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## **GROUND INVESTIGATION**

**37 BROADWATER ROAD, WELWYN GARDEN CITY** 

FOR BISHOPSWOOD ESTATES LTD

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The qualitative assessment of risk presented in this report presents an assessment of potential pollutant linkages between sources, pathways and receptors. A level of risk is attributed to these linkages. However, a low or insignificant risk does not imply that elevated concentrations of various determinants are not present on the site when compared to background or 'greenfield' conditions.

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## 1. INTRODUCTION

#### SITE LOCATION

1.1. The site is located directly to the east of Broadwater Road, approximately 800m to the south-east of the centre of Welwyn Garden City. The site can be located approximately by National Grid Reference 524210, 212550 as shown on Figure 1.

#### SITE DESCRIPTION

- 1.2. The site comprises an approximately rectangular shaped piece of land with maximum dimensions of approximately 65m by 35m.
- 1.3. It is understood that the site was previously occupied by a commercial building located within the central portion of the site. At the time of the investigation the former structure had been demolished and removed from site, with the area of the former structure comprising a level area surfaced with crushed demolition type materials.
- 1.4. Limited areas of soft landscaping together with associated shrubs and trees are present along the western and eastern boundaries of the site. The remainder of the site generally comprises areas of tarmacadam hardstandings which appear to have provided access and areas of car parking for the former development.
- 1.5. The site is generally topographically flat with no significant change in elevation across the site.
- 1.6. A single storey wooden shed with a sloping felt roof is present in the south-west of the site, with a single shipping container present in the south-east.
- 1.7. The boundaries of the site are formed by metal palisade fencing approximately 2.5m in height, with timber site hoarding also present along the western and southern boundaries. A number of mature trees are present directly to the east of the site and locally to the north-east.
- 1.8. The site is bound to the west by Broadwater Road with residential properties and areas of soft landscaping beyond, to the south by residential properties and to the east by an area of dense trees with a school playing field beyond. The site is bound to the north and north-east by areas of carparking with assumed commercial properties beyond.
- 1.9. Access to the site is gained via a double timber gate in the hoarding in the south-west of the site.
- 1.10. The general site layout is presented as Figure 2.

#### PROPOSED DEVELOPMENT

- 1.11. It is understood that the proposed development comprises the construction of a new four storey residential apartment block with associated areas of hardstandings and limited soft landscaped areas.
- 1.12. A proposed development layout is presented in Appendix A.

SCOPE

1.13. This report presents a review of the previous reports, the factual results of an intrusive ground investigation and a geotechnical assessment of the ground conditions encountered in relation to the proposed development.

## 2. GEOLOGY

- 2.1. Reference to the British Geological Survey (BGS) Sheet No. 239, Hertford (Solid and Drift) and the BGS Geoindex indicates the site to be directly underlain by drift geology of the Lowestoft Formation. The Lowestoft Formation is generally described as 'chalky till, together with outwash sands and gravels, silts and clays. The till is characterised by its chalk and flint content' by the BGS. The thickness of the Lowestoft Formation is not defined by the BGS in the vicinity of the site, however its thickness is indicated to be extremely variable.
- 2.2. Further drift geology of the Kesgrave Subgroup is indicated to be present approximately 50m to the north of the site, which may encroach onto the site. The Kesgrave Subgroup is generally described as 'mainly gravels characterised by quartz and quartzite' by the BGS. The thickness of the Kesgrave Subgroup is not defined by the BGS in the vicinity of the site, however, if present it is anticipated to be of limited thickness.
- 2.3. The Lowestoft Formation is indicated to be underlain by solid geology of the Lewes Nodular Chalk Formation and Seaford Chalk Formation (Undifferentiated) of the White Chalk Subgroup. The White Chalk Subgroup is generally described as 'Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout' by the BGS. The thickness of the White Chalk Subgroup is not defined by the BGS in the vicinity of the site, however it is anticipated to extend to significant depth.
- 2.4. In addition to the published geology, it is anticipated that Made Ground will be present at the surface or beneath hardstandings given the current development of the site.

## 3. PREVIOUS INVESTIGATION

#### **GROUND INVESTIGATION REPORT**

- 3.1. Geotechnical and Environmental Associates have completed a Ground Investigation report (report reference J16261A dated May 2017) for the site on behalf of Stay New Homes Limited associated with the proposed residential redevelopment of the site comprising the extension of the existing structure including the addition two further storeys. The investigation was undertaken to review the findings of a previous desk study, to determine the ground conditions and extent of any contamination and to provide information to assist with the design of foundations. The following summarises the scope and findings of this previous assessment.
  - The site was identified as being occupied by a two storey building in the central western portion
    of the site together with areas of hardstandings for vehicle parking and limited areas of soft
    landscaping;
  - The desk study identified the site to have remained undeveloped until approximately 1938, after which the site is indicated to have been developed with a manufactory present in the west. The onsite structure is indicated to have undergone extension by approximately 1960, with the onsite structure indicated to be a chemical works by 1968. The site is indicated to have been redeveloped with an office building by 1994. The surrounding area has generally comprised a mixture of industrial and residential properties;
  - Several natural cavities are recorded within 250m of the site and include sinkholes located approximately 22m, 96m and 190m to the north and 56m to the north-east. In addition, a sinkhole has been encountered on the adjacent site to the south, with a further such feature identified beyond Broadwater Road to the west. Further to this an elongated circular feature/depression has been identified approximately 70m to the east;
  - The site was identified as being underlain by drift geology of the Lowestoft Formation overlying solid geology of the Lewes Nodular Chalk Formation and Seaford Chalk Formation;
  - The site investigation comprised three opendrive sampler boreholes to a maximum depth of 6m bgl, nine dynamic probe holes to a maximum depth of 10m bgl and four trial pits to a maximum depth of 1.1m bgl, to examine the foundations to the existing structure;
  - The ground conditions at the site were found to comprise a limited thickness of Made Ground overlying materials of the Lowestoft Formation to the maximum depth of the sampling at 6m bgl. The Lowestoft Formation generally comprised soft becoming firm clay with varying quantities of silt, sand and gravel;
  - The probes generally indicated an increase in soil density below depths of between 5m and 7.6m bgl. Whilst no significant weak zones or voids were encountered, within Probe Nos 5 and 6, located in the north-west and centrally in the south-west, respectively, the probing maintained low to moderate blow counts with little increase with depth;
  - Groundwater was not encountered during the investigation however damp strata was locally noted at depths between approximately 1m and 4m bgl. During the subsequent monitoring event groundwater was encountered at depths of 4.04m and 4.56m bgl;

- Based on the gas monitoring results it was considered that no gas protection measures are required;
- It was considered that strip or pad foundations could be adopted in the firm clay and silty sand of the Lowestoft Formation at a minimum depth of 1.25m bgl (allowing for restricted new planting) and designed to a net allowable bearing pressure of 100kN/m<sup>2</sup>;
- Where anticipated loads are likely to be high a piled foundation solution may prove more suitable. A deeper cable percussion borehole would be required to determine pile design parameters;
- Due to the known presence of solution features in the area, Welwyn and Hatfield Borough Council have requirements for the area and Building Control state that foundations will need to be suitably reinforced to span a potential solution feature with a minimum diameter of 3m, where extensions are proposed and 5m for new buildings and that footings need to extend beyond the corners of the building to provide the spanning capability;
- The ground investigation did not encounter any evidence of solution features, but soft clay was
  encountered in the west of the site. It was recommended that further investigation in this
  portion of the site would be prudent;
- It was considered that ground bearing floor slabs could be adopted following the removal of the Made Ground materials.

