESTING

3.1 GENERAL

Subsequent to the fieldwork, a programme of laboratory testing was carried out to provide additional quantitative data on the materials encountered. The tests were completed in accordance with the procedures laid down in BS1377: 1990 and BS EN ISO 17892, unless stated otherwise and consisted of:

- Natural moisture content
- Atterberg limits
- Dry density/saturation moisture content of chalk
- Unconsolidated undrained triaxial testing
- Point load strength
- Sulphate content and pH value
- Total sulphur

3.2 TEST PROCEDURES

3.2.1 Natural Moisture Content

The natural moisture content (also known as water content) is determined according to BS EN ISO 17892: Part 1: 2014: clause 5.2. This represents the mass of moisture content retained by the soil in its natural state as a percentage of its dry mass. For organic soils and peats care should be taken to avoid heating the sample above 50°C to prevent irreversible physical changes to the material.

3.2.2 Atterberg Limits

The Atterberg limits are determined in the laboratory by the procedures given in BS EN ISO 17892: Part 12: 2018. The liquid limit (LL) is the moisture content of the soil at the point that its behaviour passes from that of a plastic solid to that of a liquid. The test procedure given as clause 5.3 was used based on the cone penetrometer in which the penetration of a free-fall cone into moistened and cured samples of the soil is measured. The plastic limit (PL) is the moisture content of the soil at the point that its behaviour passes from a plastic solid to a brittle solid. This point is measured according to clause 5.5 and is the point at which a thread of the soil rolled to 3 mm diameter begins to crumble.

Together the Atterberg limits can be used to define the plastic range of the soil. The plasticity index (PI) is the difference between the liquid and plastic limit and is broadly correlated to the engineering behaviour of the soil. When used with the natural moisture content of the soil they can also give an indication of its in situ condition.

3.2.3 Dry Density/Saturation Moisture Content of Chalk

The determination of the dry density and saturation moisture content of chalk is carried out in accordance with BS 1377: Part 2: 1990: clause 3.3. The test is based on the determination of the dry density of a lump of chalk, using the immersion in water method. A calculation is made from this of the potential moisture content at saturation, assuming a particle density of 2.7 Mgm^{-3}.

3.2.4 Unconsolidated Undrained Triaxial Testing

The undrained shear strength can be measured, as stated in BS EN ISO 17892: Part 8: 2018 or BS 1377: Part 7: 1990: clause 8, by axial compression of 100 mm diameter cylindrical specimens cut from the U100 undisturbed samples. The nature of the test is such that no change in moisture content of the specimen is allowed during shear.

The theory of behaviour of saturated materials in undrained shear failure gives that the strength will not be influenced by the confining pressure such that the measured angle of internal friction for the material will apparently be equal to zero. Experience has shown that this is true only for samples of unweathered heavily overconsolidated pure cohesive deposits. Where the material is weathered or it contains a significant granular content a plastic rather than a brittle failure develops which produces a strain hardening during shear. In this situation measurable apparent undrained angle of internal friction is produced. A similar situation develops in partially saturated materials. The test results are also influenced by sample variation, and in particular the presence of natural fissures or inclusions within the sample.

The use of large diameter specimens is preferred as this compensates for the scale effects of random features in smaller specimens. One of two tests are carried out according to the soil characteristic. Unweathered specimens of heavily overconsolidated material which have a brittle failure in shear are tested in a single stage according to BS EN ISO 17892: Part 8: 2018. The confining pressure is taken as the total overburden pressure of the sample *in situ*. It is then failed by axial compression and the measured deviator stress reported as the apparent undrained cohesion. Specimens of weathered material or those with granular contents are tested in a multistage manner according to BS 1377: Part 7: 1990: clause 9.

The test procedure is similar to the single stage but at the point that failure begins the confining pressure is increased and the specimen compressed for a further 2% of vertical strain at which point the confining pressure is again increased and held for a further 2% strain. The deviator stresses at each of the confining pressures are used to plot the Mohr envelope and the apparent undrained cohesion and if appropriate the undrained angle of internal friction.

3.2.5 Point Load Strength

The test can be carried out either in the laboratory or in the field on unprepared samples. A sample is placed between two points and a load applied axially through these points. The minimum length of the sample should 1.5 times the diameter, with the point load index being the ratio between the applied load at failure and the square of the diameter of the sample. If a clean fracture of the sample does not occur, leading to deformation, then the test should be rejected.

The test is carried out in accordance with the methods described by BS EN 1997-2:2007 and ISRM (2007), although if less than ten determinations of strength are taken, the results do not conform to the requirements of the BS. The Point Load Strength test is intended as an index test for the strength classification of rock material. It may also be used to give an approximation of other strength parameters, such as uniaxial compressive strength, although the test results can be used as an index value in their own right. Testing may be performed with portable equipment in the field or using laboratory apparatus.

Rock specimens can be in the form of either cores (diametral and axial tests), cut blocks, or irregular lumps. The specimens are taken to failure by the application of a concentrated load through a pair of spherically truncated conical platens. A number of point load index, determinations Is(50) are made from each sample, and in this case ten determinations from both samples.

3.2.6 Sulphate Content and pH Value

In order to aid the evaluation of any aggressive tendency of the subsoil or groundwater to buried concrete, the pH, water soluble and total sulphate concentrations in a number of samples were determined using in-house procedures based on other methodologies.

The pH of a groundwater sample or a soil filtrate was established electrometrically according to BS 1377: Part 3: 1990: clause 9.5, while water soluble sulphate and groundwater sulphate were determined using procedures based on Standard Methods for the Examination of Water and Wastewater Part 3120 B – 21st Edition (AWWA & WEF, 2005). This requires the preparation of a soil extract using deionised water at a 2:1 ratio. The filtered extract of the soil, or a water sample, are then injected into an ion exchange chromatograph with a conductivity detector. The samples are compared against commercially available standards to evaluate the sulphate concentration.

The total sulphate content of a soil was measured on a filtrate following digestion of the soil by 10% hydrochloric acid, as shown by BS 1377: Part 3: 1990: clause 5.5 and TRL 447 (Reid *et al* 2005). Subsequently the soil filtrate is introduced into ICP-OES equipment to determine sulphate concentration.

3.2.7 Total Sulphur Content

To aid the evaluation of aggressive tendency of the subsoil to buried concrete as a result of its pyritic potential, the total potential sulphate content can be determined from the relationship between the total (acid soluble) sulphate content and the amount of total sulphur present. The total sulphur content is determined by a laboratory in-house methodology based on Standard Methods for the Examination of Water and Wastewater Part 3120 B – 21st Edition (AWWA & WEF, 2005).

4. ENGINEERING INTERPRETATION

4.1 GENERAL

The layout of the proposed scheme and other details were provided by Plandescil Limited on a series of drawings and associated correspondence. This indicates it is intended to construct three bunded fermenter tanks and a post-fermenter tank, four silage clamps, a surface water lagoon, a dirty water lagoon and a covered digestate storage lagoon, as well as other ancillary structures, buildings and tanks. There will also be concrete and asphalt surfacing, and an access road. The layout is incorporated into Drawing 22.348/02/Rev01 and the finished site levels abstracted from Plandescil drawing 27951/008 RevB.

The comments and recommendations contained in the report are based on the data obtained from the relevant exploratory holes, field tests, associated laboratory testing and the information supplied. Extrapolation between and to other parts of the site is considered within the light of the geological setting as interpreted, but no responsibility can be accepted for varying geological and geotechnical conditions from those on which the report is based. It should be noted that the solutions discussed assume the design indicated at the time of reporting and must be subject to a more complete assessment if changes are made at a later date.

4.2 GROUND MODEL

4.2.1 Site Description

At the time of the investigation, the site comprised a large field under arable cultivation. Webb's Road lay beyond the northern boundary close to its junction with Dean Road. The Streetly Hall Estate was positioned to the east and further agricultural land existed outside of the site, while there were also occasional tracts of woodland.

The site sloped generally to the north and was highest in the south-east corner where the ground surface lay at about 86 mOD and was lowest in the north and north-west at around 70 to 72 mOD. A site survey drawing that had been provided annotated the land to the north as 'Area of Potential Flooding'. Outside of the site, a drainage channel followed the southern side of Webb's Road and flowed north-eastwards to join another water channel that flowed south-westwards.

4.2.2 General Geology

Geological mapping for the area by the British Geological Survey (BGS, 2023) indicated a bedrock geology of undifferentiated Lewes Nodular Chalk Formation and Seaford Chalk Formation of the White Chalk Subgroup. This is shown to outcrop in the immediate area of the site, with the closest superficial geology comprising Terrace deposits some 300 m to the south-west of TP06 and the Lowestoft Formation approximately 100 m to the south of DCP01.

The **Chalk** is a white very pure carbonate debris of microfossil skeletal material laid down during the Cretaceous Period. In south east England it tends to be soft and friable although this is interspersed with a number of beds of rock chalk which are harder and more compact. The chalk is naturally fissured and since it is water soluble these may be open as a result of solution and can produce very high secondary permeabilities.

Additionally chalk is very susceptible to freeze-thaw action and its upper levels may show the evidence of severe disruption and fracturing as a result of the climatic changes in the geologic past. Besides an increase in the frequency of fracturing this disruption also allowed an increase in the moisture content producing a softer material, generally referred to as 'putty chalk'. In the disrupted state the chalk was subject to remoulding and transport by hillslope processes and may have produced a mantle of material very different to the underlying intact material.

The **Lowestoft Formation** of the Anglian Stage glaciation is shown to be **diamicton** which is typically cohesive and comprises, in its unweathered state, a bluish grey, variably sandy and silty clay, with abundant flint and chalk gravel. Other gravel lithologies may also be found and fine-grained chalk may be present within the matrix of the deposit. At surface the material may be decalcified, weathering to yellowish brown or brownish grey with a noticeable absence of chalk.

The whole is generally stiff with apparent high degrees of overconsolidation, although it may contain or overlie other glacial materials which can be very much softer. Glacial deposits are irregular in deposition so that extrapolation is not always reliable. Bands of sand and gravel may be found within of above the general sequence and can often be water bearing.

The **River Terrace Deposits** were derived from the chalk and younger Eocene deposits during the Pleistocene and laid down while rivers, such as the Granta and its tributaries, were flowing with greater discharges than today. Subsequent readjustment has left these deposits as terraces along valley sides or as lag deposits along the floor of present day valleys. They comprise a superficial sequence of flint sand and gravel, locally displaying vertical sorting. Terraces may be capped by finer alluvium, but often this has been removed by later erosion. Towards the edges of the terraces the material has often been reworked and transported so that it may be found draped over lower levels than those at which it was originally deposited.

4.2.3 Historical Features

A brief review of historical mapping[1] and aerial images[2] has been undertaken. The earliest available map edition from the survey of **1885** shows the site to be located in same field as the present-day. The lines of Webb's Road and Dean Road appear to follow the same routes, while the water channels also existed.

An old chalk pit and what was assumed to be an active pit at the time were indicated approximately 650 m to the north-east of the site, and a chalk pit with an adjacent limekiln were shown about 640 m to the south-west of the site. The survey of **1901** suggested the limekiln no longer existed.

Other than a few modifications to field boundaries outside of the site's footprint, no further changes were apparent up to and including the final edition published in **1960**.

Aerial images are available between **1945** and **2022**, but added nothing of significance.

4.2.4 Site Geology and Geotechnical Condition

Within the site area, the investigation proved a sequence of deposits dominated by chalk, with no evidence for the presence of the River Terrace Deposits or the Lowestoft Formation. The chalk was covered by pale coloured calcareous clay, occasionally calcareous silt and more rarely sand. These materials may represent weathered or cryoturbated chalk, while a more distinct brown or orange brown clay is tentatively identified as an unmapped localised superficial deposit. For the purpose of reporting, the latter is not generally differentiated from the other materials overlying the chalk, and all were covered by a thickness of topsoil, with no evidence for the presence of any made ground or other artificial ground. The findings are summarised on a series of Nominal Sections (Figures 22.348/03a to 23.348/03e/Rev01) which, together with other geotechnical data plots, are presented in Appendix G.

[1] National Library of Scotland archives used under the terms of the Creative Commons Attribution (CC-BY) licence
[2] Google Earth

Topsoil

Topsoil was encountered throughout the site to depths ranging from 0.2 to 0.5 m and was typically cohesive and occasionally a granular material.

Weathered or Cryoturbated Chalk and Potential Superficial Deposits

These materials were encountered to depths ranging from about 1.0 to 2.0 m, but occasionally were found to less than a metre. The thinner deposit appeared to be more prevalent towards the western end of the site, for example at SA01, SA02, TP04, TP05 and TP06, where these materials extended to less than 0.6 m.

The more cohesive deposit was assessed to be soft with Atterberg limits determinations indicating a low plasticity clay with a plasticity index between 11% and 15% (Figure 22.348/04). This was tentatively identified as a possible unmapped superficial deposit and there was some evidence to suggest it was more common towards the eastern end of the site where it was found to depths ranging from 0.7 to 1.0 m at DCP02, DCP05, DCP06 and TP01.

Chalk

The underlying bedrock chalk formed the bulk of the sequence investigated and was proved to the limit of the boreholes at 15 m. The material encountered in the trial pits, soakage test positions and the DCPs has been described in general accord with CIRIA C574 (Lord *et al*, 2002). The upper parts of the chalk is typically a structureless silt matrix containing gravel size chalk fragments which is considered to be CIRIA Grade Dm. With depth it became gravel size chalk fragments set in a silt matrix corresponding with CIRIA Grade Dc. Throughout there was a variable quantity of chalk cobbles and also flints.

The structureless matrix-dominated **Grade Dm** chalk was composed of off-white slightly gravelly silt, with the clasts consisting of very weak low density gravel. Occasional flint gravel and cobbles were also apparent. The black specks noted are mineralogical and common in chalk, and have no significance. The Grade Dm chalk was found typically to depths ranging from about 1.0 to 2.0 m although the shallower DCP holes often terminated within it. Elsewhere, it overlay structureless clast-dominated **Grade Dc** chalk that was composed of off-white subangular to subrounded mainly medium to coarse gravel size chalk, which is very weak and of low density with occasional black specks. The gravel is set in a matrix of off-white occasionally stained orange-brown sandy silt. Chalk cobbles were present in places together with occasional flints. Rarely, the chalk cobbles were weak and of medium density.

Overall, this was supported by the results from the dry density/saturation moisture content testing of chalk fragments that showed the tested samples had **intact dry densities** ranging from 1.27 to 1.56 Mgm^{-3}, but were typically between 1.40 and 1.49 Mgm^{-3}. **Saturation moisture contents** were from 27 to 42% and typically were between 30% and 35%. Point load index values produced estimated unconfined compressive strength values of 1.4 and 1.6 MNm^{-2}, suggesting the potential for very weak material.

It should be noted that chalk recovered from the boreholes cannot be assessed with the same degree of certainty, given that the cable percussive technique produces sample disturbance and a potential underestimation of the condition of the chalk, such that most of it would appear to be matrix-dominated Grade Dm. However, the triaxial testing provided values that suggested a 'stiff' condition, while the deeper chalk was often associated with higher SPT N-values such that it may be structured in places.

The SPT plots (Figures 22.348/05a/Rev01 to 22.348/05d) demonstrate **N-Values** that vary overall from 4 to in excess of 50, but were typically between 7 and about 29. As it has been shown that Grade Dc chalk was present normally by about 2 m depth, it is estimated that potentially structured chalk may exist below depths ranging from approximately 8.5 to 13.0 m, based on the arbitrary basis of an N-value of 13 or more. However, to prove this contention it would be necessary to undertake rotary borehole fieldwork to fully assess the condition and nature of the deeper chalk.

The N-value plots suggest no significant differences across the site with the test results from BH02 and BH03 in the general area of the post-fermenter and fermenter tanks and also the surface and dirty water lagoons when plotted separately from BH04 and BH05 in the vicinity of the digestate storage lagoon (Figures 22.348/05a/Rev01 and 22.348/05b/Rev01). The combined plots are considered appropriate for the site as a whole and also include results from BH01 (Figures 22.348/05c and 22.348/05d). They provide the distribution of N-values against depth and level respectively, and suggest a slight increase in competence against level.

Dynamic Cone Penetrometer Testing

The DCP testing (Appendix E) was undertaken in the top approximate 1.2 to 1.4 m of ground, but below the agricultural topsoil. This enabled California Bearing Ratio values to be determined for the *in situ* chalk and the overlying materials, which produced wide-ranging values:

- In the clay and pale calcareous clay overall from 3.4% to 60%, but typically 5% to about 24%, with the higher values possibly affected by flint gravel, but generally with a trend of increasing CBR with depth,

- A single value of 13% in pale coloured silty sand,

- A single value of 27% in pale coloured silt that is likely to be cryoturbated or weathered chalk,

- Testing carried out in the chalk provided an overall range over in CBR value from 19% to 57% but were typically in the order of 20 to 33%.

4.2.5 Chemical Considerations

Risks to construction materials can be assessed primarily using the sulphate and pH results according to the recommendations of Building Research Establishment Special Digest 1 (BRE, 2005). These analyses were undertaken in order to evaluate any aggressive tendency of the soil to buried concrete. The results of analysis within the chalk and overlying materials can be summarised as follows:

- pH between 8.0 and 8.1,
- water soluble sulphate of 0.01 g/l or less,
- acid soluble sulphate from 0.04 to 0.06%,
- total sulphur of 0.02% or less.

The sulphur determinations were made to complement the sulphate testing according to the recommendations of the Digest. This establishes if a material is pyritic and uses a relationship between total sulphur, acid soluble and water soluble sulphate, and Total Potential Sulphate (TPS), to determine whether it is necessary to increase the Design Sulphate (DS) class. All samples of the produced oxidisable sulphide (OS) values below the 0.3% trigger concentration.

4.2.6 Groundwater

Groundwater was not encountered during the fieldwork and was not subject to any long-term monitoring through piezometer installations. No nearby BGS archive records were available to provide any further data.

However, any groundwater observations reported during boring will have been affected by the permeability of the ground, the rate of progress of the borehole and the drilling techniques. The general procedures used do not allow precise measurements of the groundwater conditions, but give only a general guide to the overall situation. Fluctuations in any groundwater table will occur as a result of seasonal or climatic effects.

Limited information is available on a hydrogeology map of the area (IGS, 1981) which provides contours on the potentiometric surface of the chalk water level. This suggests that it lay at approximately 58 to 59 mOD at the time of mapping, but this should be treated with caution. Additionally, there were no symbols on the hydrogeology map to indicate a potential for artesian water pressures in the area.

4.3 FOUNDATIONS

4.3.1 Proposals and Ground Conditions

The principal structures are the four 30 m diameter **post-fermenter and fermenter tanks**, with an assumed maximum bearing stress of 150 kNm^{-2}.

Due to the nature of the sloping site, the proposals involve a cut and fill operation with the tanks founded mainly on recompacted chalk. The drawings provided indicate that the ground surface may be raised as much as 3.0 to 3.5 m above existing ground level. They also show the tanks are bunded with a base at 77.5 mOD, and with the formation level of the tanks co-incident with the base level of the bund (Figure 22.348/03b/Rev01).

It is not possible to assess bearing capacity and settlement for the compacted chalk fill material, but it is assumed that it will be in a comparable or better condition than the *in situ* Grades Dm and Dc chalk. Therefore the parameters used in the following assessment are taken directly from the material established at the exploratory holes during the investigation, effectively ignoring the presence of the chalk fill.

The four **silage clamps** each appear to be approximately 113 by 25 m in plan and typically comprise basal slabs with integrated side walls and are surrounded by an earth bank. Their design is usually based on CBR values. The clamps may be partly set at the natural ground level and partly on raised chalk fill. The formation levels steps down each clamp towards the north, as indicated on the generalised section on Figure 22.348/03c/Rev01.

For the **ancillary structures and buildings**, these are understood to be more lightly loaded than the 30 m diameter tanks, with bearing stresses anticipated to be in the order of 80 to 100 kNm^{-2}. The buildings are largely founded on imported made ground in the vicinity of the new road (Figure 22.348/03d/Rev01), but it should be noted that limited ground investigation was undertaken in this area, and there is less certainty regarding the depth of the Grade Dc chalk.

No information was made available for the **surface water pond and storage lagoon** development (Figure 22.348/03e/Rev01), but can be assessed at a later date if required.

The layout drawings provided also show it is intended to construct an **access road**, and an asphalted storage area.

4.3.2 Risks Associated with Chalk (dissolution features)

Chalk is susceptible to dissolution by water, and therefore should always be considered as a potential risk when designing foundations within chalk. Whilst the presence of dissolution features on the site cannot be ruled out, it should be noted that no positive evidence was identified during the fieldwork. They are often indicated by a marked reduction in N-value, a sinking of the SPT rods and/or changes in the colour of the chalk. Although a moderate reduction in N-value at BH03, with an N of 7 recorded at 14.5 m depth, dissolution features are not considered to be a particular risk at this site.

However, in situations where chalk is exposed at formation level, as may be the case for some of the proposed buildings near to the access road, the upper surface can be inspected directly to determine its condition and review the potential further. In theory, if any are identified the feature should be excavated and replaced with a suitable compactable material, or the area bridged with reinforcement. Grouting may be necessary if the feature is noted to extend to considerable depth or is too large to bridge.

4.3.3 Tank Foundation Design in Chalk

The foundations can be considered as two elements; that for the perimeter wall and central column loads and, that for the base load. However, collectively and individually they will influence the overall behaviour each structure.

Information provided suggested that the maximum load is 150 kNm^{-2} which is assumed to be the wall load exerted onto a perimeter ring beam of about a metre width with a similar central column load onto a central pad. In addition, the contained fluid would exert a stress across the base, with experience from similar projects in the past suggesting this may be in the order of about 65 kNm^{-2}.

The majority of work carried out in relation to chalk behaviour under loading is based on elastic theory. In order to limit settlements the applied stress at foundation level should not exceed a yield stress value, qy. The establishment of qy and the determination of the actual settlement is based on *in situ* plate bearing test data which is presented in published sources (Lord *et al*, 2002).

To minimise settlement and stay below the qy value, an appropriate allowable bearing pressure for Grade Dc chalk would be 225 kNm^{-2}, while no value is supplied for Grade Dm chalk, experience suggests that the maximum load of 150 kNm^{-2}, should be accommodated. However, this may be verified by undertaking plate bearing tests directly on the upper chalk surface as recommended by the CIRIA guidelines.

The immediate elastic settlement, p, can also be obtained using the general expression:

$$p = \frac{q \times 2 \times B \times (1 - \mu^2) \times Ip \times 0.8}{E} \qquad \text{(Equation 1)}$$

where:

q	is the net foundation pressure
B	is the width or diameter of the foundation
μ	is Poisson's ratio
Ip	is an influence factor
E	is the elastic modulus

The influence factor provides a measure of the stress increase at any depth due to the loading by the structure, and is taken to be 0.5, assuming the thickness of the chalk below the foundations is greater than the depth significantly stressed. Poisson's ratio is taken to be 0.24, and the modulus as 200 MNm^{-2} for Grade Dc chalk and 6 MNm^{-2} for Grade Dm (Lord *et al*, 2002). The adjustment factor of 0.8 is used as the foundations are designed to be stiff rather than flexible.

Initially, the settlement is assessed with an applied bearing stress of 150 kNm^{-2} onto the perimeter ring beam taken to be about a metre in width and central pad for the column load. In order to be conservative, this is assumed to stress only the weaker Grade Dm chalk, then substitution into the above equation would give an immediate elastic settlement of:

$$p = \frac{150 \times 2 \times 1 \times (1 - 0.24^2) \times 0.5 \times 0.8}{6000}$$

$$= \quad 0.019 \text{ m } \mathbf{(19\ mm)}$$

However, in the case of the **tank bases**, the potential settlement that develops from a widely loaded area may be expected to stress the chalk to a greater depth, such that it will be more appropriate to take the elastic modulus for the Grade Dc material:

$$p = \frac{65 \times 2 \times 30 \times (1 - 0.24^2) \times 0.5 \times 0.8}{200000}$$

$$= \quad 0.0074 \text{ mm } (\mathbf{7.4\ mm})$$

Or in the worst case if the entire 150 kNm^{-2} is taken by the base slab, settlement is estimated to be **17 mm**.

A number of factors will influence the actual settlement that will be experienced by the structures. In particular, the engineering parameters of the soil may vary both laterally and vertically within the soil profile.

4.3.4 Ancillary Structures and Buildings

This approach has also been taken for the foundations for the proposed buildings, although limited investigation has been carried out for those located near the access road, which comprise the more substantial structures. There would be some advantage in extending the associated foundation excavations in this area so that they are founded directly in the Grade Dc chalk on the basis that it is approximately 2 m deep as found elsewhere at the site. It is recommended that any soft clay cover is removed as well as the matrix-dominated Dm chalk. This has the added benefit of allowing the upper chalk surface to be examined for any evidence of dissolution features.

The following assumes that the construction adopts a raft foundation, although some information is also provided for strip footings. Firstly, if it is assumed that the load exerted over the widest base slab is taken by Grade Dc chalk, or imported fill of comparable mechanical character:

$$p = \frac{100 \times 2 \times 30 \times (1 - 0.24^2) \times 0.5 \times 0.8}{200000}$$

$$= \quad 0.011 \text{ m } (\mathbf{11\ mm})$$

However, if the Dm chalk is thicker and exerts a greater influence, it should be noted that the settlement could be significantly greater. Although this is unlikely, as an alternative, a calculation is presented for a 1 m wide strip footing that stresses only the Grade Dm chalk:

$$p = \frac{100 \times 2 \times 1 \times (1 - 0.24^2) \times 0.5 \times 0.8}{6000}$$

$$= 0.012\ (\mathbf{12\ mm})$$

4.4 SITE DRAINAGE

The soakage tests undertaken at trial pits SA01 and SA02 were carried out in accordance with BRE 365 between 1.1 m and about 2.0 m, with both carried out in essentially Grade Dc Chalk.

The test at SA01 was deemed a failure due to insufficient drainage while that at SA02 produced an infiltration rate of **4.33×10^{-5} ms^{-1}**.

Chalk can present a risk to soakaway design as it can activate dissolution features when present as a low density material; soakaways should be sited at a recommended distance from new foundations (Lord *et al*, 2002). Overall, there appears to be no positive evidence for dissolution features, and so long as any further inspections of the upper chalk surface maintains this assertion, the CIRIA guidance suggests soakaways should be sited at least 10 m from new foundations. In the presence of dissolution features they would need to be sited at least 20 m away, or avoided if at all possible.

4.5 ROADS, HARDSTANDING AND SILAGE CLAMPS

The plans indicate that it is intended to construct an access road and associated hardstanding, as well as the silage clamps. The strength of the subgrade material is a principal factor in determining the thickness of the proposed pavement and can be assessed from the CBR values derived from the in situ DCP testing.

Single CBR values of 13% and 27% were recorded in sand at DCP03 and silt at DCP08 respectively, although the latter is likely to represent weathered or cryoturbated chalk and should be included in the following CBR assessment for chalk.

In the chalk, a typical minimum value of about 20% was recorded during *in situ* testing, although CIRIA guidance suggests such a value can be adopted for structured material, a minimum design value of 2% is considered as appropriate for highly weathered *in situ* chalk, as often found at this site. Chalk and the highly weathered or cryoturbated cover are also frost susceptible and the subbase should be thick enough to prevent frost action from affecting the road, hardstands and silage clamp bases. Typically, a total pavement thickness of 450 mm (including sub-base) should be adopted.

It can be considered that the more cohesive materials are associated with an average plasticity index of about 13% with the Atterberg limits testing indicating a low plasticity clay. This is in general agreement with tabulated data for equilibrium CBR values for material of comparable character where there is a deep water table (at least a metre depth), and a thick pavement. Hence the minimum *in situ* value of around 3% could be taken for design purposes. However, given that there is a limited amount of potentially superficial clay and considering that some of the silage clamp area will be constructed in the chalk fill, overall it would be prudent to adopt **2%** throughout.

4.6 EXCAVATIONS

Proposed excavation depths are not known, but will encounter topsoil and chalk, together with the overlying weathered/cryoturbated chalk and minor potential superficial material. Moderately deep excavations to say 3.0 m are expected to remain dry and should retain stability, as demonstrated by the trial pits during the ground investigation. The resultant excavations should be free-standing in the short to medium term, allowing the formation level to be attained without the need for any additional means of support beyond those required for standard health and safety measures.

However, provision should be made to control surface water run-off, in order to maintain adequately dry conditions for work and prevent disturbance to the founding strata, and the overall stability of any excavation in general, may be improved by applying a batter to the sidewalls if needed.

Exposed chalk is prone to mechanical disturbance and should be kept as dry as possible, with work preferably restricted to good weather conditions. Regardless, the base of the excavation should be protected with a blinding layer of concrete as soon as possible after exposure to protect it from the influence of weather, and as a precaution against deterioration by water. In addition, it is essential that the base of the excavations are protected at all times from freezing or frost inducing conditions which can cause severe disruption of chalk.

4.7 BURIED CONCRETE

Selected samples were subjected to chemical analyses in order to evaluate any aggressive tendency of the subsoil to buried concrete. All the results corresponded with a design sulphate class of **DS-1** according to Building Research Establishment Special Digest 1 (BRE, 2005).

The Digest identifies a number of different site categories, which include those with ‘natural’ soil conditions, those that have been subject to ‘brownfield’ development, and sites which contain pyrite bearing ground that will be subject to future disturbance and could result in pyritic oxidation.

The BRE Digest also shows that it is necessary to take into account other factors related to the environment into which any new concrete may be placed i.e. the pH of the ground and the mobility of the groundwater table. It is then possible to assign an ACEC (aggressive chemical environment for concrete) class.

‘Natural’ soil conditions have been adopted given the long-standing assumed arable land use and with no evidence for any nearby industrial activity. In the absence of groundwater, static conditions are adopted.

For concrete placed in the strata established during the investigation, an ACEC classification of **AC-1s** would be appropriate.

5. SUMMARY

1. A ground investigation was undertaken at Streetly End, Cambridgeshire, CB21 4RP. This was required to establish the ground conditions for the design of foundations and pavements associated with the construction of an anaerobic digester plant.

2. The site currently and historically was located in open agricultural land, with no evidence of any nearby chalk workings or past industrial activity.

3. Beneath a layer of agricultural soil, chalk was encountered that was assumed to be the undifferentiated Lewes Nodular Chalk and Seaford Chalk Formations of the BGS mapping. This was expected at outcrop and the pale coloured often calcareous clay and silt over the chalk is most likely cryoturbated or weathered chalk. No groundwater was encountered during the investigation, but could potentially lie at about 58 to 59 mOD.

4. Direct examination of the chalk in trial pits and DCP locations showed it to be Grade Dm, often becoming Grade Dc by about 2 m. Chalk recovered from the boreholes was too disturbed to assess the deeper material, but triaxial testing and more significantly SPT N-values suggest competent chalk at depth. There was no positive evidence for the presence of dissolution features.

5. The proposals show the sloping site will be subject to a cut and fill operation, with the principal structures consisting of four 30 m diameter tanks to be constructed on filled chalk ground. Silage clamps, ancillary buildings and structures, hardstanding and an access road are also proposed.

6. The foundation parameters for bearing capacity and settlement of the chalk are taken solely from the investigated material assuming the chalk fill will be the same or in a better condition than the *in situ* material.

7. For chalk the recommended maximum allowable pressure is 225 kNm^2 for the deeper Grade Dc, while it is generally recommended that this is determined by plate bearing tests in the case of Grade Dm chalk. Experience suggests the maximum 150 kNm^{-2} stress should be accommodated.

8. Calculation shows settlement in the region of 19 mm with respect to the tank wall loading acting onto a 1 m wide ring beam assuming Grade Dm chalk, but as the tank bases will stress the deeper Grade Dc chalk, a maximum of 17 mm is predicted.

9. Some of the proposed buildings are of a similar width to the tanks, but are located in an area of limited deeper ground investigation, such that the level of better quality chalk has not been determined. The buildings are largely at existing ground level and it is recommended that foundations are extended into the Grade Dc chalk as a precaution again unacceptable settlement if Dm chalk should be thicker than anticipated.

10. Buildings directly stressing Grade Dc chalk assuming a raft foundation and loads of 100 kNm^{-2} or less, may expect about 11 mm of settlement. It is also recommended that the formation level is inspected for evidence of dissolution.

11. Excavations of 3.0 m or less are likely to remain dry and should retain short to medium term stability, although a suitable batter is recommended. Exposed chalk should be protected from adverse weather and is frost susceptible.

12. CIRIA guidance recommends that a CBR value of 2% should be adopted for chalk and the weathered or cryoturbated material, despite higher valued recorded during DCP testing. All should be assumed to be frost susceptible and treated accordingly, with a total pavement thickness of 450 mm for new roads.

13. An infiltration rate of 4.33×10^{-5} ms^{-1} was recorded at one position while the other soakage test failed. Unless further chalk inspection provides evidence of dissolution features, new foundations should be sited at a distance of at least 10m from soakaways.

14. A design sulphate class of DS-1 and an ACEC classification of AC-1s can be adopted for buried concrete in contact with the natural strata.