#### DISCUSSION

- 3.2. Based on the findings of the previous investigation and the risk posed at the site from the potential presence of solution features, it is considered that further investigation is required at the site to confirm the underlying ground conditions and further assess the risk posed by the presence of solution features at the site. Any further works should include investigation in the west of the site where softer cohesive materials have been previously identified.
- 3.3. In addition, the current proposed development differs from that detailed within the previous report, with the current proposal comprising the construction of a new four storey residential apartment block. Due to the higher anticipated loads associated with the proposed development, it is considered that the use of conventional shallow foundations is unlikely to be feasible. It is therefore considered that a piled foundation solution is likely to be required.
- 3.4. It is therefore recommended that deeper cable percussion boreholes are required at the site to determine the nature of the deeper ground conditions and to provide data to assist with pile design.
- 3.5. Whilst the previous report suggests that the use of pad foundations may be feasible, it is considered that due to the potential for the presence of solution features at the site, the use of pad foundations is not recommended.
- 3.6. Structa agrees with the recommendations of the previous report with respect to the design of foundations to be protective against the presence of solution features and that any proposed foundations should be designed in accordance with the guidance provided in CIRIA C574 'Engineering in Chalk'.

## 4. GROUND INVESTIGATION AND TESTING

#### **GROUND INVESTIGATION**

- 4.1. The scope of works for the intrusive investigation comprised four cable percussion boreholes and twenty super heavy weight dynamic probe holes. This investigation was completed to obtain information relating to the geotechnical properties of the underlying ground conditions and to establish the presence of any softer/weaker zones which may be indicative of the presence of solution features. The positions of exploratory holes have been surveyed and taped from recognisable features and are presented on Figure 2 of this report.
- 4.2. The ground investigation was carried out in general accordance with BS5930:2015 "Code of Practice for Site Investigation" and BS10175+A2:2017 "Investigation of Potentially Contaminated Sites Code of Practice" and in accordance with current best practice.
- 4.3. The scope of works for the current ground investigation was as follows:
  - 4 No. cable percussion (BH) boreholes to a maximum depth of 25.45m bgl;
  - 20 No. dynamic probe (DP) holes to a maximum depth of 10m bgl;
  - In-situ standard penetration tests (SPT) at regular intervals in BH;
  - Geotechnical laboratory testing.
- 4.4. The ground investigation was undertaken between 25 September and 01 October 2019. The intrusive investigation was supervised by a suitably trained and experienced geotechnical engineer from Structa LLP. The exploratory holes were logged by the supervising engineers and the logs are presented in Appendix B.

#### GEOTECHNICAL LABORATORY TESTING.

- 4.5. Geotechnical laboratory testing was completed on selected soil samples. The samples have been scheduled for Atterberg Limit testing to assess their volume change potential and material properties and for pH and sulphate testing to assess the concrete classification for the proposed development.
- 4.6. The results of the geotechnical laboratory testing are presented in Appendix C.

## 5. GROUND AND GROUNDWATER CONDITIONS

#### MATERIALS ENCOUNTERED

- 5.1. The published geology provided by the BGS indicates the site to be underlain by drift geology of the Lowestoft Formation overlying solid geology of the White Chalk Subgroup.
- 5.2. The ground investigation generally confirmed the published geology. In addition to the published geology, the intrusive investigation encountered a limited thickness of Made Ground at the surface and beneath existing hardstandings across the site, with these materials encountered to a maximum depth of 0.9m bgl at BH4 located in the north-east of the site.
- 5.3. Table 1 presents a summary of the ground conditions encountered during the investigations of the site. Full details of the conditions encountered are presented on the exploratory hole logs in Appendix B.

Description	Top o (m	f Unit bgl)	Thicknes (m	ss of Unit bgl)	SPT N
	Min	Max	Min	Max	value
Made Ground Soft and firm brown slightly sandy to sandy gravelly CLAY. Gravel is angular to rounded fine to coarse concrete, flint, brick, timber and glass;					
Brown gravelly and locally very gravelly slightly clayey to very clayey SAND. Gravel is angular to rounded fine to coarse brick, concrete, flint, tarmacadam, metal, plastic, timber, ceramic and clinker;	0.00	0.20	0.25	0.75	None Taken
Light brown sandy slightly clayey angular to subangular fine to coarse GRAVEL of roadstone;					
<b>Lowestoft Formation</b> Firm and stiff, locally soft orange brown and brown slightly sandy to very sandy slightly gravelly to gravelly locally silty CLAY. Gravel is angular to subrounded fine to coarse flint, chalk and ironstone. Occasional pockets of black organic clay;					
Medium dense and dense orange brown sandy locally clayey angular to rounded fine to coarse GRAVEL of flint;	0.40	0.75	9.50	20.60	1 - >50
Stiff brown gravelly CLAY. Gravel is angular to rounded fine to coarse flint, chalk and mudstone;					
Orange brown gravelly slightly clayey SAND. Gravel is angular to rounded fine to coarse flint;					

#### TABLE 1: SUMMARY OF STRATA ENCOUNTERED

Description	Top o (m	f Unit bgl)	Thicknes (m	ss of Unit bgl)	SPT N
	Min	Max	Min	Max	value
White Chalk Subgroup Structureless Chalk composed of firm to very stiff white and cream and locally light grey slightly gravelly to very gravelly SILT. Gravel is angular to subangular fine to coarse very weak to weak low density white and light grey chalk and angular fine to coarse flint; Structureless Chalk composed of firm white clayey SILT; Structureless Chalk composed of soft cream mottled orange brown gravelly SILT. Gravel is angular fine to coarse very weak low density white and cream chalk with rare black specks;	9.90	21.20	3.80*	10.55*	0 - >50

Notes 1. \*Base not proven

- 5.4. In addition, to the strata summarised in Table 1 tarmacadam hardstandings were encountered at the surface at all exploratory boreholes, with the exception of BH103 and were present to depths of between approximately 0.1m and 0.2m bgl.
- 5.5. Forty SPTs were completed within the cohesive Lowestoft Formation materials which recorded SPT 'N' values between 1 and 30, with SPT 'N' values typically recorded in excess of 8 indicating generally medium to high strength cohesive materials.
- 5.6. At BH103, located in the north-west of the site, SPT 'N' Values of between 1 and 4 were recorded for the cohesive Lowestoft Formation materials between 2m and 12m bgl, indicating the presence of extremely low to very low strength cohesive materials. In addition, lower SPT 'N' values of between 4 and 7 were locally recorded within the shallow cohesive Lowestoft Formation materials at BH101, located in the south-west of the site, at depths between 3m and 7m bgl.
- 5.7. Fourteen SPTs were completed within the granular Lowestoft Formation materials encountered at BH102 and BH104, which recorded SPT 'N' values between 16 and 58, indicating generally medium dense to dense granular materials. Granular materials of the Lowestoft Formation were not encountered at BH101 or BH103.
- 5.8. Twenty-six SPTs were completed within the White Chalk Subgroup materials that typically recorded SPT 'N' values between 7 and >50, with SPT 'N' values typically increasing with depth indicating typically competent chalk materials.
- 5.9. At BH103, located in the north-west of the site, the results of SPT tests undertaken within the uppermost chalk materials recorded SPT 'N' values of 0 and 3 between approximately 13m and 15m bgl indicating very low strength chalk materials.
- 5.10. As part of the current investigation, twenty dynamic probe holes were formed across the site to provide information on the underlying ground conditions and to identify any areas of soft/poor ground which may be indicative of the presence of possible solution features.