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5 September 2023

APPENDIX A: COPYRIGHT

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APPENDIX B: REFERENCES

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APPENDIX C: CABLE PERCUSSIVE BOREHOLE RECORDS

BH01 to BH05

B	Bulk disturbed sample
D	Small disturbed sample
ES	Environmental sample
W	Water sample (suffix P denotes sample taken from piezometer)
U	100 mm diameter undisturbed open tube drive sample
X blows	The associated figure ‘X’ is the number of blows to drive the sample tube over the given depth range
SPT(C)	Standard penetration test using a solid cone. N Value is uncorrected, but the hammer energy ratio is provided (in remarks)
SPT	Standard penetration test using a split spoon sampler. N Value is uncorrected, but the hammer energy ratio is provided (in remarks)
X,X/X,X,X,X	Blows per increment during the standard penetration test. The initial value relates to the seating drive (150 mm) and the remaining four to the 75 mm increments of the test length
N=X	SPT blow count ‘N’ given by the summation of the blows ‘X’ required to drive the full test length (300 mm)
X*/Y	Incomplete standard penetration test where the seating drive could not be completed. The blows ‘X’ represent the total blows for the given length of seating drive ‘Y’ (mm)
X/Z	Incomplete standard penetration test where the seating drive was achieved but the full test length was not. The blows ‘X’ represent the total blows for the given test length ‘Z’ (mm)
dd/mm/yy: 1.0 **dd/mm/yy: dry**	Date, water level at the borehole depth at the end of shift and the start of the following shift

Each sample type is numbered sequentially with depth and relates to the depth range quoted

All depths and measurements are given in metres, except as noted

Strata descriptions complied by visual examination of samples obtained during boring, after BS 5930:2015+A1:2020 and modified in accordance with laboratory test results where applicable

A F Howland Associates Geotechnical Engineers	Site: Proposed AD Plant, Streetly End, Cambridge	Borehole Number: **BH01**

Machine : Dando 2000 Method : Cable Percussion	Casing Diameter: 150mm cased to 1.50m	Ground Level (mOD): 77.42	Client: Streetly Hall Estate	Job Number: 22.348
	Location: 560107 E 248497 N	Dates: 10/01/2023-11/01/2023	Engineer: Plandescil Limited	Sheet: 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
						(0.50)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
					76.92	0.50	
0.50	D1						Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint and flint cobbles
1.00	D2					(1.20)	
1.50-1.95	SPT(C) N=11	1.50		4,3/4,2,2,3			
1.50-1.95	D3				75.72	1.70	Off white structureless CHALK. Recovered as clayey slightly gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk
2.50-2.95	SPT(C) N=17	1.50		2,3/3,5,5,4			
2.50-2.95	D4					(2.20)	... becoming slightly clayey
3.50-3.95	U1			60 blows			
					73.52	3.90	Off white structureless CHALK. Recovered as slightly clayey silty subangular to subrounded fine to medium very weak chalk GRAVEL
4.00	D5					(0.30)	
					73.22	4.20	Off white structureless CHALK. Recovered as clayey slightly gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk
4.50-4.95	SPT(C) N=8	1.50		1,1/2,2,1,3			
4.50-4.95	D6						
5.50-5.95	SPT(C) N=7	1.50		1,2/1,2,2,2			
5.50-5.95	D7						
7.00-7.45	U2			35 blows			
7.50	D8			10/01/2023:			
				11/01/2023:			
8.50-8.95	SPT(C) N=17	1.50		1,3/7,4,3,3			
8.50-8.95	D9						
						(10.80)	
10.00-10.45	SPT(C) N=21	1.50		5,8/8,4,5,4			

Remarks
1. Location CAT scanned prior to excavation
2. Hand dug inspection pit to 1.20 m
3. No groundwater encountered
4. SPT Hammer Energy Ratio = %
5. Exploratory hole backfilled with arisings

Scale (approx)	Logged By
1:50	ZRH

Figure No. 22.348.BH01

A F Howland Associates
Geotechnical Engineers

Machine : Dando 2000 **Method :** Cable Percussion	**Casing Diameter** 150mm cased to 1.50m	**Ground Level (mOD)** 77.42	**Client** Streetly Hall Estate	**Job Number** 22.348
	Location 560107 E 248497 N	**Dates** 10/01/2023- 11/01/2023	**Engineer** Plandescil Limited	**Sheet** 2/2

Site: Proposed AD Plant, Streetly End, Cambridge

Borehole Number: BH01

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00-10.45	D10						Off white structureless CHALK. Recovered as clayey slightly gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk		
11.50-11.95	SPT(C) N=10	1.50		1,2/2,2,3,3					
11.50-11.95	D11								
13.00-13.45	SPT(C) N=16	1.50		2,2/4,3,4,5					
13.00-13.45	D12								
14.50-14.95	SPT(C) N=13	1.50		2,1/2,3,4,4					
14.50-14.95	D13								
				11/01/2023:	62.42	15.00	Complete at 15.00m		

Remarks

Scale (approx)	**Logged By**
1:50	ZRH

Figure No.
22.348.BH01

A F Howland Associates Geotechnical Engineers	**Site** Proposed AD Plant, Streetly End, Cambridge		**Borehole Number** BH02
Machine : Dando 2000 **Method :** Cable Percussion	**Casing Diameter** 150mm cased to 1.50m	**Ground Level (mOD)** 75.25	**Client** Streetly Hall Estate	**Job Number** 22.348
	Location 560051 E 248564 N	**Dates** 11/01/2023	**Engineer** Plandescil Limited	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.30	D1				74.85	(0.40) 0.40	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
1.00	D2				73.75	(1.10) 1.50	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to medium chalk with occasional flint		
1.50-1.95 1.50-1.95	SPT(C) N=8 D3	1.50		2,1/2,2,2,2			Off white mottled beige structureless CHALK. Recovered as clayey gravelly SILT. Gravel is subangular to subrounded mostly fine to medium very weak chalk		
2.50-2.95 2.50-2.95	SPT(C) N=10 D4	1.50		1,2/1,2,4,3					
							... occasional flint gravel		
3.50-3.95 3.50-3.95	SPT(C) N=9 D5	1.50		1,1/2,2,2,3					
4.50-4.95	U1			40 blows					
5.00	D6								
5.50-5.95 5.50-5.95	SPT(C) N=8 D7	1.50		1,1/2,1,2,3					
7.00-7.45 7.00-7.45	SPT(C) N=12 D8	1.50		1,2/3,3,3,3					
						(13.50)			
8.50-8.95	U2			45 blows					
9.00	D9						... becoming slightly clayey and very gravelly		
10.00-10.45	SPT(C) N=12	1.50		2,1/2,3,3,4					

Remarks
1. Location CAT scanned prior to excavation
2. Hand dug inspection pit to 1.20 m
3. No groundwater encountered
4. SPT Hammer Energy Ratio = %
5. Exploratory hole backfilled with arisings

Scale (approx)	Logged By
1:50	ZRH

Figure No. 22.348.BH02

A F Howland Associates Geotechnical Engineers		Site: Proposed AD Plant, Streetly End, Cambridge	Borehole Number: BH02
Machine : Dando 2000 Method : Cable Percussion	Casing Diameter: 150mm cased to 1.50m Ground Level (mOD): 75.25	Client: Streetly Hall Estate	Job Number: 22.348
	Location: 560051 E 248564 N Dates: 11/01/2023	Engineer: Plandescil Limited	Sheet: 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00-10.45	D10						Off white mottled beige structureless CHALK. Recovered as clayey gravelly SILT. Gravel is subangular to subrounded mostly fine to medium very weak chalk		
11.50-11.95 11.50-11.95	SPT(C) N=25 D11	1.50		2,2/4,5,6,10					
13.00-13.45 13.00-13.45	SPT(C) N=17 D12	1.50		3,4/4,4,4,5					
14.50-14.95 14.50-14.95	SPT(C) N=50 D13	1.50		3,19/35,15					
					60.25	15.00	Complete at 15.00m		

Remarks

Scale (approx)	Logged By
1:50	ZRH

Figure No. 22.348.BH02

A F Howland Associates
Geotechnical Engineers

Site	Borehole Number
Proposed AD Plant, Streetly End, Cambridge	**BH03**

Machine / Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Machine : Dando 2000 **Method :** Cable Percussion	150mm cased to 1.50m	72.23	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	559936 E 248601 N	11/01/2023-12/01/2023	Plandescil Limited	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.50)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
0.30	D1								
					71.73	0.50	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to medium chalk with occasional flint and flint cobbles		
1.00	D2								
						(1.60)			
1.50-1.95	D3			11/01/2023:					
1.50-1.95	SPT(C) N=7	1.50		12/01/2023: 3,2/1,2,2,2					
					70.13	2.10	Off white structureless CHALK. Recovered as slightly clayey gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk and occasional flint		
2.50-2.95 2.50-2.95	SPT(C) N=8 D4	1.50		2,1/2,2,2,2					
3.50-3.95 3.50-3.95	SPT(C) N=8 D5	1.50		1,2/1,2,2,3					
4.50-4.95 4.50-4.95	SPT(C) N=11 D6	1.50		1,2/2,3,3,3					
5.50-5.95	U1			40 blows					
6.00	D7								
						(9.10)			
7.00-7.45 7.00-7.45	SPT(C) N=13 D8	1.50		2,2/2,3,4,4					
8.50-8.95 8.50-8.95	SPT(C) N=20 D9	1.50		2,8/7,5,4,4					

Remarks
1. Location CAT scanned prior to excavation
2. Hand dug inspection pit to 1.20 m
3. No groundwater encountered
4. SPT Hammer Energy Ratio = 54%
5. Exploratory hole backfilled with arisings

Scale (approx)	Logged By
1:50	ZRH

Figure No. 22.348.BH03

A F Howland Associates Geotechnical Engineers			Site: Proposed AD Plant, Streetly End, Cambridge	Borehole Number: BH03
Machine : Dando 2000 Method : Cable Percussion	Casing Diameter: 150mm cased to 1.50m	Ground Level (mOD): 72.23	Client: Streetly Hall Estate	Job Number: 22.348
	Location: 559936 E 248601 N	Dates: 11/01/2023-12/01/2023	Engineer: Plandescil Limited	Sheet: 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00-10.45	U2			65 blows			Off white structureless CHALK. Recovered as slightly clayey gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk and occasional flint		
10.50	D10								
					61.03	11.20	Off white structureless CHALK. Recovered as slightly clayey silty subangular to subrounded fine to medium weak chalk GRAVEL		
11.50-11.95 11.50-11.95	SPT(C) N=50 D11 SMC	1.50		3,18/21,25,4		(0.70)			
					60.33	11.90	Off white structureless CHALK. Recovered as slightly clayey gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk and occasional flint		
13.00-13.45 13.00-13.45	SPT(C) N=16 D12	1.50		2,3/4,4,4,4					
						(3.10)			
14.50-14.95 14.50-14.95	SPT(C) N=7 D13	1.50		1,2/1,2,2,2					
				12/01/2023:	57.23	15.00	Complete at 15.00m		

Remarks	Scale (approx)	Logged By
	1:50	ZRH
	Figure No. 22.348.BH03	

A F Howland Associates Geotechnical Engineers			Site: Proposed AD Plant, Streetly End, Cambridge	Borehole Number: BH04
Machine : Dando 2000 Method : Cable Percussion	Casing Diameter: 150mm cased to 1.50m	Ground Level (mOD): 79.34	Client: Streetly Hall Estate	Job Number: 22.348
	Location: 559910 E 248488 N	Dates: 09/01/2023-10/01/2023	Engineer: Plandescil Limited	Sheet: 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	D1					(0.50)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
					78.84	0.50			
0.60-0.80	B1					(0.50)	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint and flint cobbles		
					78.34	1.00	Off white structureless CHALK. Recovered as clayey slightly gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk and occasional flint		
1.50-1.95	D2			09/01/2023:					
1.50-1.95	SPT(C) N=19	1.50		10/01/2023: 2,3/4,4,5,6		(1.70)			
2.50-2.95	U1	1.50		100 blows					
					76.64	2.70	Off white structureless CHALK. Recovered as slightly clayey gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk		
3.00	D3								
3.50-3.95 3.50-3.95	SPT(C) N=15 D4	1.50		1,2/3,4,4,4					
4.50-4.95 4.50-4.95	SPT(C) N=12 D5	1.50		3,5/4,3,2,3					
5.50-5.95	U2	1.50		70 blows			... becoming very clayey		
6.00	D6								
							... occasional flint gravel		
7.00-7.45 7.00-7.45	SPT(C) N=11 D7	1.50		2,3/3,3,2,3					
8.50-8.95 8.50-8.95	SPT(C) N=11 D8	1.50		2,3/3,3,2,3			... occasional beige mottling		
						(12.30)	... becoming clayey		
10.00-10.45	SPT(C) N=11	1.50		2,3/2,2,3,4					

Remarks
1. Location CAT scanned prior to excavation
2. Hand dug inspection pit to 1.20 m
3. No groundwater encountered
4. SPT Hammer Energy Ratio = 54%
5. Exploratory hole backfilled with arisings

Scale (approx)	Logged By
1:50	ZRH

Figure No. 22.348.BH04

A F Howland Associates Geotechnical Engineers	Site: Proposed AD Plant, Streetly End, Cambridge	Borehole Number: BH04

Machine : Dando 2000 / Method : Cable Percussion	Casing Diameter: 150mm cased to 1.50m	Ground Level (mOD): 79.34	Client: Streetly Hall Estate	Job Number: 22.348
	Location: 559910 E 248488 N	Dates: 09/01/2023-10/01/2023	Engineer: Plandescil Limited	Sheet: 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00-10.95	D9						Off white structureless CHALK. Recovered as slightly clayey gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk		
11.50-11.95 11.50-11.95	SPT(C) N=9 D10	1.50		1,2/2,2,2,3					
13.00-13.45 13.00-13.45	SPT(C) N=29 D11	1.50		4,10/9,7,6,7					
							... becoming very clayey		
14.50-14.95 14.50-14.95	SPT(C) N=14 D12	1.50		2,2/2,3,4,5					
				10/01/2023:	64.34	15.00	Complete at 15.00m		

Remarks	Scale (approx)	Logged By
	1:50	ZRH
	Figure No. 22.348.BH04	

A F Howland Associates
Geotechnical Engineers

Site Proposed AD Plant, Streetly End, Cambridge			**Borehole Number** BH05
Machine : Dando 2000 **Method :** Cable Percussion	**Casing Diameter** 150mm cased to 1.50m	**Ground Level (mOD)** 72.79	**Client** Streetly Hall Estate	**Job Number** 22.348
	Location 559836 E 248528 N	**Dates** 09/01/2023	**Engineer** Plandescil Limited	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	D1					(0.40)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
					72.39	0.40			
0.60-0.80	B1					(0.90)	Off white light brown slightly clayey gravelly calcareous SILT. Gravel is subangular to subrounded fine to coarse very weak chalk		
					71.49	1.30	Off white structureless CHALK. Recovered as very clayey slightly gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk		
1.50-1.95	SPT(C) N=9	1.50		1,2/2,2,2,3					
1.50-1.95	B2								
2.50-2.95	SPT(C) N=7	1.50		2,1/1,2,2,2					
2.50-2.95	B3								
							... occasional subangular to subrounded fine to coarse flint gravel		
3.50-3.95	SPT(C) N=4	1.50		1/1,1,1,1					
3.50-3.95	B4								
4.50-4.95	SPT(C) N=12	1.50		2,2/3,2,3,4					
4.50-4.95	B5								
						(7.70)			
5.50-5.95	SPT(C) N=7	1.50		1,2/2,2,2,1					
5.50-5.95	B6								
7.00-7.45	SPT(C) N=12	1.50		2,3/3,3,3,3					
7.00-7.45	B7								
8.50-8.95	SPT(C) N=10	1.50		1,2/3,3,2,2					
8.50-8.95	B8								
					63.79	9.00	Off white structureless CHALK. Recovered as slightly clayey gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk		
10.00-10.45	SPT(C) N=8	1.50		3,4/2,2,2,2					

Remarks
1. Location CAT scanned prior to excavation
2. Hand dug inspection pit to 1.20 m
3. No groundwater encountered
4. SPT Hammer Energy Ratio = 54%
5. Exploratory hole backfilled with arisings

Scale (approx)	Logged By
1:50	ZRH

Figure No.
22.348.BH05

A F Howland Associates Geotechnical Engineers		Site: Proposed AD Plant, Streetly End, Cambridge	Borehole Number: BH05
Machine : Dando 2000 Method : Cable Percussion	Casing Diameter: 150mm cased to 1.50m	Ground Level (mOD): 72.79	Client: Streetly Hall Estate	Job Number: 22.348
	Location: 559836 E 248528 N	Dates: 09/01/2023	Engineer: Plandescil Limited	Sheet: 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00-10.45	B9					(3.00)	Off white structureless CHALK. Recovered as slightly clayey gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk ... becoming very gravelly		
11.50-11.70 11.50-11.95	SPT(C) 25*/135 50/65 D2	1.50		7,18/50					
					60.79	12.00	Off white structureless CHALK. Recovered as clayey slightly gravelly SILT. Gravel is subangular to subrounded fine to medium very weak chalk		
13.00-13.45	SPT(C) N=13	1.50		1,1/2,3,3,5		(3.00)			
14.50-14.95 14.50-14.95	SPT(C) N=19 D3	1.50		1,2/3,3,6,7					
				09/01/2023:	57.79	15.00	Complete at 15.00m		

Remarks

Scale (approx)	Logged By
1:50	ZRH

Figure No. 22.348.BH05

APPENDIX D: TRIAL PIT AND SOAKAGE TEST RECORDS

TP01 to TP06

SA01 and SA02

B	Bulk disturbed sample
D	Small disturbed sample

Each sample type is numbered sequentially with depth and relates to the depth range quoted

All depths and measurements are given in metres, except as noted

Strata descriptions complied by visual examination of samples obtained during boring, after BS 5930:2015+A1:2020 and modified in accordance with laboratory test results where applicable

A F Howland Associates Geotechnical Engineers	Site: Proposed AD Plant, Streetly End, Cambridge	Trial Pit Number: **TP01**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 2.0 m x W 0.6 m x D 3.0 m	78.63	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560143 E 248448 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
0.30-0.50 0.30-0.70	D1 B1			78.33	0.30 (0.70)	Soft brown silty slightly sandy CLAY with rare flint gravel. Locally sandy. Occasional roots and rootlets ...with occasional flint cobbles		
1.10-1.20 1.10-1.60	D2 B2			77.63	1.00 (1.00)	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel. Locally stained orange brown (Grade Dm) ...with occasional flint cobbles ...with occasional light brown sand lenses to 1.9 m		
2.00-2.20 2.00-2.40 2.60-3.00 2.60-3.00	D3 B3 B4 D4			76.63	2.00 (1.00)	Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc) ...orange brown staining absent below 2.0 m		
			12/01/2023:DRY	75.63	3.00	Complete at 3.00m		

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.TP01

A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	TP02

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 2.0 m x W 0.6 m x D 2.8 m	77.68	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560053 E 248518 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10-0.20 0.20-0.50	D1 D2			77.48	(0.20) 0.20	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
				76.88	(0.60) 0.80	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint ...with occasional flint cobbles		
0.80-1.20 1.00-1.20	B1 D3			75.88	(1.00) 1.80	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel and cobbles. Locally stained orange brown (Grade Dm)		
1.80-2.00 2.00-2.30 2.50-2.80 2.50-2.80	D4 B2 B3 D5		12/01/2023:DRY	74.88	(1.00) 2.80	Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc) ...with occasional chalk cobbles ...with occasional flint cobbles		
						Complete at 2.80m		

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.TP02

A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	TP03

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 2.0 m x W 0.6 m x D 3.0 m	73.03	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560011 E 248605 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
					(0.30)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
0.30-0.50	D1			72.73	0.30 (0.20)	Soft light orange brown silty slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk
0.50-0.80 0.50-1.00	D2 B1			72.53	0.50 (0.30)	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint ...with occasional flint cobbles and boulders
0.80-1.00 0.80-1.00	B2 D3			72.23	0.80 (0.80)	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel and cobbles. Locally stained orange brown (Grade Dm) ...becoming gravelly to 1.6 m
1.60-1.80 1.60-1.80 2.40-2.50 2.50-3.00 2.80-3.00	B3 D4 D5 B4 D6			71.43	1.60 (1.40)	Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc) ...with occasional flint cobbles ...flint gravel absent below 2.2 m
			12/01/2023:DRY	70.03	3.00	Complete at 3.00m

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.TP03

A F Howland Associates
Geotechnical Engineers

Site			Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge			TP04

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 2.0 m x W 0.6 m x D 3.0 m	77.86	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	559952 E 248525 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10-0.20	D1				(0.30)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
0.30-0.50	D2			77.56	0.30 (0.30)	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint		
0.60-0.90 0.60-1.10	D3 B1			77.26	0.60 (1.10)	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel and cobbles. Locally stained orange brown (Grade Dm) ...with occasional flint cobbles ...becoming gravelly to 1.4 m		
1.70-2.00 2.00-2.20 2.60-2.90 2.80-2.90	B2 D4 B3 D5			76.16	1.70 (1.20)	Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc) ...flint gravel absent below 1.9 m		
			12/01/2023:DRY	74.96	2.90	Complete at 2.90m		

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.TP04

A F Howland Associates Geotechnical Engineers	Site: Proposed AD Plant, Streetly End, Cambridge	Trial Pit Number: TP05

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 2.0 m x W 0.6 m x D 3.0 m	74.45	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	559860 E 248525 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
0.10-0.20	D1				(0.30)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
0.30-0.50	D2			74.15	0.30 (0.20)	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint
0.50-0.80	B1			73.95	0.50 (0.60)	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel and cobbles. Locally stained orange brown (Grade Dm) ...with occasional flint cobbles
1.10-1.20	D3			73.35	1.10 (1.90)	Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc)
1.50-1.80	B2					
2.20-2.50	D4					...chalk gravel becoming predominately subangular with some weak, low to medium density cobbles. Orange brown staining absent
2.60-3.00	B3					...with occasional silt pockets
			12/01/2023:DRY	71.45	3.00	Complete at 3.00m

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.TP05

A F Howland Associates Geotechnical Engineers	Site Proposed AD Plant, Streetly End, Cambridge	Trial Pit Number **TP06**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 2.0 m x W 0.6 m x D 3.0 m	80.41	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	559864 E 248434 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
				80.16	0.25	Soft light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint		
0.30-0.40	D1			80.11	0.30	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel and cobbles. Locally stained orange brown (Grade Dm)		
0.30-0.80	B1				(0.70)	...with occasional flint cobbles		
1.00-1.50	B2			79.41	1.00	Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc)		
1.80-1.90	D2					...chalk gravel becoming predominately subangular with some weak, low to medium density cobbles. Orange brown staining absent		
2.00-2.50	D3				(2.00)	...with occasional flint cobbles		
2.80-3.00	B3							
			12/01/2023:DRY	77.41	3.00	Complete at 3.00m		

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.TP06

A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	SA01

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 1.6 m x W 0.6 m x D 2.0 m	79.24	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560016 E 248499 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10-0.30	D1				(0.30)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
0.30-0.40	D2			78.94	0.30 (0.10)	Light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint		
1.00-1.20	B1			78.84	0.40 (0.80)	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel and cobbles. Locally stained orange brown (Grade Dm) ...becoming less mottled brown ...with occasional flint cobbles		
1.30-1.50 1.40-1.50	B2 D3			78.04	1.20 (0.80)	Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc) ...with occasional flint cobbles		
			12/01/2023:DRY	77.24	2.00	Complete at 2.00m		

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Pit backfilled with gravel to 1.1 m and then arisings to surface
5. Soakage test performed between 1.1 m and 2.0 m

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.SA01

A F Howland Associates
Geotechnical Engineers

Soakage Test (BRE Digest 365)

Site : Proposed AD Plant, Streetly End, Cambridge

Client : Streetly Hall Estate

Engineer : Plandescil Limited

Job Number 22.348

Sheet 1 / 1

Location	Date	Level	Location
SA01	12/01/2023	79.24 mOD	E: 560016 N: 248499

Pit Width (m)	0.60
Pit Depth (m)	2.00
Pit Length (m)	1.60

Soil type at test level	CHALK
Groundwater	Not encountered
Drain discharge depth	Not known
Sidewall stability	Stable, vertical
Stone filled or open pit	Stone filled

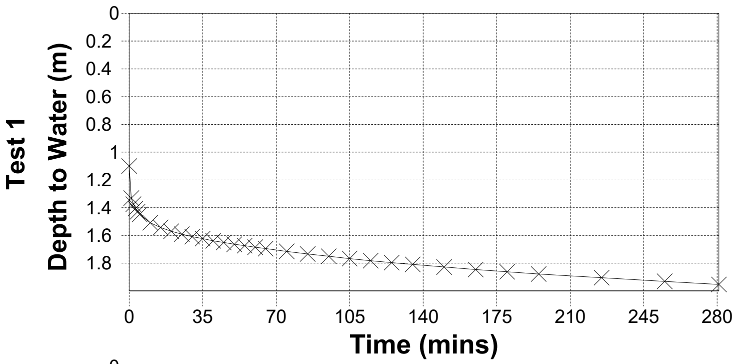
	1	2	3
Effective depth (m)	0.90	0.98	0.86
Volume outflowing between 75% & 25% (m3)*			
Mean surface area through which outflow occurs (m2)			
Time for outflow between 75% & 25% (min)	109.36	69.79	75.01
SOIL INFILTRATION RATE (ms-1), f	Test Failed	Test Failed	Test Failed

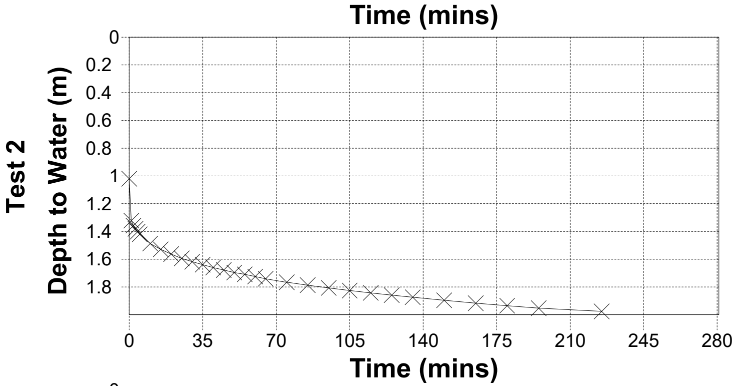
Remarks

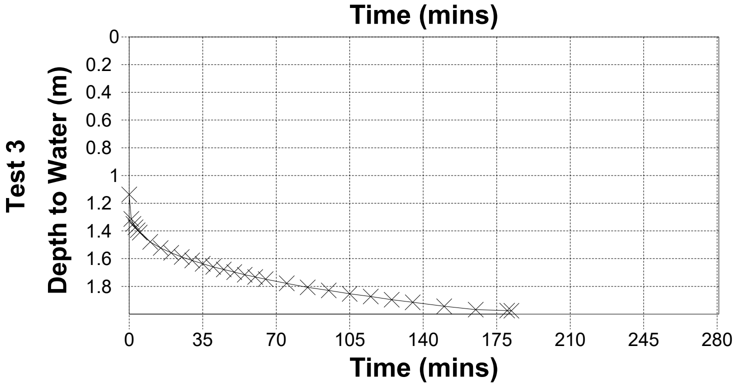
1. Soakage test undertaken between 1.1 m and 2.0 m
2. No groundwater encountered
3. Datalogger serial no. 21172050
4. Test 1 and 2 carried out on 12/01/23
5. Test 3 carried out on 13/01/23

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (mins)	Depth to Water Test 1	Depth to Water Test 2	Depth to Water Test 3
0	1.10	1.02	1.137
1	1.331	1.322	1.314
2	1.375	1.358	1.349
3	1.406	1.381	1.374
4	1.429	1.402	1.395
5	1.449	1.42	1.412
10	1.509	1.487	1.479
15	1.543	1.529	1.523
20	1.57	1.563	1.558
25	1.591	1.594	1.588
30	1.609	1.618	1.613
35	1.623	1.639	1.637
40	1.639	1.66	1.659
45	1.651	1.678	1.678
50	1.664	1.696	1.697
55	1.674	1.709	1.716
60	1.685	1.725	1.732
65	1.695	1.741	1.748
75	1.715	1.766	1.778
85	1.734	1.787	1.807
95	1.75	1.807	1.829
105	1.767	1.826	1.854
115	1.782	1.843	1.873
125	1.796	1.859	1.896
135	1.809	1.874	1.915
150	1.828	1.896	1.944
165	1.846	1.917	1.968
180	1.862	1.935	1.975
182			1.976
195	1.878	1.953	
225	1.905	1.976	
255	1.931		
280.833	1.953		







A F Howland Associates Geotechnical Engineers	Site	Trial Pit Number
	Proposed AD Plant, Streetly End, Cambridge	**SA02**

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Machine dug pit (8 tonne tracked excavator)	L 1.6 m x W 0.6 m x D 2.0 m	77.45	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	559883 E 248500 N	12/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.10-0.20	D1				(0.30)	PLOUGHED SOIL (Brown silty slightly sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
				77.15	0.30			
0.30-0.40	D2				(0.10)	Light brown mottled off-white silty slightly sandy slightly gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse chalk with occasional flint		
				77.05	0.40			
					(0.30)	Structureless CHALK composed of uncompact, off-white, slightly gravelly sandy SILT. Gravel is very weak, low density, off-white with occasional black specks and subangular to subrounded. Occasional flint gravel and cobbles. Locally stained orange brown (Grade Dm)		
				76.75	0.70			
0.70-1.00 0.70-1.20	D3 B1					Structureless CHALK composed of slightly sandy silty, subangular to subrounded, mainly medium to coarse GRAVEL with some subangular cobbles. Gravel is very weak, low density, white occasional black specks. Matrix is uncompact, off-white with occasional orange brown staining sandy silt (Grade Dc)		
1.00-1.40	D4				(1.30)	...with occasional flint cobbles ...with occasional brown staining		
1.60-1.70 1.60-2.10 1.70-1.80	D5 B2 D6					...with some weak, low to medium density chalk cobbles		
			12/01/2023:DRY	75.45	2.00	Complete at 2.00m		

Remarks

1. Location CAT scanned prior to excavation
2. No groundwater encountered
3. Trial pit remained open and sidewalls stable during excavation.
4. Pit backfilled with gravel to 1.1 m and then arisings to surface
5. Soakage test performed between 1.1 m and 2.0 m

Scale (approx)	Logged By	Figure No.
1:25	PJM	22.348.SA02

A F Howland Associates
Geotechnical Engineers

Soakage Test (BRE Digest 365)

Site	: Proposed AD Plant, Streetly End, Cambridge	**Job Number** 22.348
Client	: Streetly Hall Estate	**Sheet** 1 / 1
Engineer	: Plandescil Limited	

Location	Date	Level	Location
SA02	12/01/2023	77.45 mOD	E: 559883 N: 248500

Pit Width (m)	0.60
Pit Depth (m)	1.90
Pit Length (m)	1.60

Soil type at test level	CHALK
Groundwater	Not encountered
Drain discharge depth	Not known
Sidewall stability	Stable, vertical
Stone filled or open pit	Stone filled

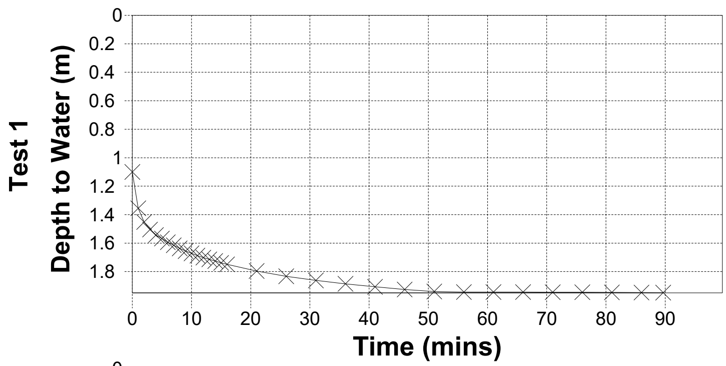
	1	2	3
Effective depth (m)	0.80	0.80	0.77
Volume outflowing between 75% & 25% (m3)*	0.12	0.12	0.11
Mean surface area through which outflow occurs (m2)	2.72	2.72	2.65
Time for outflow between 75% & 25% (min)	11.08	16.31	15.43
SOIL INFILTRATION RATE (ms-1), f	6.37E-5	4.33E-5	4.52E-5

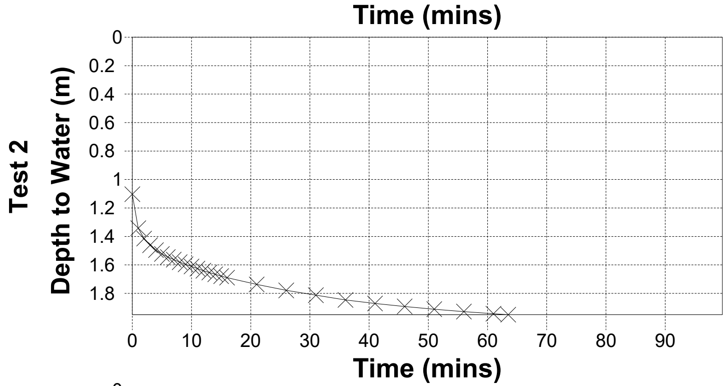
Remarks

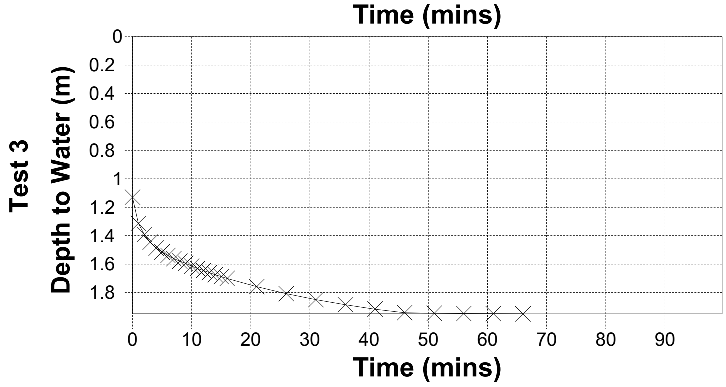
1. Soakage test undertaken between 1.1 m and 1.9 m
2. No groundwater encountered
3. Datalogger serial no. 21172070
4. Test 1 and 2 carried out on 12/01/23
5. Test 3 carried out on 13/01/23

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (mins)	Depth to Water Test 1	Depth to Water Test 2	Depth to Water Test 3
0	1.10	1.103	1.129
1	1.355	1.342	1.313
2	1.452	1.415	1.392
3	1.505	1.462	1.446
4	1.543	1.496	1.488
5	1.568	1.523	1.515
6	1.594	1.545	1.539
7	1.615	1.563	1.562
8	1.637	1.581	1.579
9	1.656	1.596	1.595
10	1.672	1.611	1.614
11	1.688	1.626	1.631
12	1.702	1.641	1.645
13	1.714	1.654	1.66
14	1.726	1.666	1.675
15	1.739	1.679	1.688
16	1.749	1.69	1.701
21	1.796	1.737	1.759
26	1.833	1.779	1.808
31	1.862	1.813	1.85
36	1.886	1.846	1.886
41	1.907	1.871	1.917
46	1.926	1.892	1.942
51	1.94	1.911	1.946
56	1.944	1.928	1.948
61	1.944	1.943	1.949
63.5		1.95	
66	1.944		1.95
71	1.945		
76	1.945		
81	1.946		
86	1.947		
89.667	1.948		







APPENDIX E: DYNAMIC CONE PENETROMETER TEST RESULTS

DCP01 to DCP08

B	Bulk disturbed sample
D	Small disturbed sample

Each sample type is numbered sequentially with depth and relates to the depth range quoted

All depths and measurements are given in metres, except as noted

Strata descriptions complied by visual examination of samples obtained during boring, after BS 5930:2015+A1:2020 and modified in accordance with laboratory test results where applicable

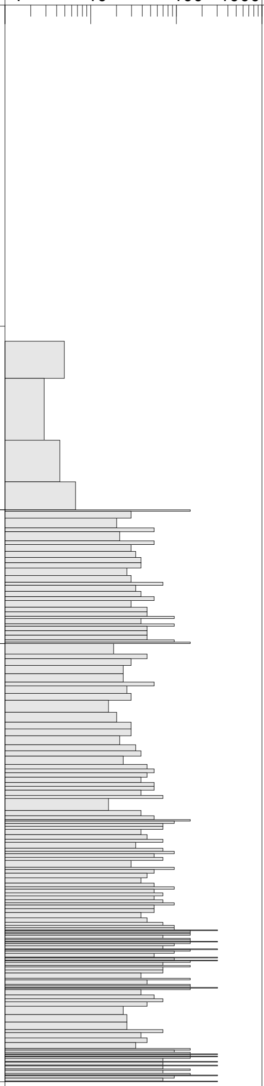
A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	**DCP01**