- 5.11. The results of the dynamic probing generally identified the presence of competent materials across the site with incremental probe results typically recorded in excess of 2, with results typically increasing with depth.
- 5.12. Within the north-west of the site, namely at DP110 and DP116 to DP119, the probing results have identified zones of soft/less competent ground, where incremental probe results of <2 have been recorded. The probing results for DP110 and DP117 recorded the presence of soft materials to depths of approximately 9m bgl. The results for DP116, DP118 and DP119 identified the presence soft materials to depths of up to approximately 6.5m bgl.
- 5.13. Four samples of the cohesive Lowestoft Formation materials recovered from depths between 1.2m and 2.5m bgl were scheduled for Atterberg Limit determinations and moisture content analysis. The results indicate the materials tested to comprise clay of low plasticity with liquid limits of between 30% and 34%, plastic limits of 11% and 14% and modified plasticity indices of approximately 16%, indicating the materials tested to be of low volume change potential.
- 5.14. Two samples of the granular Lowestoft Formation materials recovered from BH102 and BH104 at depths of 3.5m and 5.5m bgl respectively were scheduled for Atterberg Limit determinations and moisture content analysis. The results indicate the materials tested to be non-plastic.
- 5.15. A single sample of the White Chalk Subgroup materials recovered from BH102 at 10.5m bgl was scheduled for Atterberg Limit determinations and moisture content analysis. The results indicate the material tested to comprise silt of intermediate plasticity with a liquid limit of 48%, plastic limit of 31% and a plasticity index of 17%, indicating the material tested to be of low volume change potential.
- 5.16. Natural moisture contents between 12% and 17% were recorded for the cohesive Lowestoft Formation materials tested, indicating the materials are locally in a state of potential desiccation.
- 5.17. The results are presented in full in Appendix C.

#### GROUNDWATER

5.18. During the intrusive investigation groundwater was only encountered within BH104 during its formation at a depth of approximately 21m bgl.

## 6. GEOTECHNICAL ASSESSMENT

#### INTRODUCTION

- 6.1. It is understood that the proposed development comprises the construction of a new four storey residential apartment block with associated areas of hardstandings and limited soft landscaped areas.
- 6.2. A proposed development layout is presented in Appendix A.
- 6.3. The ground conditions at the site have been found to comprise a limited thickness of Made Ground overlying cohesive and granular materials considered to represent drift geology of the Lowestoft Formation. The Lowestoft Formation materials were found to be underlain by chalk materials of the White Chalk Subgroup materials.
- 6.4. The thickness of the Lowestoft Formation materials was found to be variable across the site, with the underlying Chalk materials encountered at depths between approximately 9.9m at BH102, located in the south-east of the site and 21.2m bgl at BH104, located in the north-east of the site. At BH101 and BH103 the chalk materials were encountered at depths of 16.4m and 12.45m bgl, respectively.
- 6.5. The Lowestoft Formation materials have typically been found to comprise firm to stiff and locally soft cohesive materials, with medium dense to dense granular materials also encountered within BH102 and BH104, between depths of approximately 8m and 19m bgl and 7m and 10m bgl, respectively.
- 6.6. The cohesive Lowestoft Formation materials encountered at BH103, located in the north-west of the site were found to be soft in nature, with SPT results of between 1 and 4 recorded within these materials between depths of approximately 2m and 12m bgl.
- 6.7. Solid geology of the White Chalk Subgroup was encountered within all of the exploratory boreholes at depths between approximately 9.9m and 21.2m bgl. The White Chalk Subgroup was typically found to comprise competent chalk materials, with these materials generally recovered as firm to stiff silt with variable quantities of sand and gravel sized fractions. The uppermost portion of the Chalk materials encountered at BH103, located in the north-west of the site were found to be noticeably softer in nature than those encountered across the remainder of the site with these softer materials encountered to a depth of approximately 16m bgl.
- 6.8. The probing results have identified zones of less competent ground in the north-west of the site, namely DP110 and DP116 to DP119, the location of which is consistent with the softer materials encountered within BH103. All of the exploratory holes in this part of the site terminated in more competent materials.
- 6.9. Based on the information obtained from the intrusive investigation, it is not possible to confirm whether the less competent materials identified in the north-west of the site are associated with the dissolution of the underlying chalk materials however, it is understood that solution features have been identified in the vicinity of the site and therefore the possible presence of dissolution features at the site cannot be discounted.
- 6.10. The approximate area where the less competent materials have been encountered is presented on Figure 2.

#### FOUNDATION DESIGN

- 6.11. Based on the nature of the proposed development together with the localised presence of areas of less competent materials in the north-west of the site which extend to significant depth, the use of conventional strip or pad foundations is not recommended for the proposed development due to the potential for unacceptable total and differential settlements to occur across foundations.
- 6.12. In addition, the site is considered to be potentially at risk from the presence of solution features within the underlying chalk materials.
- 6.13. Due to the nature of the proposed development, the ground conditions encountered and the potential for dissolution features to be present at the site, it is recommended that a piled foundation solution is adopted for the proposed development with piles extending into the deeper more competent White Chalk Subgroup materials at depth.
- 6.14. Whilst no conclusive evidence of solution features has been identified as part of the intrusive investigation, an area of less competent materials has been encountered in the north-west of the site which may be associated with chalk dissolution. In addition, it is understood that solution features have previously been identified in close proximity to the site. It is therefore considered that a potential risk from dissolution hazards may be present at the site. It is therefore recommended that any foundations associated with the proposed development are designed and constructed in accordance with the guidance provided in CIRIA C574 'Engineering in Chalk'.
- 6.15. Based on the ground conditions present at the site it is considered that bored/CFA piles will be most appropriate. Pile depths will be subject to final design loadings, method of installation, pile diameter and encountered ground conditions however, as a guide typical working loads for bored piles based on shaft resistance only are given in Table 2.

Strata	Pile Length (m bgl)	Pile Diameter (mm)	Pile Capacity (kN)
White Chalk	20m 25m	300	275
Subgroup	2011 – 2511	450	400

TABLE 2TYPICAL PILE WORKING LOADS (BORED PILES)

- 6.16. The pile loads detailed in the table above are considered to provide a conservative estimate of the pile loads that may be achieved at the site and are based on the ground conditions encountered at BH103 and assume the presence of lower strength materials to a depth of approximately 15m bgl. It is recommended that piles are designed to ensure an adequate factor of safety based on shaft resistance alone and do not rely on base resistance.
- 6.17. Whilst it is considered that higher pile loads could be achieved outside the zone of less competent materials identified in the north-west of the site, the potential for further such areas to be present at the site cannot be discounted. It is therefore recommended that the design of any piling foundation solution allows for the potential presence of lower strength materials to be present at pile locations.
- 6.18. It is recommended that that all piles are terminated within competent materials of the White Chalk Subgroup. The investigation has indicated that the depth to competent chalk materials varies significantly across the site, with competent chalk materials encountered at depths between approximately 10m and 21m bgl. It is therefore recommended that pile installation is undertaken by an

experienced contractor and that monitoring of pile installation, including rate of penetration, etc is undertaken during pile installation to ensure piles are terminated within competent chalk materials.

- 6.19. It is recommended that the advice of a specialist piling contractor is sought regarding the design and installation of any piling solution.
- 6.20. A bored pile solution is likely to generate significant quantities of spoil for which off-site disposal may be required.
- 6.21. If areas of significantly lower strength ground, voids or significantly differing ground conditions are encountered during the piling operations further assessment of the foundations will be required and Structa should be contacted immediately.
- 6.22. Plasticity index results indicate the cohesive Lowestoft Formation materials to be of low volume change potential with these materials indicated to be in a state of potential desiccation in the west of the site. It is therefore it is recommended that consideration is given to the inclusion of appropriate heave precautions within the proposed development.

#### FLOOR SLAB

6.23. Due to the presence the presence of underlying cohesive strata, and the potential risk posed by the presence of solution features, it is recommended that a suspended floor slab is adopted in conjunction with piled foundations.

#### ROAD PAVEMENT DESIGN

- 6.24. For the basis of design of any areas of hardstanding or access roads design CBR values of 1% could be adopted where the formation level lies within the Made Ground following removal of the overlying hardstanding.
- 6.25. For the basis of design of any areas of hardstanding or access roads design CBR values of 2% could be adopted where the formation level lies within the Lowestoft Formation following removal of the overlying Made Ground.
- 6.26. The formation should be proof rolled and any 'soft' spots removed and replaced with suitable fill. The formation is likely to deteriorate if left uncovered and therefore construction should be completed within a short time period after stripping of superficial materials or a temporary protective layer should be left in place.
- 6.27. The materials at formation level may be frost susceptible and suitable precautions should be included in the design.

#### BURIED CONCRETE REQUIREMENTS

6.28. Based on the results of chemical laboratory testing undertaken on samples recovered from the Made Ground, a Design Sulphate Class of DS-2 and an Aggressive Chemical Environment for Concrete (ACEC)

of AC-2 should be adopted for all concrete placed in contact with these materials such as foundations, and services.

6.29. Based on the results of chemical laboratory testing undertaken on samples recovered from the Lowestoft Formation and White Chalk Subgroup materials, a Design Sulphate Class of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) of AC-1 should be adopted for all concrete placed in contact with these materials such as foundations, piles and services.

#### **EXCAVATIONS**

- 6.30. Excavation of the materials encountered on site is likely to be achieved using conventional plant however, should any obstructions remain in the ground at shallow depths, such as former foundations and structures the use of pneumatic/hydraulic breakout equipment is likely to be required.
- 6.31. Shallow excavations may be stable in the short term however deeper excavations may be prone to collapse, particularly in association with inflows of water. Consequently, temporary support should be considered for all excavations where collapse is to be avoided. Heavy duty closed shoring should be provided for any excavations where man entry is necessary, to ensure safe working conditions.

#### DEWATERING

- 6.32. During the intrusive investigation groundwater was only encountered within BH104 during its formation at a depth of approximately 21m bgl.
- 6.33. Groundwater issues are therefore unlikely to occur in excavations forming part of the proposed development, however if groundwater inflows do occur it is considered that these should be suitably controlled with the use of conventional sump pumping techniques.

## 7. REFERENCES

- 1. BGS Map Sheet No. 239, 'Hertford' Solid and Drift. 1:50 000 scale
- 2. BGS Geoindex
- 3. Geotechnical and Environmental Associates Ground Investigation Report, Report Reference J16261A, dated May 2017
- 4. BS5930:2015 "Code of Practice for Site Investigation"
- 5. BS10175+A1:2017 "Code of Practice for the Investigation of Potentially Contaminated Sites"
- 6. Concrete Complementary British Standards to BS EN 206-1 Part 1: Method of specifying and guidance for the specifer (BS 8500-1:2006
- 7. Concrete Complementary British Standard to BS EN 206-1 Part 2: Specification for constituent materials and concrete (BS 8500-2:2006)
- 8. CIRIA C574 "Engineering in Chalk" 2002
- 9. NHBC Standards 2016

## FIGURES

## FIGURE 1

## SITE LOCATION PLAN



## FIGURE 2

SITE LAYOUT PLAN



Exploratory Hole Location Plan 37 Broadwater Road, Welwyn Garden City

## FIGURE 3

PLOT OF SPT 'N' VALUE VERSUS DEPTH



## **APPENDICES**

## **APPENDIX A**

## PROPOSED DEVELOPMENT LAYOUT



## **APPENDIX B**

FIELD RECORDS

chr										Bo	reho	le No.	
SU	U									В	H'	101	
engineeri	ing ei	nvironments								Sh	eet	1 of 3	
Project Name:			0.1					Project No.:		Н	ole	Туре	
Location:	ter Roa	ad, weiwyn Gardel	City					Co-ords:	Level:		Sca	ale	
Broadwater	Road,	Welwyn Garden C	ity					524186.43 E 212548.19 N	84.28m AOD		1:	50	
Client: Bishopswoo	od Esta	ates Ltd						Start Da 30/09/2019	tes: Finish 30/09/2019	Lo	Logged By AJM		
	Sample	and In Situ Testin	g		Depth	Level	Stratum	Description		Logond	Ś	W/all	
Depth (m)	Туре	SPT/U blow	(KPa)	(ppm)	(m)	(m)	Stratum	Description		Legend	S	vven	
					0.20	84.08	MADE GROUND: Tarmaca MADE GROUND: Firm bro	dam hardstandin	g. v CLAY.				
0.50	D1				0.45	83.83	Gravel is angular to rounde and brick.	ed fine to coarse o	concrete, flint				- 12
							Firm brown slightly gravelly subangular fine to coarse fl	CLAY. Gravel is	angular to				
1.00	SPT	N=9 (2,2/3,3,2,1)					5	,	,	· · · · ·			1 -
1.20 - 1.65	D2												
1.50	D3												-
0.00 0.45	54												
2.00 - 2.45 2.00	SPT	N=10 (2,2/3,3,2,2)											2 -
2.50	D5				2.40	81.88	Firm and locally stiff orange	e brown locally sa	andy slightly	· · · · · ·			
							gravelly CLAY. Gravel is an coarse flint. (Lowestoft For	igular to subround mation)	ded fine to				
3.00 - 3.45	D6												3 -
3.00	SPT	N=7 (2,2/1,2,2,2)											
3.50	D7												
4.00 - 4.45 4.00	D8 SPT	N=5 (2,1/1,1,2,1)								· · · · ·			4 -
4 50	D9												
	20												
5.00 - 5.45	D10												5 —
5.00	SPT	N=8 (2,2/2,2,2,2)											
5.50	D11												-
6.00 - 6.45 6.00	D12 SPT	N=8 (2,1/2,2,2,2)											6 -
6.50	D13				6.40	77.88	Soft orange brown sandy s	lightly gravelly sil	ty CLAY.	· · · · · ·			
							Gravel is angular to subance (Lowestoft Formation)	gular fine to coars	se flint.				
7.00 - 7.45	D14												7 -
7.00	SPT	N=4 (1,1/1,1,1,1)											
7.50	D15												-
8.00 - 8.45 8.00	D16 SPT	N=9 (1,2/2,1,2,4)											8 -
8 50	D17												
0.00													
9.00 - 9.45	D18				9.00	75.28	Firm orange brown sandy s	lightly gravelly si	Ity CLAY				9 -
9.00	SPT	N=13 (2,2/2,3,4,4)					Gravel is angular to subance (Lowestoft Formation)	gular fine to coars	se flint.				
9.50	D19												
10.00 - 10.45	D20											<u>///X//</u>	10 -
Remarks Hardstanding I not encountere	broken o ed. Bac	out. Cable percussion kfilled with arisings on	drilling f comple	from 0.2 tion.	0m to co	mpleted d	lepth. Groundwater	urbed Sample ronmental Sample Sample surbed Sample	N/R - No Recover HVP - Hand Vane W/S - Water Strike	y Shear Test			
							SS - Surf VS - Vali W - Wate	face Sample dation Sample er Sample				AU	נ