DCP Details	Excavation Method	Ground Level (mOD)	Client	Job Number
Hammer weight - 8 kg Hammer drop - 575 mm Cone diameter - 20 mm Cone angle - 60 degrees Zero error - + 10 mm Initial Penetration - 0 mm	Hand dug	85.70	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560142 E 248341 N	13/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Layer CBR % Value	Level (mOD)	Depth (m) (Thickness)	Description
				(0.40)	PLOUGHED SOIL (Brown slightly clayey slightly silty gravelly fine to medium sand. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
			85.30	0.40	
0.50-0.60	D1	5.0		(0.40)	Soft orange brown silty sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint
		41	84.90	0.80	
1.20-1.40	D2	57		(0.60)	Off white structureless CHALK. Recovered as sandy gravelly SILT. Gravel is subangular to subrounded fine to coarse flint and very weak chalk (Grade Dm)
			84.30	1.40	Complete at 1.40m

CBR Value Per Blow



Plan

Remarks
1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.40 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP01

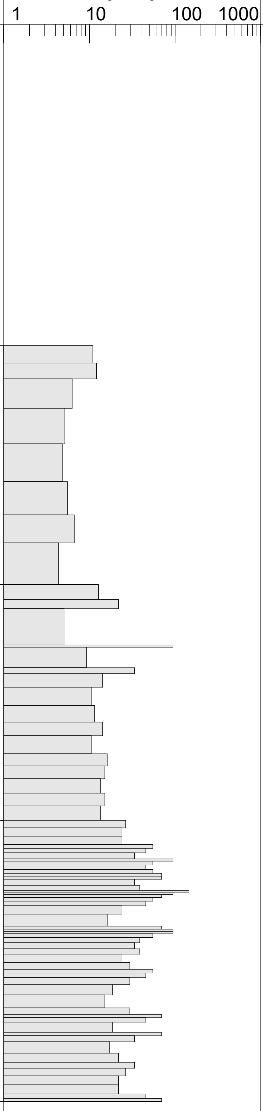
A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	DCP02

DCP Details	Excavation Method	Ground Level (mOD)	Client	Job Number
Hammer weight - 8 kg Hammer drop - 575 mm Cone diameter - 20 mm Cone angle - 60 degrees Zero error - 12 mm Initial Penetration - 0 mm	Hand dug	84.62	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560075 E 248381 N	13/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Layer CBR % Value	Level (mOD)	Depth (m) (Thickness)	Description
				(0.30)	PLOUGHED SOIL (Soft brown silty sandy gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
0.40-0.50	D1	6.2	84.32	0.30 (0.40)	soft orange brown silty sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk
1.00-1.20	D2	13 35	83.92	0.70 (0.70)	orange white gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk
			83.22	1.40	Complete at 1.40m

CBR Value Per Blow



Plan

Remarks

1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.40 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP02

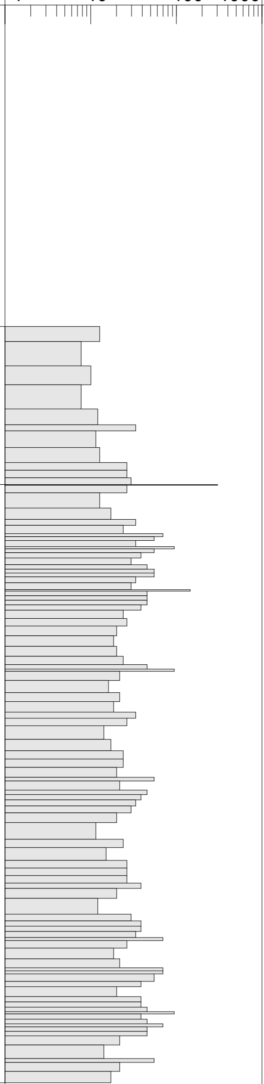
A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	DCP03

DCP Details	Excavation Method	Ground Level (mOD)	Client	Job Number
Hammer weight - 8 kg Hammer drop - 575 mm Cone diameter - 20 mm Cone angle - 60 degrees Zero error - 10 mm Initial Penetration - 0 mm	Hand dug	81.22	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	559981 E 248464 N	13/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Layer CBR % Value	Level (mOD)	Depth (m) (Thickness)	Description
				(0.30)	PLOUGHED SOIL (Brown clayey silty gravelly fine to medium sand. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
0.20-0.30	D1				
			80.92	0.30	Off white brown silty gravelly fine to medium SAND. Gravel is subangular to subrounded fine to coarse flint and chalk
0.40-0.50	D2			(0.30)	
		13			
			80.62	0.60	Off white structureless CHALK. Recovered as silty subangular to subrounded fine to coarse very weak chalk GRAVEL and occasional flint gravel (Probably Grade Dc)
1.00-1.20	D3	29		(0.80)	
			79.82	1.40	Complete at 1.40m

CBR Value Per Blow



Plan

Remarks

1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.40 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP03

A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	DCP04

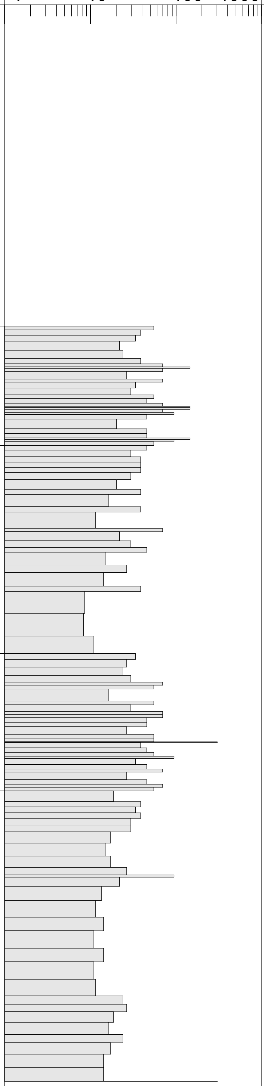
DCP Details
Hammer weight - 8 kg
Hammer drop - 575 mm
Cone diameter - 20 mm
Cone angle - 60 degrees
Zero error - 10 mm
Initial Penetration - 0 mm

Excavation Method	Ground Level (mOD)	Client	Job Number
Hand dug	80.82	Streetly Hall Estate	22.348

Location	Dates	Engineer	Sheet
560036 E 248462 N	13/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Layer CBR % Value	Level (mOD)	Depth (m) (Thickness)	Description
0.20	D1			(0.40)	PLOUGHED SOIL (Soft brown silty sandy gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
		47	80.42	0.40	Soft orange brown mottled white silty gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk ... occasional flint cobbles
0.70	D2	21		(0.40)	
		42	80.02	0.80	Off white structureless CHALK. Recovered as gravelly SILT. Gravel is subangular to subrounded fine to coarse very weak chalk and occasional flint (Grade Dm)
1.10	D3	19		(0.60)	
			79.42	1.40	Complete at 1.40m

CBR Value Per Blow



Plan

Remarks
1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.40 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

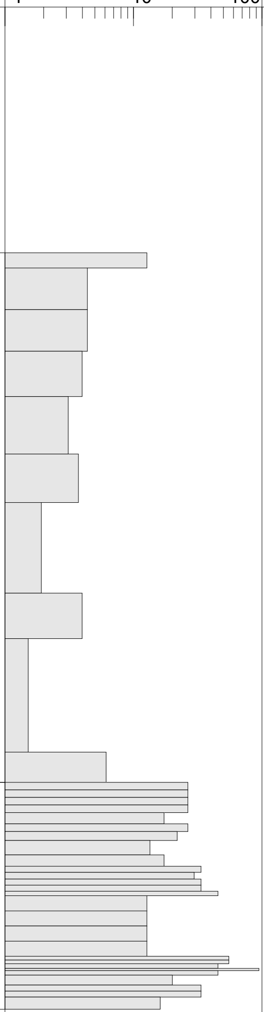
Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP04

A F Howland Associates Geotechnical Engineers	Site Proposed AD Plant, Streetly End, Cambridge	Trial Pit Number **DCP05**

DCP Details	Excavation Method	Ground Level (mOD)	Client	Job Number
Hammer weight - 8 kg Hammer drop - 575 mm Cone diameter - 20 mm Cone angle - 60 degrees Zero error - 10 mm Initial Penetration - 0 mm	Hand dug	81.80	Streetly Hall Estate	22.348
	Location 560103 E 248412 N	**Dates** 13/01/2023	**Engineer** Plandescil Limited	**Sheet** 1/1

Depth (m)	Sample / Tests	Layer CBR % Value	Level (mOD)	Depth (m) (Thickness)	Description
0.20	D1			(0.30)	PLOUGHED SOIL (Soft brown silty sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
0.60	D2	3.4	81.50	0.30 (0.55)	Soft orange brown silty slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk
1.10	D3	24	80.95	0.85 (0.45)	Soft orange light brown silty sandy gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk
			80.50	1.30	Complete at 1.30m

CBR Value Per Blow



Plan

Remarks

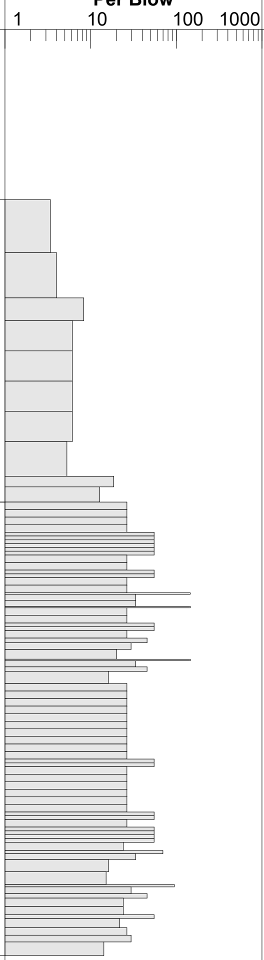
1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.30 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP05

A F Howland Associates Geotechnical Engineers	Site Proposed AD Plant, Streetly End, Cambridge	Trial Pit Number **DCP06**

DCP Details	Excavation Method	Ground Level (mOD)	Client	Job Number
Hammer weight - 8 kg Hammer drop - 575 mm Cone diameter - 20 mm Cone angle - 60 degrees Zero error - 8 mm Initial Penetration - 0 mm	Hand dug	76.24	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560153 E 248489 N	13/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Layer CBR % Value	Level (mOD)	Depth (m) (Thickness)	Description
				(0.30)	PLOUGHED SOIL (Brown clayey silty sandy gravelly . Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
		6.1	75.94	0.30	Soft brown silty sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk
0.50	D1			(0.60)	
0.90	D2	32	75.34	0.90	Off white structureless CHALK. Recovered as sandy gravelly SILT. Gravel is subangular to subrounded fine to coarse very weak chalk and occasional flint (Grade Dm)
				(0.30)	
			75.04	1.20	Complete at 1.20m



Plan

Remarks
1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.20 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

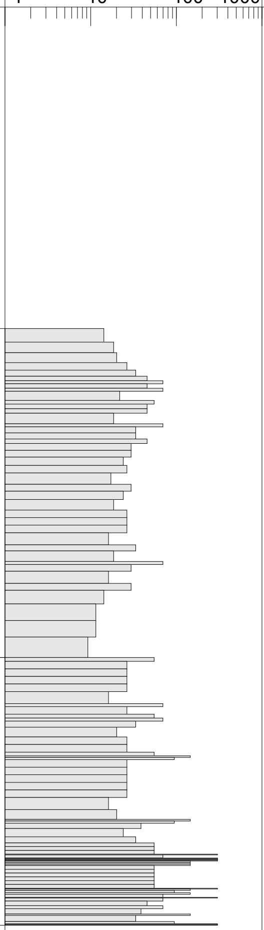
Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP06

A F Howland Associates Geotechnical Engineers	Site Proposed AD Plant, Streetly End, Cambridge	Trial Pit Number **DCP07**

DCP Details	Excavation Method	Ground Level (mOD)	Client	Job Number
Hammer weight - 8 kg Hammer drop - 575 mm Cone diameter - 20 mm Cone angle - 60 degrees Zero error - 10 mm Initial Penetration - 00 mm	Hand dug	76.00	Streetly Hall Estate	22.348
	Location 560089 E 248535 N	**Dates** 13/01/2023	**Engineer** Plandescil Limited	**Sheet** 1/1

Depth (m)	Sample / Tests	Layer CBR % Value	Level (mOD)	Depth (m) (Thickness)	Description
				(0.45)	PLOUGHED SOIL (Soft brown silty sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)
			75.55	0.45	Soft orange brown mottled white silty gravelly calcareous CLAY. Gravel is subangular to subrounded fine to coarse flint and chalk
		24			
0.70-0.80	D1				
				(0.75)	
		60			
			74.80	1.20	Complete at 1.20m

CBR Value Per Blow



Plan

Remarks

1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.20 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

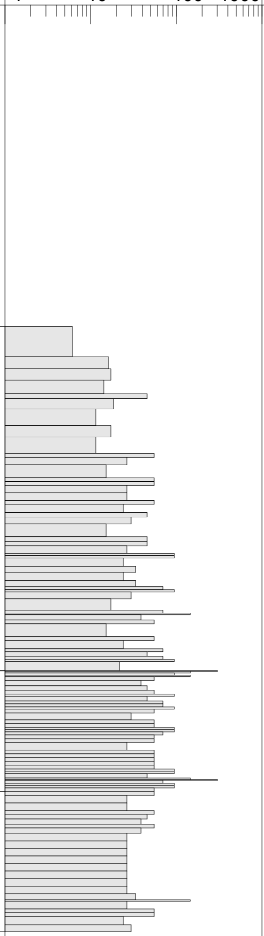
Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP07

A F Howland Associates
Geotechnical Engineers

Site	Trial Pit Number
Proposed AD Plant, Streetly End, Cambridge	DCP08

DCP Details	Excavation Method	Ground Level (mOD)	Client	Job Number
Hammer weight - 8 kg Hammer drop - 575 mm Cone diameter - 20 mm Cone angle - 60 degrees Zero error - 10 mm Initial Penetration - 0 mm	Hand dug	78.62	Streetly Hall Estate	22.348
	Location	**Dates**	**Engineer**	**Sheet**
	560099 E 248479 N	13/01/2023	Plandescil Limited	1/1

Depth (m)	Sample / Tests	Layer CBR % Value	CBR Value Per Blow	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	PLOUGHED SOIL (Brown clayey silty gravelly fine to medium sand. Gravel is subangular to subrounded fine to coarse flint with occasional chalk. Occasional rootlets)		
0.70	D1	27		78.22	0.40 (0.55)	Light brown sandy gravelly SILT. Gravel is subangular to subrounded fine to coarse chalk and flint ... with occasional flint cobbles		
		36 33		77.67	0.95 (0.25)	Off white structureless CHALK. Recovered as sandy gravelly SILT. Gravel is subangular to subrounded fine to coarse very weak chalk and occasional flint (Grade Dm)		
				77.42	1.20	Complete at 1.20m		



Plan

Remarks
1. CBR % value equated from TRL method : (log (CBR) = 2.48 - 1.057 x log (penetration rate))
2. Location CAT scanned prior to excavation
3. Hand dug inspection pit to 1.20 m
4. No groundwater encountered
5. Trial pit remained open and sidewalls stable during excavation.
6. Trial pit backfilled with arisings upon completion.

Scale (approx)	Logged By	Figure No.
1:10	MJJG	22.348.DCP08

APPENDIX F: LABORATORY TESTING

Natural moisture content

Atterberg limits

Dry density/saturation moisture content

Unconsolidated undrained triaxial testing

Point load strength

Sulphate content, total sulphur and pH value

A F Howland Associates
Geotechnical Engineers

Laboratory Test Results

Site : Proposed AD Plant, Streetly End, Cambridge		**Job Number** 22.348
Client : Streetly Hall Estate		**Sheet** 1 / 1
Engineer : Plandescil Limited		

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Group Symbol	Laboratory Description
				Percentage %	Moisture Content %						
DCP05	0.60	D2	14.5	97	14.9	29	14	15	0.06	CL	Brown slightly sandy slightly gravelly CLAY. Sand is fine.
DCP06	0.50	D1	13.4	98	13.7	24	13	11	0.06	CL	Brown slightly sandy slightly gravelly CLAY with rare rootlets. Sand is fine.
TP03	0.30	D1	18.3	80	22.9	29	16	13	0.53	CL	Brown slightly sandy slightly gravelly CLAY. Sand is fine.

Method of Preparation : BS EN ISO 17892:PART 1:2014:5.1 Test specimen preparation (moisture content). BS EN ISO 17892:PART 1:2018:5.2 Preparation of samples for classification tests

Method of Test : BS EN ISO 17892:PART 1:2014:5.2 Test execution (moisture content) BS EN ISO 17892: PART 12:5.3 & 6.2 Determination of the liquid limit BS EN ISO 17892:PART 5.5, 6.4 & 6.5 Determination of the plastic limit and plasticity index

Remarks :

A F Howland Associates
Geotechnical Engineers

Laboratory Test Results

Site : Proposed AD Plant, Streetly End, Cambridge

Client : Streetly Hall Estate

Engineer : Plandescil Limited

Job Number 22.348

Sheet 1 / 1

DETERMINATION OF SATURATION MOISTURE CONTENT

Borehole/ Trial Pit	Depth (m)	Sample	Water Content %	Bulk Density (Mg/m³)	Dry Density (Mg/m³)	Saturation Moisture Content %	Porosity %	Laboratory Description
SA01	1.40	D3	25.5	1.8	1.43	33	47	White CHALK.
SA02	1.00	D4	30.8	1.85	1.41	34	48	White CHALK.
SA02	1.70	D6	26.4	1.95	1.54	28	43	White CHALK.
TP01	2.60	B4B	33.8	1.86	1.39	35	49	White CHALK.
TP01	2.60	B4A	42.1	1.81	1.27	42	53	White CHALK.
TP02	2.00	B2B	30.3	1.94	1.49	30	45	White CHALK.
TP02	2.00	B2A	33.9	1.88	1.4	34	48	White CHALK.
TP02	2.50	D5	30.6	1.9	1.45	32	46	White CHALK.
TP04	2.00	D4	29.3	1.85	1.43	33	47	White CHALK.
TP04	2.80	D5	29.2	1.86	1.44	32	47	White CHALK.
TP05	1.10	D3	25.7	1.96	1.56	27	42	White CHALK.
TP06	1.00	B2	25.8	1.79	1.42	33	47	White CHALK.
TP06	2.00	D3	25.5	1.84	1.47	31	46	White CHALK.