										Boreh	nole No	).
SU	U									BH	101	
engineeri		nvironments								Shee	t2 of 3	3
Project Name:	- ig oi							Project No.:		Hole	е Туре	
37 Broadwa	ter Roa	ad, Welwyn Garde	n City					5608	1	(	CP	
Location: Broadwater	Road	Welwyn Garden C	itv					Co-ords: 524186.43 E 212548 19 N	Level: 84.28m AOD	Si Si	cale ∙50	
Client:	noau,	Weiwyn Garden O	ity					Start Da	tes: Finish	Loge	ged By	
Bishopswoo	od Esta	ates Ltd					1	30/09/2019	30/09/2019	A	JM	
5	Sample	and In Situ Testin	g HVP	PID	Depth	Level	Stratum	Description		Legend ≶	Wel	1
Depth (m)	Туре Сот	SP1/U blow	(KPa)	(ppm)	(m)	(m)	Firm orango brown candy s	Nightly gravally si				//
10.00	011	N=13 (2,0/3,0,0,0,+)					Gravel is angular to subang	gular fine to coars	se flint.			
10.50	D21						(Loweston Formation)	m.				-
								_				ý .
11.00	D22	N-15 (2 4/4 2 4 4)										11 -
11.00	351	N-13 (2,4/4,3,4,4)										
11.50	D23											§ -
12.00 12.00	D24 SPT	N=16 (3,4/4,4,4,4)										12 -
10.50	Doc											× 1
12.50	D25											
13.00	D26											
13.00	SPT	N=17 (3,2/3,4,5,5)										
13.50	D27											
14.00	D28											14 —
14.00	SPT	N=16 (2,4/4,3,4,5)										
14.50	D29											ž :
15.00 - 15.45 15.00	D30 SPT	N=14 (2.3/3.3.4.4)										15 -
		(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,										
												8 -
16.00	D24											
16.00	031											16 -
16 50 - 16 95	D32				16.40	67.88	CHALK recovered as: Strue	ctureless CHALK	composed of			
16.50	SPT	N=7 (2,1/1,2,2,2)					firm white and cream grave to coarse weak low density	elly SILT. Gravel is white chalk and	s angular fine rare angular			
							fine to coarse flint. (Lewes Formation)	Nodular and Sea	ford Chalk			17 –
							,					
17.50	D33											§ -
												ý .
18.00 - 18.45 18.00	D34 SPT	N=50										18 -
10.00		(4,6/8,11,19,12)					_	_				
							Becoming stiff.	_				- 8
19.00	D35											19 -
19 50 - 19 95	D36				19.40	64.88	CHALK recovered as: Strue	ctureless CHALK	composed of			ý : -
19.50	SPT	50 (7,10/50 for					very stiff white SILT with ran of weak low density angula	re angular fine to r white chalk and	coarse gravel angular fine			ý .
		22011111)					to coarse flint. (Lewes Nod	ular and Seaford	Chalk			20 -
Romarke							Koy					
Hardstanding I	oroken o	out. Cable percussion	drilling f	from 0.2	0m to co	mpleted c	depth. Groundwater	urbed Sample ronmental Sample	N/R - No Recovery HVP - Hand Vane	/ Shear Test		
not encountere	ed. Bac	KTILLED with arisings on	comple	etion.			B - Bulk U - Undis	Sample sturbed Sample face Sample	W/S - Water Strike		AG	S
1							VS - Vali	dation Sample				

	-									Borel	nole No.
SU	U									BH	i101
engineeri	ng ei	nvironments								Shee	et 3 of 3
Project Name:								Project No.:		Hole	э Туре
37 Broadwat Location:	ter Roa	ad, Welwyn Garder	n City					5608 Co-ords:	Level:	s	cale
Broadwater	Road,	Welwyn Garden C	ity					524186.43 E 212548.19 N	84.28m AOD	1	:50
Client: Bishonswoo	nd Esta	ates I to						Start Da	tes: Finish 30/09/2019	Log	ged By
S	ample	and In Situ Testin	g		Depth	Level	<b>.</b>	-	00,00,2010		
Depth (m)	Туре	SPT/U blow	HVP (KPa)	PID (ppm)	(m)	(m)	CHALK recovered as: Stru	Description	Legend		
20.50 21.00 - 21.45 21.00	D37 D38 SPT	50 (6,11/50 for 225mm)					very stiff white SILT with ra of weak low density angula to coarse flint. (Lewes Nod Formation)	angular fine to ar white chalk and ular and Seaford	coarse gravel angular fine Chalk		21
22.00	D39	2201111)									22 -
22.50 22.50	D40 SPT	N=50 (7,9/13,13,14,10)									23 -
23.50	D41										
24.00 24.00	D42 SPT	50 (9,14/50 for 225mm)									24 -
24.50	D43	,									
25.00 25.00	D44 SPT	50 (9,10/18,22,10,)									25 -
					25.45	58.83	End of Bore	shole at 25.450m			
Remarks Hardstanding I not encountere	oroken o ed. Bac	but. Cable percussion kfilled with arisings on	drilling f comple	rom 0.2 tion.	0m to co	 mpleted d	iepth. Groundwater B - Distres- ES-Env B - Bulk U - Undi SS - Su VS - Val W - Wat	urbed Sample ironmental Sample Sample sturbed Sample face Sample dation Sample er Sample	N/R - No Recovery HVP - Hand Vane W/S - Water Strike	Shear Test	AGS

ch										Borel	nole No.
SU	U									BH	1102
engineer	ing ei	nvironments		_						Shee	et 1 of 3
Project Name: 37 Broadwa	tor Po	ad Wolwyn Gardor	City					Project No.:		Hole	е Туре Ор
Location:		ad, weiwyn Garder	loity					Co-ords:	Level:	s	cale
Broadwater	Road,	Welwyn Garden C	ity					82418.36 E 212536.40 N	84.17m AOD	1	:50
Client: Bishopswoo	od Esta	ates Ltd						Start 26/09/2019	<sup>tes:</sup> Finish 27/09/2019	Log	ged By JM
	Sample	and In Situ Testin	g	-	Depth	Level					
Depth (m)	Туре	SPT/U blow	HVP (KPa)	PID (ppm)	(m)	(m)	Stratum	Description		Legend	vveii
0.30	D1 SPT	N=13 (2,3/3,2,4,4)			0.10	84.07 83.77	MADE GROUND: Tarmaca MADE GROUND: Brown gi clayey SAND. Gravel is ang brick, concrete, flint, tarmaca Stiff orange brown slightly s Gravel is angular to rounde (Lowestoft Formation)	dam hardstandin ravelly and locally gular to rounded t cadam, metal and sandy slightly gra d fine to coarse o	g. / very gravely fine to coarse I timber. velly CLAY. chalk and flint.		
1.20 - 1.65	D2				1 40	00 77					
1.50 2.00 - 2.45 2.00 2.50	D3 D4 SPT D5	N=20 (2,4/4,6,5,5)			1.40	82.77	Firm orange brown sandy to frequent angular to subang and rare chalk. (Lowestoft I	o very sandy CLA ular fine to coarse Formation)	AY with e gravel of flint		2
3.00 - 3.45 3.00	D6 SPT	N=19 (3,3/4,5,5,5)			3 40	80 77					3 -
3.50	D7				0.10		Medium dense orange brow rounded fine to coarse GRA Formation)	vn sandy clayey a AVEL of flint. (Lov	angular to vestoft		
4.00 4.00	D8 SPT	N=16 (2,3/3,3,5,5)			4 40	79 77					4 -
4.50	D9				4.40	13.11	Stiff brown gravelly CLAY. ( fine to coarse flint, chalk an Formation)	Gravel is angular nd mudstone. (Lov	to rounded westoft		
5.00 - 5.45 5.00	D10 SPT	N=22 (4,4/5,5,6,6)									5 -
5.50	D11										
6.00 - 6.45 6.00	D12 SPT	N=29 (4,5/6,6,8,9)					Slightly sandy.	_		· · · · · · · · · · · · · · · · · · ·	6 -
6.50	D13										
7.00 7.00	D14 SPT	N=28 (3,5/5,7,7,9)			6.90	77.27	Medium dense to dense ora rounded fine to coarse GRA Formation)	ange brown sand AVEL of flint. (Lov	y angular to vestoft		7 -
7.50	D15										
8.00 8.00	D16 SPT	N=35 (4,6/6,9,9,11)									8 -
8.50	D17										
9.00 9.00	D18 SPT	N=58 (5,7/9.13,17.19)									9 -
9.50	D19										
10.00	D20				9.90	74.27					10 -
Remarks Hardstanding encountered.	broken o Backfille	u out. Cable percussion ed with arisings on cor	drilling f	from 0.1	m to com	upleted de	Pepth. Groundwater not B- Disru B- Buik U - Undis S5 - Surt	Irbed Sample ronmental Sample Sample sturbed Sample face Sample	N/R - No Recovery HVP - Hand Vane 5 W/S - Water Strike	Shear Test	AGS