Method of Preparation : BS 1377:PART 1:1990:7.3 and 7.4 Preparation of samples for classification tests

Method of Test : BS 1377:PART 2:1990:3 Determination of Saturation moisture content and water content 1990:7 Determination of density

Remarks :

A F Howland Associates
Geotechnical Engineers

Laboratory Test Results

Site : Proposed AD Plant, Streetly End, Cambridge

Client : Streetly Hall Estate

Engineer : Plandescil Limited

Job Number 22.348

Sheet 1 / 1

DETERMINATION OF DENSITY, MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Trial Pit	Depth (m)	Sample	Moisture Content %	Bulk Density (Mg/m³)	Dry Density (Mg/m³)	Cell Pressure (kN/m²)	Deviator Stress (kN/m²)	Apparent Cohesion (kN/m²)	Angle of Shearing Resistance (degrees)	Laboratory Description
BH01	3.50	U1	27.9	1.86	1.46	35 70 140	91 178 262	13	26.5	Very stiff off white structureless CHALK.
BH02	4.50	U1	31.4	1.91	1.45	45 90 180	218 270 368	54	21.9	Very stiff fissured structureless CHALK.

Method of Preparation : BS EN ISO 17892:PART 1:2014:5.1 Test specimen preparation (moisture content). BS EN ISO 17892:PART 8:2018: 6.2 Preparation of undisturbed samples for testing

Method of Test : BS EN ISO 17892:PART 1:2014:5.2 Test execution (moisture content) and PART 2:2014 Determination of density. BS EN ISO 17892: PART 8: 2018: 6,7 + 8 Undrained shear strength (Single stage). BS 1377:PART 7:1990:9 Multistage loading

Remarks :

A F Howland Associates
Geotechnical Engineers

Laboratory Test Results

Site : Proposed AD Plant, Streetly End, Cambridge

Client : Streetly Hall Estate

Engineer : Plandescil Limited

Job Number 22.348

Sheet 1 / 1

DETERMINATION OF POINT LOAD STRENGTH OF ROCK

Borehole/ Trial Pit	Depth (m)	Sample	Type and Direction	W (mm)	D (mm)	P (kN)	De (mm)	Is P/De² (MPa)	Is(50) (MPa)	eUCS (MPa)	Average eUCS (MPa)	Laboratory Description
TP04	2.80 -2.90	D5(a)	L r	60	45	0.25	58.63	0.07	0.08	1.76	1.6	White CHALK.
		D5(b)	L r	85	72	0.54	88.27	0.07	0.09	1.98		
		D5(c)	L r	62	48	0.04	61.55	0.01	0.01	0.22		
		D5(d)	L r	65	40	0.17	57.53	0.05	0.05	1.10		
		D5(e)	L r	45	25	0.13	37.84	0.09	0.08	1.76		
		D5(f)	L r	75	53	0.13	71.14	0.03	0.03	0.66		
		D5(g)	L r	60	41	0.16	55.96	0.05	0.05	1.10		
		D5(h)	L r	45	26	1.15	38.59	0.77	0.68	14.96		
		D5(i)	L r	50	43	0.30	52.32	0.11	0.11	2.42		
		D5(j)	L r	52	36	0.18	48.82	0.08	0.08	1.76		
TP06	2.00 -2.50	D3(a)	L r	75	95	0.50	95.24	0.05	0.07	1.54	1.4	White CHALK.
		D3(b)	L r	108	38	0.09	72.28	0.02	0.02	0.44		
		D3(c)	L r	104	41	0.38	73.68	0.07	0.08	1.76		
		D3(d)	L r	94	40	0.20	69.19	0.04	0.05	1.10		
		D3(e)	L r	84	51	0.34	73.85	0.06	0.08	1.76		
		D3(f)	L r	95	96	0.30	107.75	0.03	0.04	0.88		
		D3(g)	L r	99	70	0.57	93.93	0.06	0.09	1.98		
		D3(h)	L r	92	55	0.23	80.26	0.04	0.04	0.88		
		D3(i)	L r	95	35	0.30	65.06	0.07	0.08	1.76		
		D3(j)	L r	89	37	0.23	64.75	0.06	0.06	1.32		

Key to abbreviations: **Test Type & Direction**

- **A** axial
- **D** diametrical
- **L** irregular lump
- **B** block
- **Pl** parallel to planes of weakness
- **Pd** perpendicular to planes of weakness
- **r** random or unknown orientation

Others

- **W** sample width
- **D** platen separation
- **P** failure load
- **De** equivalent diameter
- **Is** uncorrected point load index
- **Is50** corrected point load index
- **eUCS** estimated uniaxial compressive strength
- **Italics value - number of tests carried out does not conform to BS EN ISO 1997-2:2007 requirements**

Method of Preparation : BS EN ISO 1997-2:2007, Based on ISRM Commission on Testing Methods (1985)

Method of Test : BS EN ISO 1997-2:2007, Based on ISRM Commission on Testing Methods (1985)

Remarks :

A F Howland Associates
Geotechnical Engineers

Laboratory Test Results

Site : Proposed AD Plant, Streetly End, Cambridge

Client : Streetly Hall Estate

Engineer : Plandescil Limited

Job Number 22.348

Sheet 1 / 1

DETERMINATION OF pH, SULPHATE CONTENT AND TOTAL SULPHUR OF SOIL AND GROUNDWATER

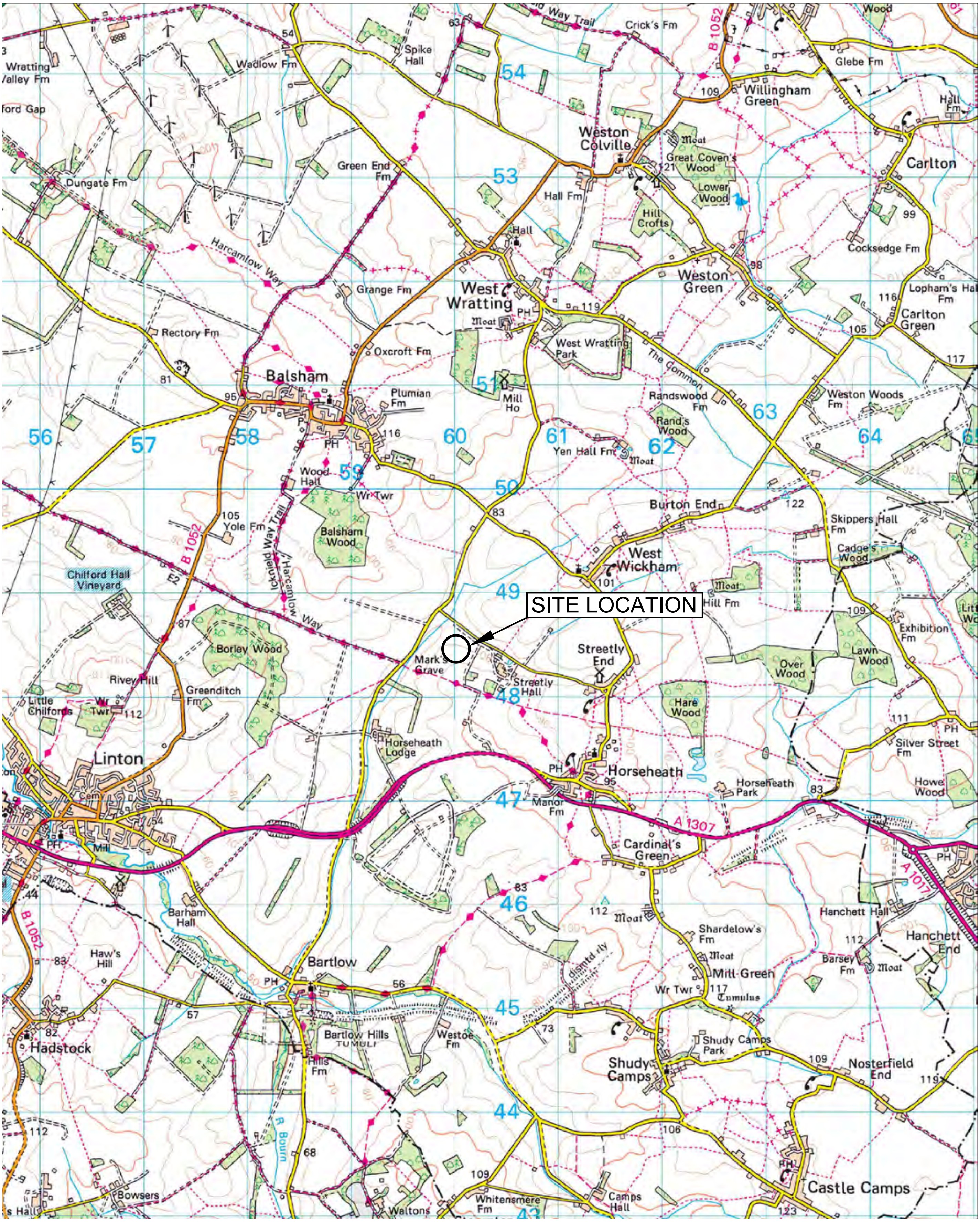
Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Soluble Sulphate			Total Sulphur %	Percentage of sample passing 2mm Sieve %	pH	Classification	Laboratory Description
			Soil		Groundwater g /l					
			Total S04 %	S03 in 2:1 water:soil g /l						
DCP05	0.60	D2	0.04	0.01		< 0.02		8.0	DS-1	Brown slightly sandy slightly gravelly CLAY. Sand is fine.
TP02	0.20	D2	0.04	0.01		< 0.02		8.1	DS-1	Light brown CHALK
TP04	0.60	B1	0.04	0.01		< 0.02		8.1	DS-1	White CHALK
TP05	0.30	D2	0.06	<0.01		0.02		8.0	DS-1	Brown sandy CLAY with chalk

Method of Preparation : BS 1377:PART 1:2018+A1:2021:7.5 Preparation of soil for chemical tests

Method of Test : Laboratory in-house methods based on BS1377: Part 3 for ph and total sulphate and TRL 447 (2005) for total sulphate, Standard Methods for the Examination of Water and Wastewater Part 3120 B – 21st Edition (2005) for water soluble sulphate and total sulphur.

Remarks : Classification relates to Design Sulphate Class of BRE Special Digest 1 (2005)

APPENDIX G: DRAWINGS



North

Circle indicates approximate location of site

Scale 1: 50,000 @ A4

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Site: Proposed AD Plant, Streetly End, Cambridge

SITE LOCATION PLAN

Client : Streetly Hall Estate

Date : April 2023 **Dwg :** 22.348/01

Key:

- Borehole location and reference
- Trial pit location and reference
- BRE test location and reference
- Dynamic cone penetration test location and reference

Rev	Date	Revision Description	Drwn	Chkd

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mail: admin@howland.co.uk

Client: Streetly Hall Estate

Site: Proposed AD Plant, Streetly End, Cambridge

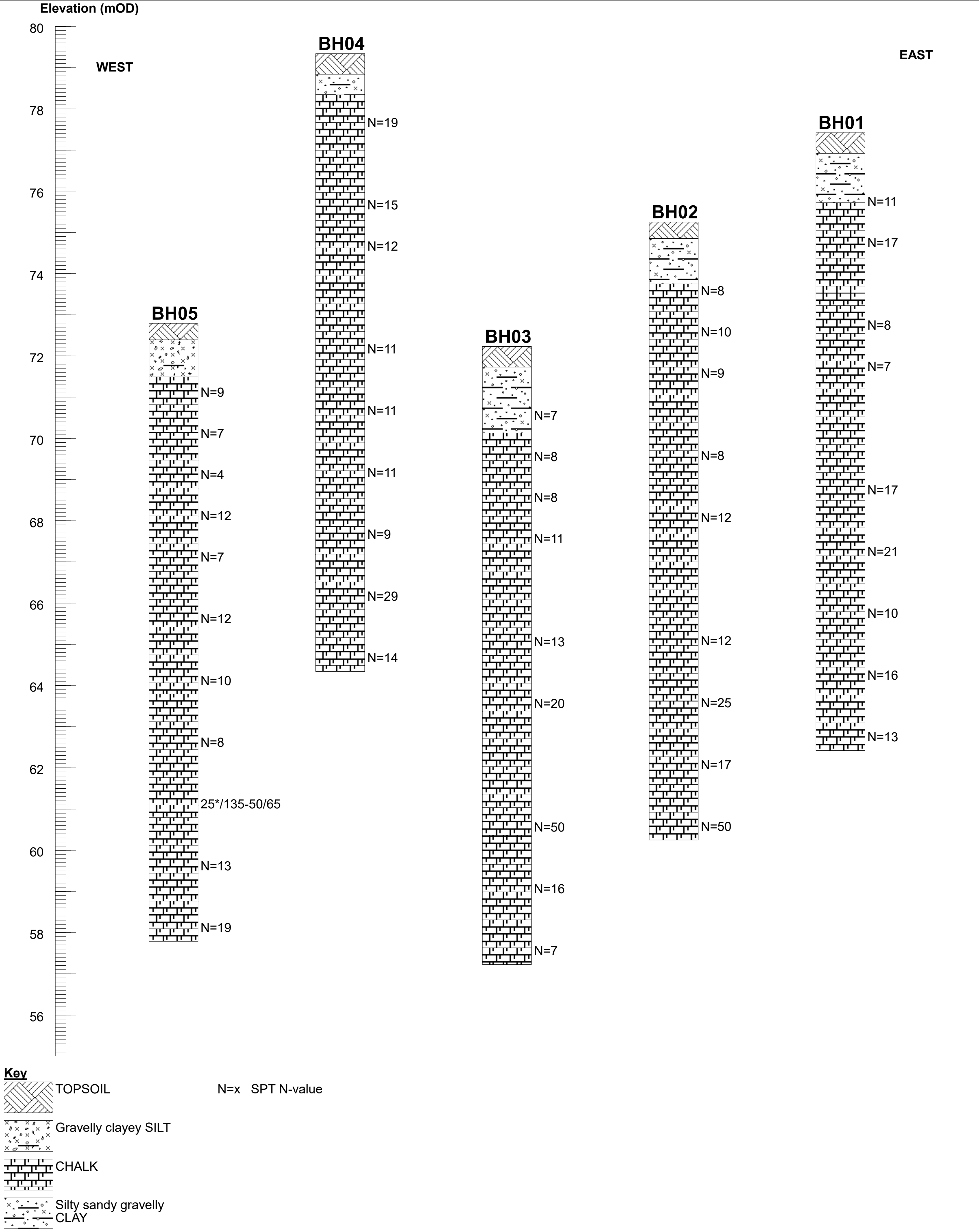
Job No.: 22.348

Drawing Title: EXPLORATORY HOLE LOCATION PLAN AND PROPOSED CONSTRUCTION

Date: September 2023

Drawing No: 22.348/02/Rev01

Scale: 1:2500 @ A4



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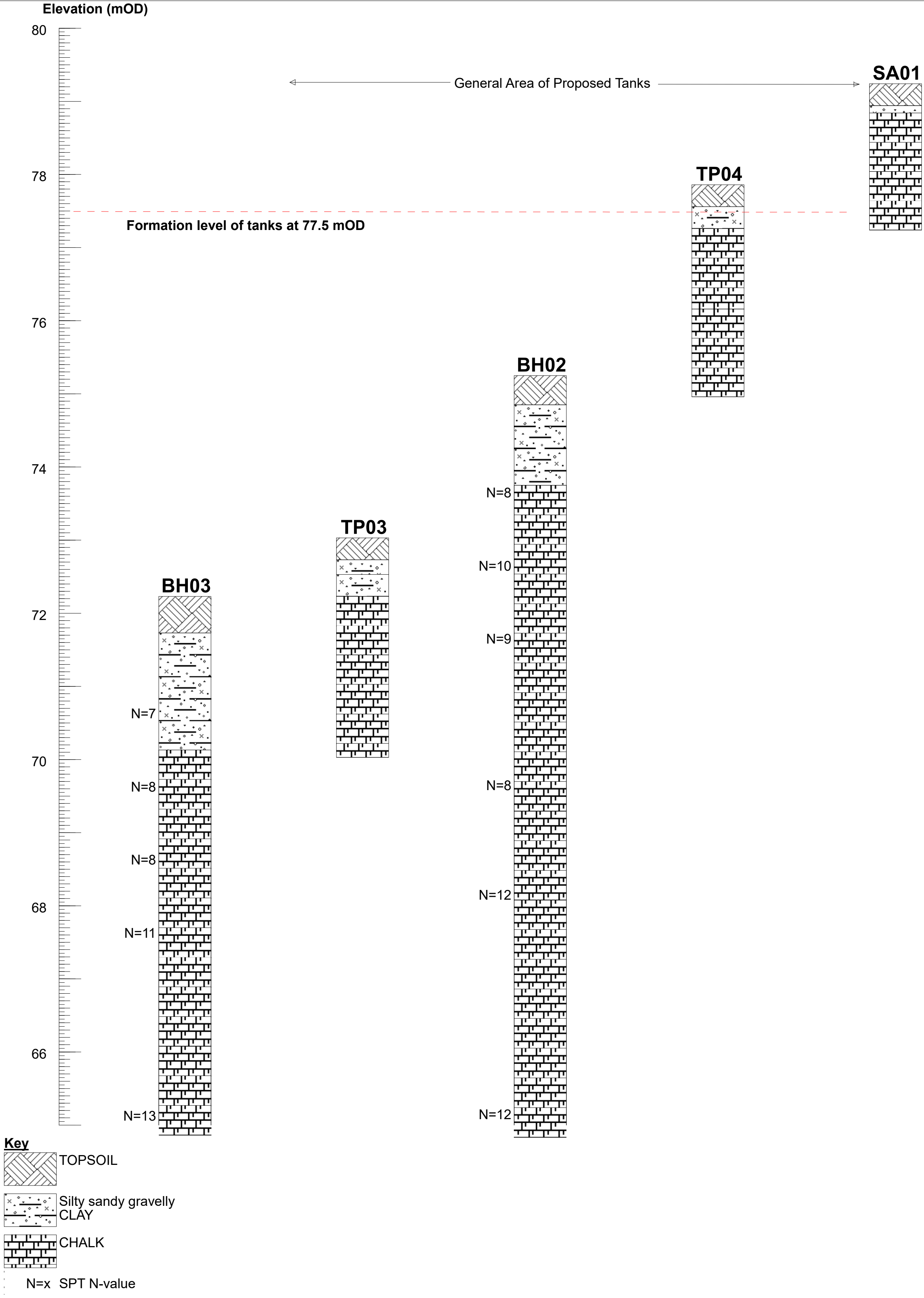
Nominal Section: All Borehole Data