										Bore	ehole No.	
SU	U									BI	H102	
engineer	ing ei	nvironments								She	et 2 of 3	
Project Name:								Project No.:		Ho	le Type	
37 Broadwa	ter Roa	ad, Welwyn Garder	n City					5608 Co-ords:	Level:		CP Scale	
Broadwater	Road,	Welwyn Garden C	ity					82418.36 E 212536.40 N	84.17m AOD		1:50	
Client:	ad Eat							Start Da	ites: Finish	Logged By		
BISHOPSWOO	Sample	and In Situ Testin	g		Denth	Level		26/09/2019	27/09/2019			
Depth (m)	Туре	SPT/U blow	HVP (KPa)	PID (ppm)	(m)	(m)	Stratum	Description		Legend	∛ Well	
10.00	SPT	N=17 (2,3/3,4,5,5)					CHALK recovered as: Stru-	ctureless CHALK	composed of			
10.50	D21						and locally gravelly SILT. G fine to coarse weak low de occasional angular fine to o and Seaford Chalk Formati	ravel is angular t nsity white chalk coarse flint. (Lew on).	o subangular and es Nodular		-	
11.00 11.00	D22 SPT	N=24 (3,4/4,6,6,8)									11 -	
11.50	D23										-	
12.00 12.00	D24 SPT	N=16 (2,3/3,3,4,6)									12 -	
13.00 13.00	D25 SPT	N=28 (6,6/6,5,8,9)									13 -	
13.50	D26				13.40	70.77	CHALK recovered as: Strue firm light grey and cream si angular fine to coarse weal	ctureless CHALK lightly gravelly SI k low density whi	composed of LT. Gravel is te and locally		-	
14.00 14.00	D27 SPT	N=35 (5,8/8,7,9,11)					light grey chalk and rare ar (Lewes Nodular and Seafo	ngular fine to coa rd Chalk Formati	rse flint. on)		14 -	
14.50	D28										-	
15.00 15.00	D29 SPT	N=50 (9,11/50 for 225mm)									15 -	
16.00	D30										16 -	
16.50 16.50	D31 SPT	N=50 (7,7/50 for 225mm)										
17.50	D32				17.40	66.77	CHALK recovered as: Strue firm white and cream slight SILT. Gravel is angular to s	ctureless CHALK ly gravelly and lo ubangular fine to	composed of cally gravelly coarse weak		-	
18.00 18.00	D33 SPT	N=50 (9,13/50 for 225mm)					low density white chalk and coarse flint. (Lewes Nodula Formation).	d occasional angu ar and Seaford Cl	ular fine to halk		18 -	
19.00	D34										-	
20.00	D35										20 -	
Remarks Hardstanding encountered.	broken o Backfille	out. Cable percussion ed with arisings on cor	drilling f	irom 0.1	m to com	pleted de	pth. Groundwater not B - Bulk U - Undit SS - Sur VS - Vali W - Wate	urbed Sample ronmental Sample Sample sturbed Sample face Sample dation Sample rr Sample	N/R - No Recovery HVP - Hand Vane : W/S - Water Strike	Shear Test	AGS	

										Во	rehc	le No.	
SU	U									В	H'	102	
engineeri	ing ei	nvironments								Sh	ieet	3 of 3	
Project Name:	4 D .		0.4					Project No.:		н	ole .	Туре	
Location:	ter Ro	ad, weiwyn Gardei						Co-ords:	Level:		Sca	Pale	
Broadwater	Road,	Welwyn Garden C	ity					82418.36 E 212536.40 N	84.17m AOD		1:5	50	
Client:								Start Da	tes: Finish	Logg		ed By	
BISHOPSWOO	Sample	ates Lto e and In Situ Testin	q		Denth	1		26/09/2019	27/09/2019		AJ	IVI	
Depth (m)	Туре	SPT/U blow	HVP (KPa)	PID (ppm)	(m)	(m)	Stratun	n Description		Legend	S/M	Well	
Depth (m) 20.00	SPT	SP1/U blow N=50 (25 for 75mm/50 for 20mm)	(KPa)		(m) 20.45	(m) 63.72	CHALK recovered as: Stru firm white and cream sligh SILT. Gravel is angular to low density white chalk an coarse flint. (Lewes Nodul Formation). End of Bor	uctureless CHALK thy gravelly and lo subangular fine to d occasional angu- ar and Seaford Ch ehole at 20.450m	composed of cally gravelly coarse weak lar fine to nalk				
													29
Remarks Hardstanding encountered.	broken Backfill	out. Cable percussion ed with arisings on cor	drilling f	from 0.1	m to com	pleted de	pth. Groundwater not ES-Em B - Bulk U - Und SS - Su	rurbed Sample vironmental Sample Sample isturbed Sample rface Sample	N/R - No Recovery HVP - Hand Vane S W/S - Water Strike	Shear Test		AG	S

chr	1									Bo	reho	ole No.			
SU	U											BH103			
engineeri	ng er	nvironments								Sh	neet	1 of 3			
Project Name:								Project No.:		н	lole	Туре			
37 Broadwa	ter Roa	ad, Welwyn Garder	n City					5608	Loveli		<u>C</u>				
Broadwater	Road,	Welwyn Garden Ci	ity					524193.34 E 212563.49 N	84.13m AOD		1:	ale 50			
Client:		•	•					Start Da	tes: Finish	Lo	ogge	ed By	-		
Bishopswoo	d Esta	ates Ltd				-	1	27/09/2019	27/09/2019		AJ	M			
	Sample	and In Situ Testing	g HVP	PID	Depth	Level	Stratum	Description		Legend	S/N	Well			
Depth (m)	Туре	SP1/U blow	(KPa)	(ppm)	(m)	(m)			ubtly clayov		>				
							SAND. Gravel is angular to	subrounded fine	to coarse						
0.50	D1						flint, brick, concrete, metal,	, timber, plastic ar	nd ceramic.				-		
0.80	D2				0.75	83.38	Firm orange brown sandy	slightly gravelly C	LAV Gravel is				-		
1.00 - 1.45	D3						angular to subangular fine	to coarse flint. (Lo	owestoft				1 —		
1.00	SPT	N=9 (2,2/2,2,2,3)					Formation)						-		
1.50	D4									· · · · · · · · ·			-		
													-		
2.00 - 2.45	D5									· · · · · ·			2 —		
2.00	SPT	N=3 (1,1/0,1,1,1)											-		
2.50	D6												-		
										· · · · ·			-		
3.00 - 3.45	D7						Mottled brown below 3.00m			· · · · ·			3 —		
3.00	SPT	N=4 (1,1/1,1,1,1)													
3.50	D8												-		
										· · · · · · ·			-		
4.00 - 4.45	D9						Occasional pockets (<10cm) o	of orange brown cla	ayey gravelly				4 -		
4.00	351	N-4 (1,1/1,1,1,1)					SAND. Gravel is angular fine t	o coarse flint.					-		
4.50	D10														
					4 90	79.23							-		
5.00 - 5.45 5.00	D11 SPT	N=2 (1.1/0.0.1.1)			1.00	10.20	Soft and locally firm orange slightly gravelly CLAY with	e brown locally sli occasional pocke	ghtly sandy ets (<5mm) of	· · · · · ·			5 —		
		()					black organic clay. Gravel i coarse flint and rare ironsto	is angular to suba one. (Lowestoft F	ngular fine to ormation)	· · · · · ·			-		
5.50	D12							·	,				-		
										· · · · ·			-		
6.00 - 6.45 6.00	D13 SPT	N=4 (1,0/1,1,1,1)								* * * * *			6 -		
0.50	5.1.1											XX	-		
6.50	D14														
7.00 7.45	DAG														
7.00 - 7.45	SPT	N=3 (1,0/0,1,1,1)								· · · · · ·					
7 50	D16												-		
1.00	DIO												-		
8.00 - 8.45	D17									· · · · · · ·			8 -		
8.00	SPT	N=1 (1,1/0,0,0,1)													
8.50	D18												-		
													-		
9.00 - 9.45	D19									· · · ·		XX	9 —		
9.00	SPT	N=2 (1,0/0,1,1,0)								* * * * *					
9.50	D20									· · · · · ·			-		
												XXX XXXX	-		
10.00 - 10.45	D21									* * * * * *			10 —		
Remarks	I		I	1	L	I	Кеу	unte d O a st							
Cable percuss Backfilled with	ion drilli arisings	ng from ground level to 3.	o compl	eted de	pth. Gro	undwater	not encountered. D - Distri ES- Envi B - Bulk	ironmental Sample Sample	N/K - No Recovery HVP - Hand Vane W/S - Water Strike	Shear Test					
	-						U - Undi: SS - Sur VS - Vali W - Wate	sturbed Sample face Sample dation Sample er Sample				AG	2		