Site	Date Drawn	Date Checked	Sheet	Job Number
Proposed AD Plant, Streetly End, Cambridge	12/04/2023		1/1	22.348
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
Streetly Hall Estate	GNB		1:125[V]	22.348/03a



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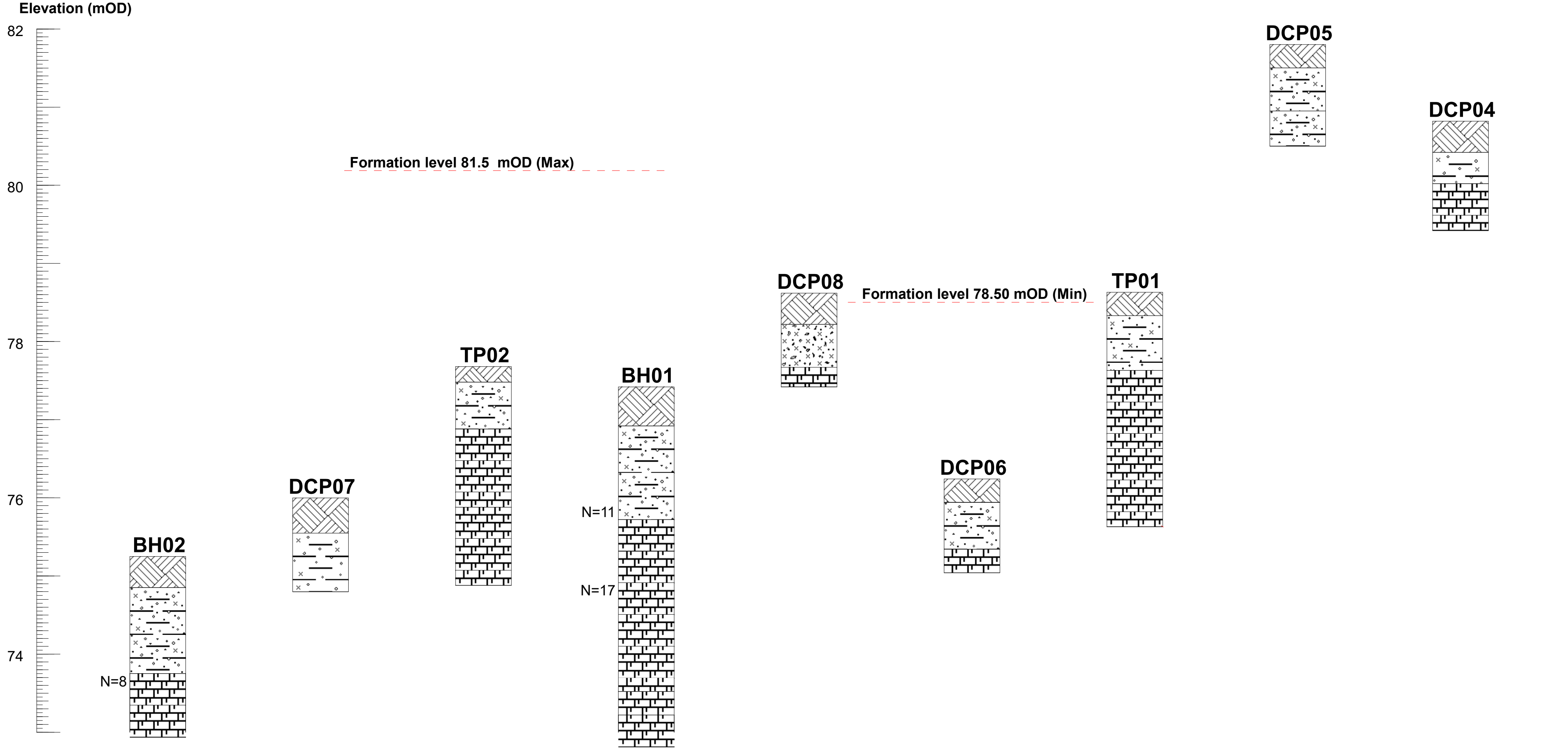
Nominal Section: Post Fermenter & Fermenter Tanks

Site	Date Drawn	Date Checked	Sheet	Job Number
Proposed AD Plant, Streetly End, Cambridge	19/04/2023		1/1	22.348
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
Streetly Hall Estate	GNB		1:75[V]	22.348/03b/Rev01



Key

TOPSOIL

Silty sandy gravelly CLAY

CHALK

Silty gravelly CLAY

Silty sandy CLAY

Sandy gravelly SILT

N=x SPT N-value

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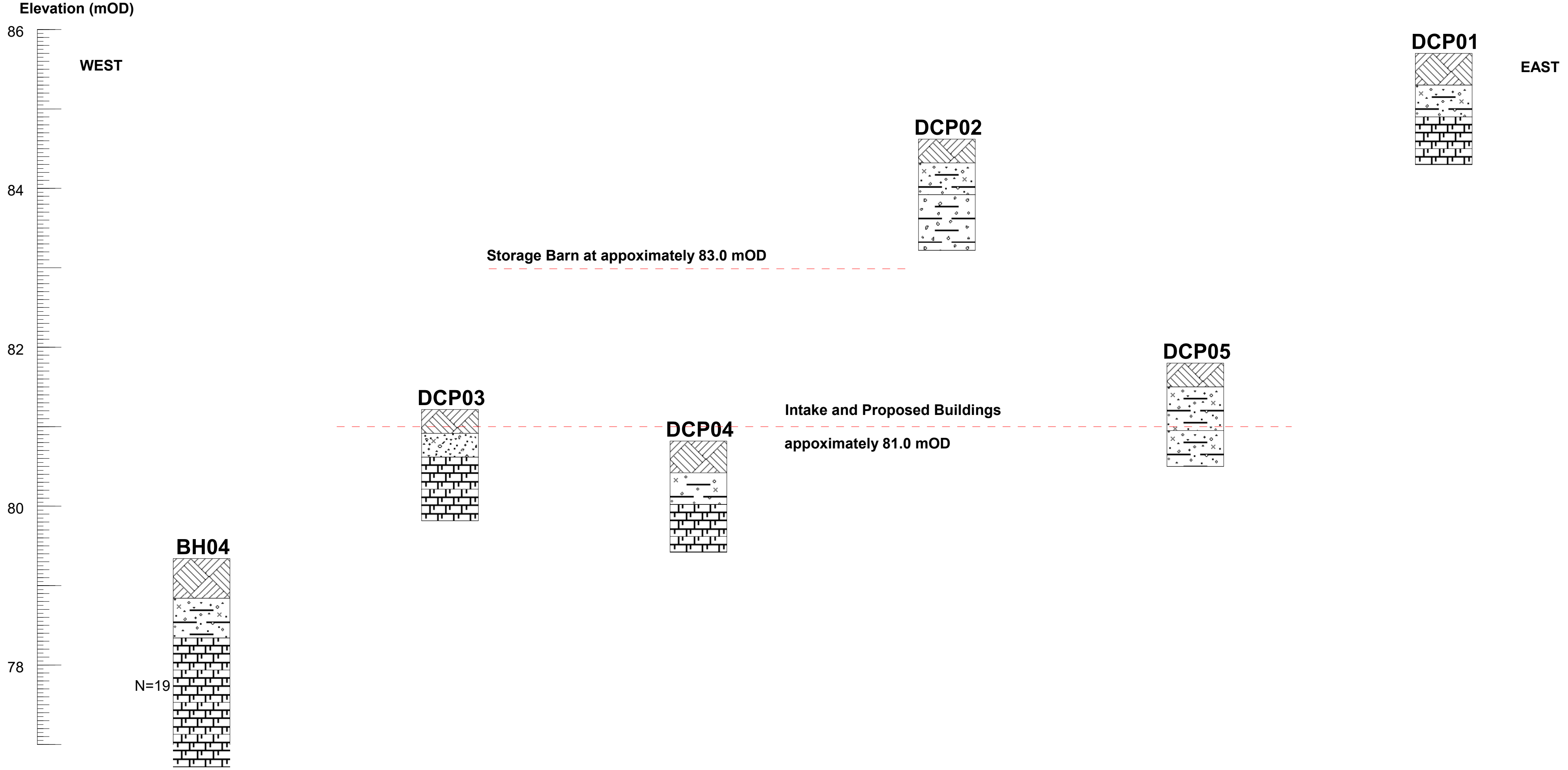
Site Proposed AD Plant, Streetly End, Cambridge

Title Nominal Section: General Area of Silage Clamps

Drawn	Checked	Sheet	Job No.
GNB		1/1	22.348
Date	**Date**	**Scale**	**Figure No.**
12/04/2023		1:75[V]	22.348/03c/Rev01



Key

- TOPSOIL
- Silty sandy gravelly CLAY
- CHALK
- Silty gravelly SAND
- Gravelly CLAY
- Silty gravelly CLAY
- N=x SPT N-value

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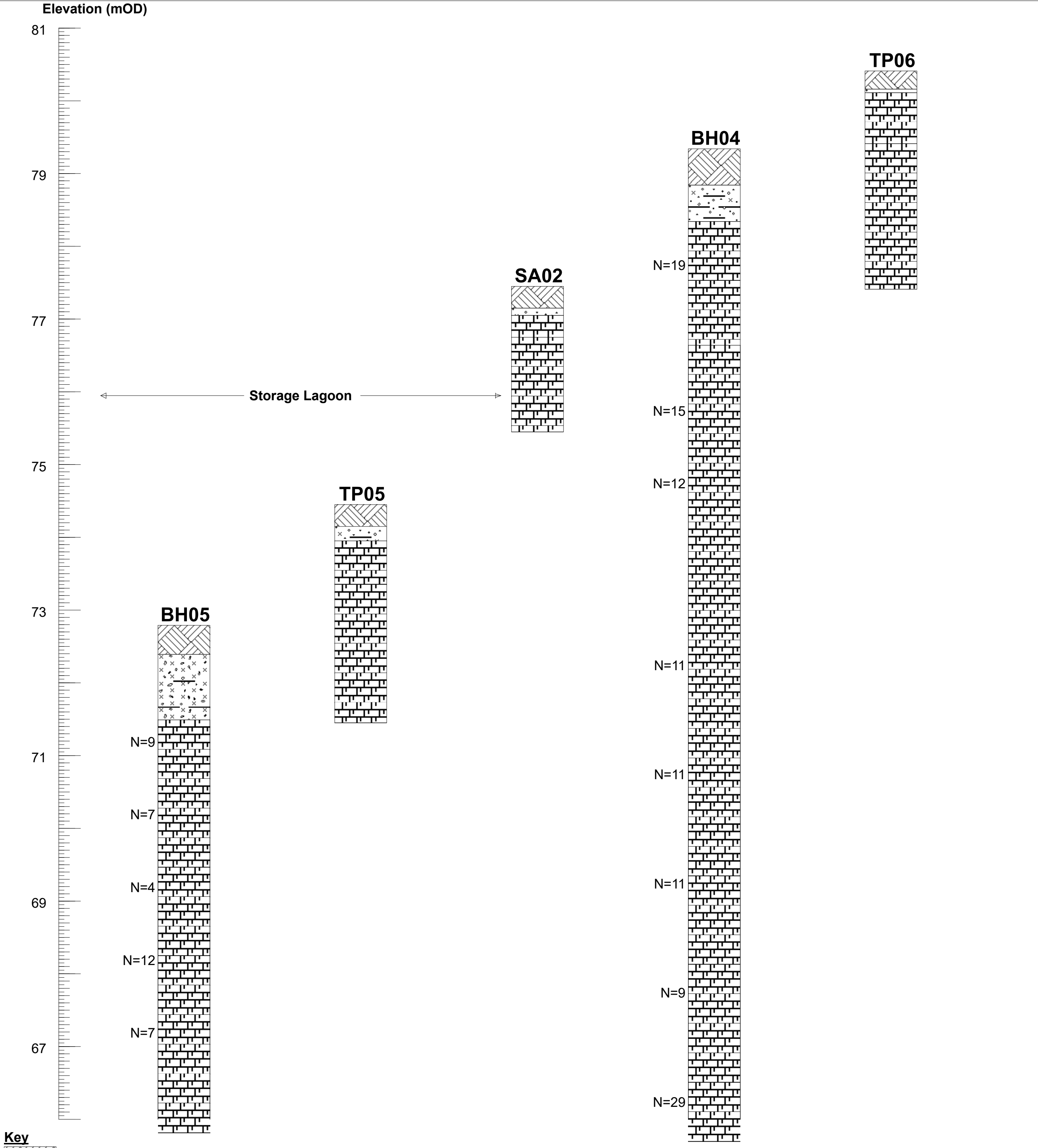
Site Proposed AD Plant, Streetly End, Cambridge			
Title Nominal Section: General Area of Access Road, Buildings and Other Structures			
Drawn GNB	**Checked**	**Sheet** 1/1	**Job No.** 22.348
Date 12/04/2023	**Date**	**Scale** 1:75[V]	**Figure No.** 22.348/03d/Rev01



Key

TOPSOIL

N=x SPT N-value

Gravelly clayey SILT

CHALK

Silty sandy gravelly CLAY

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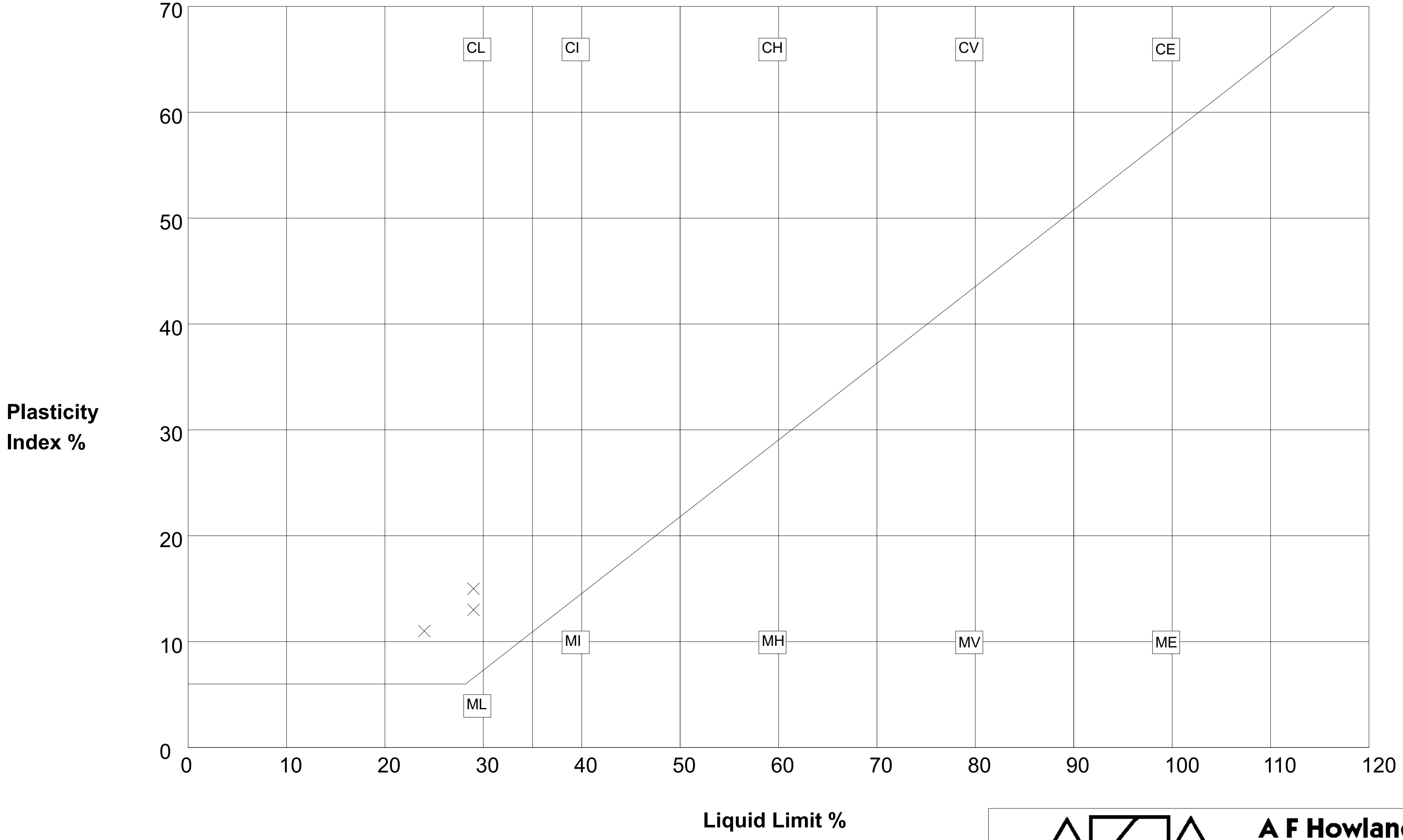
Nominal Section: Storage Lagoon Area