chr										Во	reh	ole No.	
SU	U									B	BH	103	
engineeri	ng er	nvironments								Sł	neet	2 of 3	
Project Name:								Project No.:		F	lole	Туре	
37 Broadwat	ter Roa	ad, Welwyn Garder	n City					5608 Co-ords:	Level:		C Sc	;P ale	
Broadwater	Road,	Welwyn Garden Ci	ity					524193.34 E 212563.49 N	84.13m AOD		1:	50	
Client:								Start Da	tes: Finish	L	ogg	ed By	
Bishopswoo	d Esta	ates Ltd	<u>a</u>					27/09/2019	27/09/2019		A	JM I	
Depth (m)	Type	SPT/U blow	HVP	PID	Depth (m)	Level (m)	Stratum	Description		Legend	W/S	Well	
10.00	SPT	N=2 (1,0/0,1,0,1)	(KPa)	(ppm)			Soft and locally firm orange slightly gravelly CLAY with	e brown locally sli occasional pocke	ghtly sandy ets (<5mm) of	· · · · ·	-		
10.50	D22				10.40	73.73	black organic clay. Gravel i coarse flint and rare ironsto Soft orange brown slightly angular to subrounded fine	is angular to suba one. (Lowestoft Fo gravelly sandy Cl to coarse flint an	ngular fine to ormation) _AY. Gravel is id ironstone				-
11.00 - 11.45 11.00	D23 SPT	N=3 (1,0/1,1,1,0)					(Lowestoft Formation)						11 –
11.50	D24												
12.00 - 12.45 12.00	D25 SPT	N=4 (1,1/1,0,1,2)											12 –
12.50	D26				12.45	71.68	CHALK recovered as: Stru- soft cream mottled orange angular fine to coarse very	ctureless CHALK brown gravelly S weak low density	composed of ILT. Gravel is white and				-
13.00 - 13.45 13.00	D27 SPT	N=3 (1,1/0,1,1,1)					cream chalk with rare black Seaford Chalk Formation)	k specks. (Lewes	Nodular and		-		13 —
13.50	D28										-		-
14.00 - 14.45 14.00	D29 SPT	N=3 (1,0/1,1,0,1)									-		14 -
14.50	D30										-		-
15.00 15.00	D31 SPT	N=0 (1,1/0,0,0,0)									-		15 —
15.50	SPT	N=9 (3,3/3,2,2,2)									-		-
16.00	D32						Pocoming firm				-		16 —
16.50 16.50	D33 SPT	N=12 (3,3/3,2,3,4)									-		-
					17.00	67.13	CHALK recovered as: Strue firm white and locally crear angular fine to coarse weal	ctureless CHALK n very gravelly SI k low density whit	composed of LT. Gravel is te chalk.		-		17 —
17.50	D34						(Lewes Nodular and Seafo	rd Chalk Formation	on)		-		-
18.00 18.00	D35 SPT	N=13 (2,2/2,3,4,4)									-		18 -
19.00	D36										-		19 -
20.00	D37										-		20 —
Remarks		I	1	1	1	1	Key			1			
Cable percuss Backfilled with	ion drilli arisings	ng from ground level to S.	o compl	eted de	pth. Grou	undwater	not encountered. B - Buk U - Undis S - Sur VS - Vali W - Wate	urbed Sample ironmental Sample Sample sturbed Sample face Sample dation Sample er Sample	N/R - No Recovery HVP - Hand Vane W/S - Water Strike	Shear Test		AG	S

										Bore	hole No.
SU	U									Bł	1103
engineeri	ing er	nvironments								She	et 3 of 3
Project Name:								Project No.:		Ho	le Туре
37 Broadwa	ter Roa	ad, Welwyn Garder	n City					5608	l evel:		
Broadwater	Road,	Welwyn Garden C	ity					524193.34 E 212563.49 N	84.13m AOD		1:50
Client:								Start Da	ites: Finish	Log	iged By
Bishopswoo	od Esta Samole	ates Ltd and In Situ Testin	a					27/09/2019	27/09/2019	· · · ·	AJM
Depth (m)	Туре	SPT/U blow	9 HVP (KPa)	PID (ppm)	Depth (m)	Level (m)	Stratur	n Description		Legend	Well
20.00	SPT	N=24 (5,4/4,5,7,8)	<b>`</b>				CHALK recovered as: Stru firm white and locally crea	uctureless CHALk	composed of		
					20.45	63.68	angular fine to coarse wea	ak low density whi	te chalk.		
							End of Bor	rehole at 20.450m	/		
											21 -
											-
											-
											-
											22 —
											-
											-
											23 -
											-
											24 -
											-
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											25 -
											-
											26 —
											-
											27 —
											28 -
											29
											30 —
Remarks		<u> </u>					Key	rurhed Sample	N/R - No Pecovor	,	
Cable percussion drilling from ground level to completed depth. Groundwater not encountered. Backfilled with arisings.										Shear Test	AGS

ch										Bo	reh	ole No.	
SU	U									B	ЗH	104	
engineer	ing e	nvironments								Sł	neet	1 of 3	
Project Name:								Project No.:		F	lole	Туре	
37 Broadwa	ter Ro	ad, Welwyn Garder	City					5608	1		C	P	
Location: Broadwater	Road	Welwyn Garden Ci	tv					Co-ords: 524231.29 E 212558 13 N	Level: 84.17m AOD		Sc 1·	ale 50	
Client:	Roau,	Welwyn Garden C	Ly					212006.10 N	ites: Einich	L	ogg	ed By	
Bishopswoo	od Esta	ates Ltd						25/09/2019	26/09/2019		A.	JM	
5	Sample	e and In Situ Testin	g		Depth	Level	Stratum	Description		Logond	S/	Wall	
Depth (m)	Туре	SPT/U blow	(KPa)	(ppm)	(m)	(m)	Stratum	Description		Legenu	≥	vven	
					0.15	84.02	MADE GROUND: Tarmaca	dam hardstandir	ig. v clavev				
0.30	D1				0.25	83.92	angular to subangular fine	to coarse GRAVI	EL of		0000		
0.70	D2				0.60	83.57	MADE GROUND: Soft brov	vn slightly sandy	gravelly				
4.00 4.45					0.90	83.27	CLAY. Gravel is angular to concrete, brick, timber and	rounded fine to o rare glass. (Low	oarse flint, estoft		-		
1.00 - 1.45	SPT	N=12 (2,3/3,3,3,3)					Formation) Soft orange brown locally s	lightly sandy gra	vellv CLAY		-		1 -
							with occasional pockets (<	5mm) of black or	ganic clay.		1		
1.50	D4						(Lowestoft Formation)				-		-
							Stiff orange brown locally s with rare pockets (<3mm) of	lightly sandy gra of black organic o	velly CLAY lay. Gravel is				
2.00 - 2.45 2.00	D5 SPT	N=18 (2,4/4,6,4,4)					angular to rounded fine to o	coarse flint and c	halk.				2 -
					2.40	81.77				· · · · ·	-		
2.50	D6					-	sandy CLAY. Gravel is ang	gravelly sandy a ular to subround	nd locally very ed fine to				-
							coarse flint and chalk. (Low	estoft Formation	)				
3.00 - 3.45 3.00	D7 SPT	N=20 (3.3/3.5.5.7)									_		3 -
					3 40	80 77							
3.50	D8				0.10		Firm and locally stiff orange CLAY. Gravel is angular to	e brown slightly s subangular fine f	andy gravelly o coarse chalk		-		
							and flint. (Lowestoft Forma	tion)			-		
4.00 - 4.45	D9 SPT	N=30 (2 5/6 6 10 8)									5		4 -
											-		
4.50	D10										5		-
											2		
5.00 - 5.45	D11 SPT	N=28 (3 5/6 6 8 8)									, ,		5 —
0.00					5 40	79 77				· · · · · · ·	2		
5.50	D12				5.40	10.11	Orange brown gravelly slig angular to rounded fine to c	htly clayey SANE coarse flint. (Low	). Gravel is estoft				-
					F 00	70 07	Formation)	,					
6.00 - 6.45	D13				5.90	10.21	Stiff orange brown slightly s	sandy gravelly C to coarse flint an	LAY. Gravel is d chalk	· · · · · · ·	, ,		6 —
0.00	JE I	N-24 (3,3/4,4,7,8)					(Lowestoft Formation)				,		
6.50	D14										;		- 1
7.00 - 7.45	D15	N-20 (2 2/6 7 7 10)									-		7 -
7.00	351	N=30 (2,3/0,7,7,10)								· · · · · ·	-		
7.50	D16									· · · · · ·	-		-
					7.00	70.07					1		
8.00	D17				7.90	/6.27	Dense orange brown sandy	angular to roun	ded fine to				8 -
8.00	501	N=40 (4,6/8,10,11,11)						weston ronnau	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
8.50	D18										•		-
											•		
9.00	D19										e		9 -
9.00	SPT	N=44 (5,7/9,9,12,14)									•		
9.50	D20										•		-
10.00	D21										4		10 —
Remarks	L	<u> </u>					Kev			1			L
Hardstanding	broken	out. Cable percussion	drilling	from 0.1	5m to coi	mpleted d	epth. Groundwater	rbed Sample	N/R - No Recover HVP - Hand Vane	y Shear Test			
encountered a	u ∠1.2m	i. Backfilled with arising	ys on c	ompletic	or).		B - Bulk U - Undis	Sample sturbed Sample	W/S - Water Strike	9		AGS	3
							VS - Vali W - Wate	dation Sample					