Site	Date Drawn	Date Checked	Sheet	Job Number
Proposed AD Plant, Streetly End, Cambridge	12/04/2023		1/1	22.348
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
Streetly Hall Estate	GNB		1:75[V]	22.348/03e/Rev01



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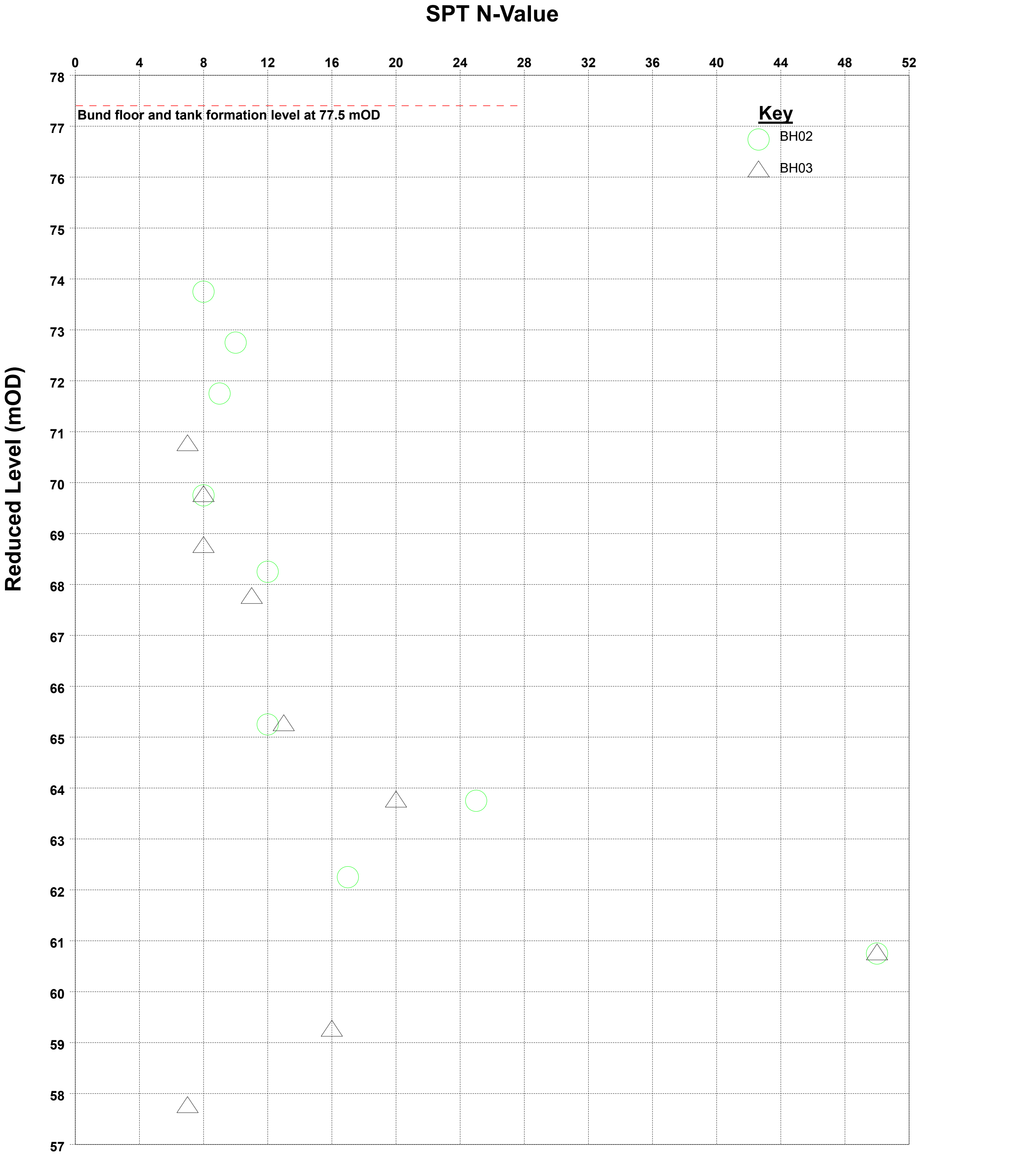
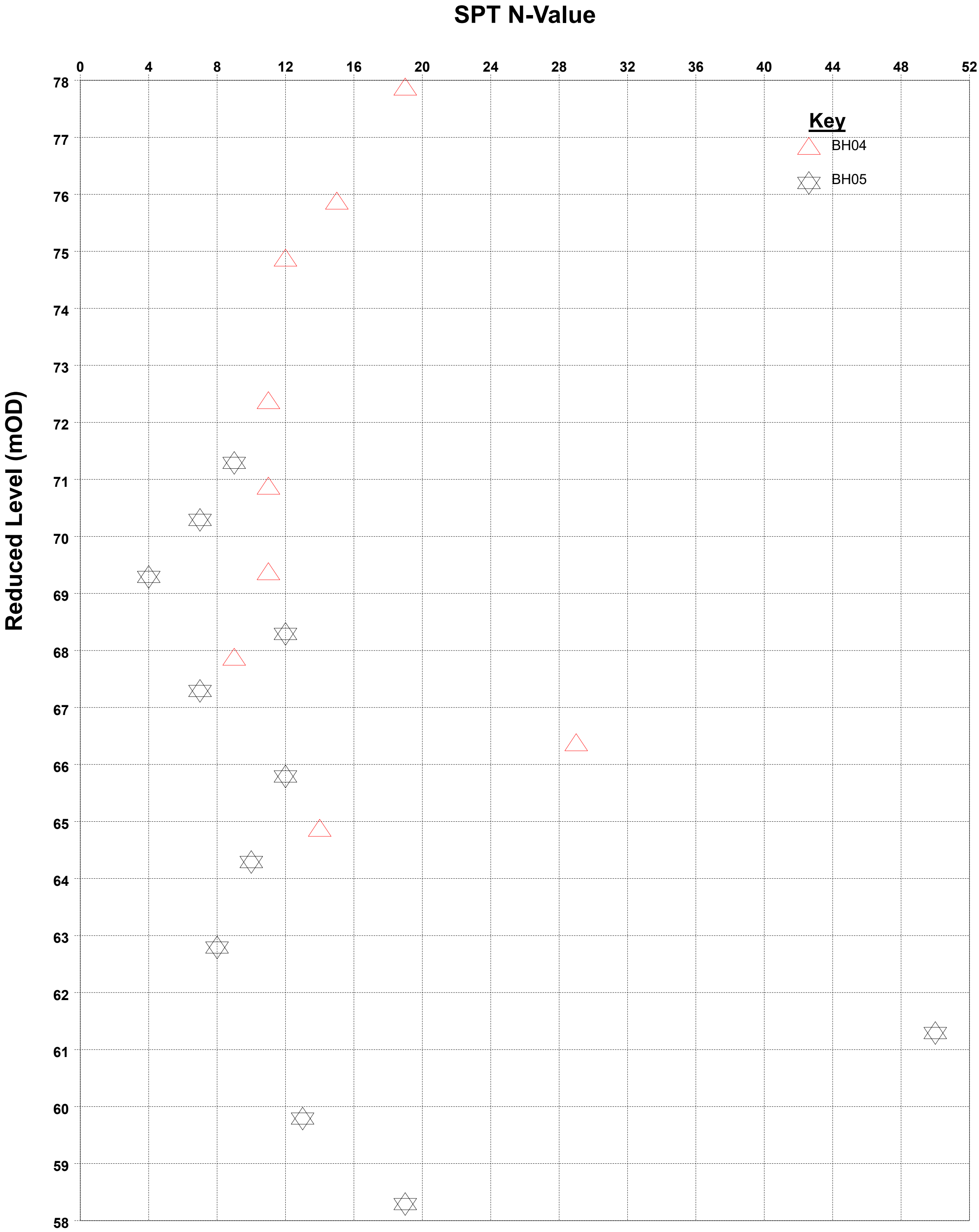
Site Proposed AD Plant, Streetly End, Cambridge			
Title A-Line Plot			
Drawn GNB	**Checked**	**Approved**	**Job No.** 22.348
Date 17/04/2023	**Date**	**Date**	**Figure No.** 22.348/04



A F Howland Associates Geotechnical Engineers		Title: SPT N-Value Plot in Area of Post-Fermenter and Fermenter Tanks and the Surface and Dirty Water Lagoons		
Site: Proposed AD Plant, Streetly End, Cambridge	Date Drawn: 18/04/2023	Date Checked:	Sheet: 1 / 1	Job Number: 22.348
Client: Streetly Hall Estate	Drawn By: GNB	Checked By:	Scale: N/A	Figure No.: 22.348/05a/Rev01



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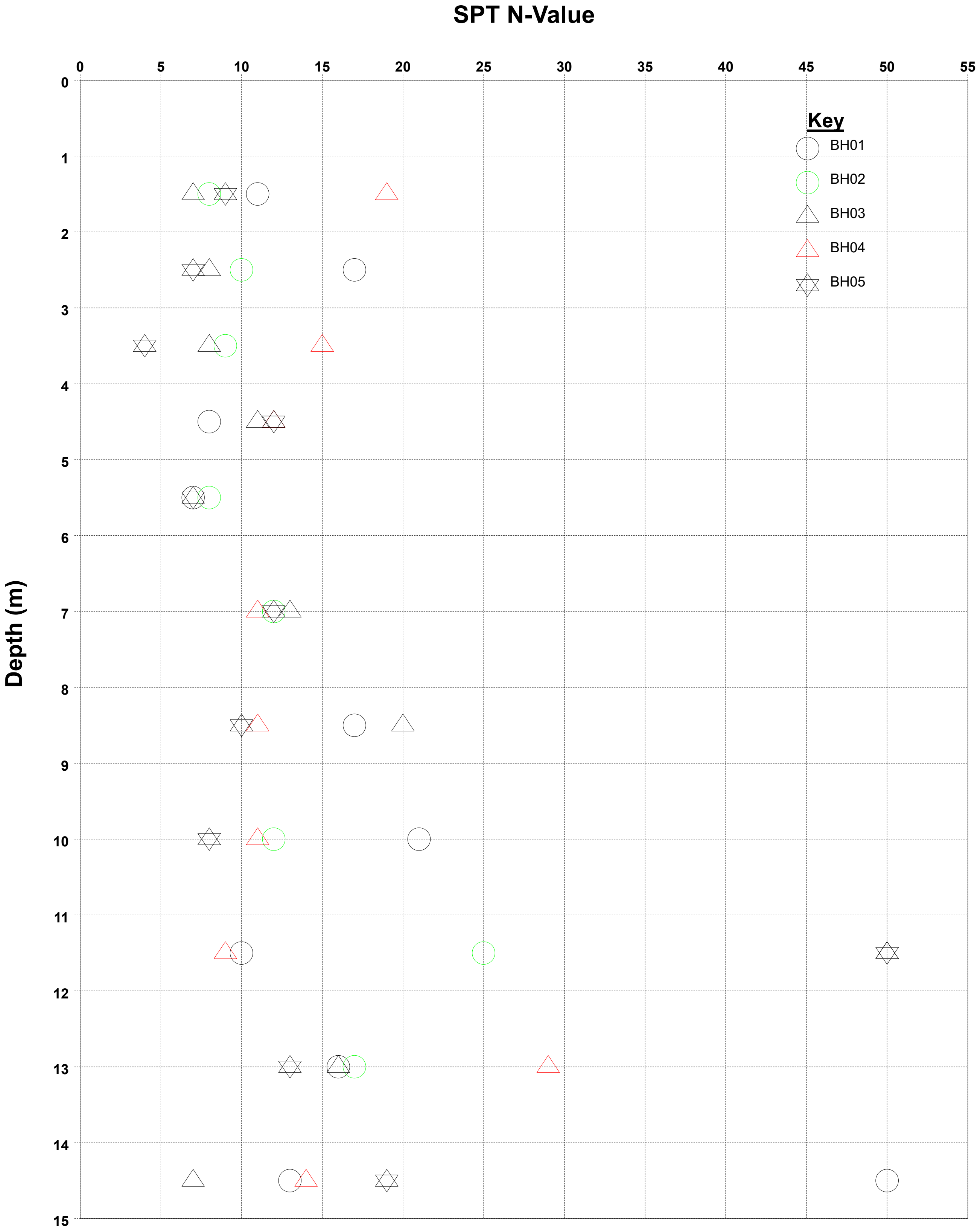
Geotechnical Engineers

Title SPT N-Value Plot for Area of the Digestate Storage Lagoon				
Site Proposed AD Plant, Streetly End, Cambridge	**Date Drawn** 18/04/2023	**Date Checked**	**Sheet** 1 / 1	**Job Number** 22.348
Client Streetly Hall Estate	**Drawn By** GNB	**Checked By**	**Scale** N/A	**Figure No.** 22.348/05b/Rev01



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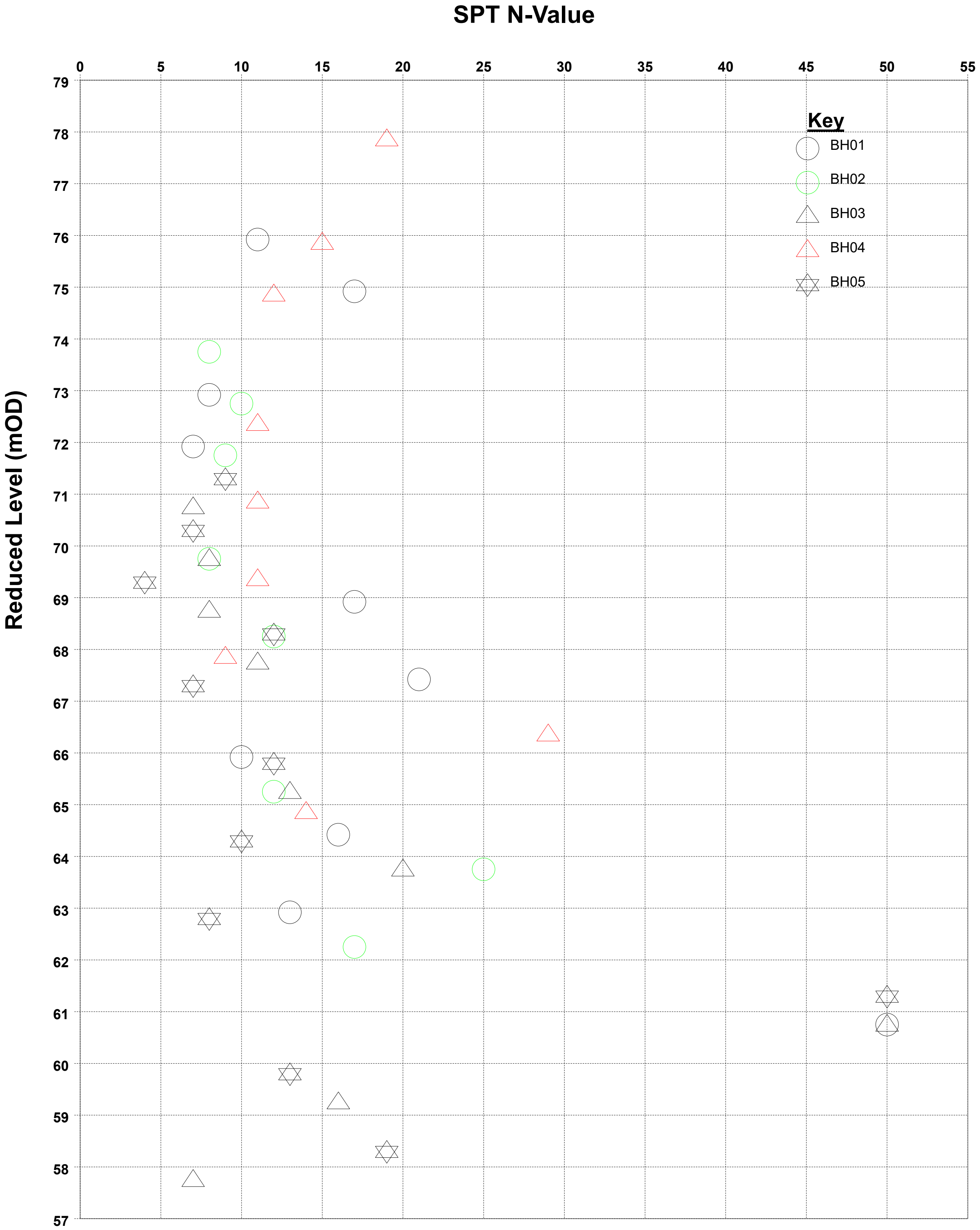
Site	Date Drawn	Date Checked	Sheet	Job Number
Proposed AD Plant, Streetly End, Cambridge	18/04/2023		1 / 1	22.348
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
Streetly Hall Estate	GNB		N/A	22.348/05c

Title
SPT N-Value Depth Plot for All Boreholes



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Title SPT N-Value vs Level Plot for All Boreholes				
Site Proposed AD Plant, Streetly End, Cambridge	**Date Drawn** 18/04/2023	**Date Checked**	**Sheet** 1 / 1	**Job Number** 22.348
Client Streetly Hall Estate	**Drawn By** GNB	**Checked By**	**Scale** N/A	**Figure No.** 22.348/05d

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