										Boreh	nole No.
SU	U									BH	104
engineeri	ing e	nvironments								Shee	et 2 of 3
Project Name:								Project No.:		Hole	е Туре
37 Broadwa Location:	ter Ro	ad, Welwyn Gardei	n City					5608 Co-ords:	Level:	S	JP cale
Broadwater	Road,	Welwyn Garden C	ity					524231.29 E 212558.13 N	84.17m AOD	1	:50
Client: Bishonswor	nd Fet	atos I tri						Start Da	tes: Finish	Logg	ged By
Sistiopswee	Sample	e and In Situ Testin	g		Denth	Level		20/00/2010	20/00/2010	<u>ر</u>	
Depth (m)	Туре	SPT/U blow	HVP (KPa)	PID (ppm)	(m)	(m)	Stratum	Description		Legend	Well
10.00	SPT	N=35 (7.10/12.15.4.4)	(* ** -×)	(F F · · · /			Dense orange brown sandy coarse GRAVEL of flint. (Lo	y angular to round owestoft Formatic	ded fine to		
10 50	D22								,		- 100 -
10.00	DLL										
11.00	D23										11 -
11.00	SPT	N=50 (6,8/10,12,15,13)									
11.50	D24										-
12.00 12.00	D25 SPT	N=40 (5,9/9,11,13,7)									12 -
12.50	D26										
12.50	020						Locally slightly clayey below 12	<u>2.5</u> m.			
13.00	D27										13 -
13.00	SPT	N=50 (7,10/50 for 180mm)									
13.50	D28										-
14.00 14.00	D29 SPT	N=51									14 -
44.50	<b>D</b> 00	(6,9/9,12,14,16)									
14.50	D30										
15.00	D31										15 -
15.00	SPT	N=42 (7,7/6,10,12,14)									
											-
16.00	D32										16 -
16 50	222										
16.50 16.50	D33 D34										
10.50	571	N=41 (0,0/7,9,12,13)									17 -
17.50	D35										-
18.00 18.00	D36 SPT	N=51									18 -
		(5,8/9,12,15,15)									
19.00	D37										19 -
19.50	D38				19.40	64.77	Stiff orange brown gravelly	slightly sandy CL	AY. Gravel is		-
19.50	SPT	N=27 (4,5/5,6,8,8)					Formation)	Joarse IIIII. (LUW	JUIL		
											20 -
Remarks					<b>-</b> .		Key	urbed Sample		,	
Hardstanding encountered a	broken it 21.2m	out. Cable percussion . Backfilled with arisin	arilling f igs on c	rom 0.1 ompletic	om to co n.	mpleted c	ieptn. Groundwater ES-Envi ES-Envi B - Bulk U - Undi SS - Suri VS - Vali	ronmental Sample Sample sturbed Sample face Sample dation Sample	HVP - Hand Vane W/S - Water Strike	Shear Test	AGS

	-									Bore	hole No.
SU	U									BI	H104
engineeri	ng er	nvironments								She	et 3 of 3
Project Name:	0							Project No.:		Ho	le Type
37 Broadwar	ter Roa	ad, Welwyn Garder	n City					5608	Lavel		CP
Broadwater	Road,	Welwyn Garden C	ity					524231.29 E 212558.13 N	84.17m AOD		1:50
Client:			-					Start Da	ites: Finish	Log	gged By
Bishopswoo	d Esta	ates Ltd and In Situ Testin	a					25/09/2019	26/09/2019		AJM
Depth (m)	Туре	SPT/U blow	9 HVP (KPa)	PID (ppm)	Depth (m)	Level (m)	Stratum	Description		Legend	Well
20.50	D39						Stiff orange brown gravelly angular to rounded fine to o Formation)	slightly sandy Cl coarse flint. (Low	LAY. Gravel is estoft		
21.00 - 21.45 21.00 22.00	D40 SPT	N=15 (2,4/3,4,4,4)			21.20	62.97	Structureless CHALK comp clayey SILT. Gravel is very to coarse soft white and lig fine to coarse flint. (Lewes Formation)	prised of stiff whit weak low density ht grey with occa Nodular and Sea	e gravelly / angular fine sional angular ford Chalk		21
22.50 - 22.95	D42	N=E0 (7.19/50 for			22.40	61.77	Structureless CHALK comp	orised of firm whi	te clayey SILT.		
22.50	581	N=50 (7,18/50 for 45mm)									23 -
23.50	D43				23.40	60.77	Structureless CHALK comp SILT. Gravel is weak low de and white chalk . (Lewes N Formation)	orised of firm whi ensity angular fin odular and Seafo	te gravelly e to coarse ord Chalk		
24.00 - 24.45 24.00	D44 SPT	N=50 (25 for 75mm/50 for 15mm)			23.90	60.27	Structureless CHALK comp (Lewes Nodular and Seafo	orised of firm whi rd Chalk Formati	te clayey SILT. on)		24
25.00	D45				25.00	59.17	End of Bore	shole at 25.000m			26
Remarks Hardstanding I encountered a	proken o t 21.2m	out. Cable percussion . Backfilled with arisin	drilling t gs on c	from 0.1 ompletic	5m to col on.	mpleted d	lepth. Groundwater B - Bulk U - Undi S - Surv V - Vali W - Wate	urbed Sample ronmental Sample Sample sturbed Sample face Sample dation Sample er Sample	N/R - No Recovery HVP - Hand Vane W/S - Water Strike	/ Shear Test	AGS

Ch	rucho							Pr	obe No.
SU								D	P101
enginee	ring environments	5						Sh	eet 1 of 1
Project Name	e:					Project No:		He	ole Type
37 Broadw	ater Road, Welwyn Gar	den City				5608	Loval		DP
Broadwate	er Road, Welwyn Garder	n City				524212.08 E 212564.08 N	84.20m AOD		1:50
Client:						D	ates End		
Bishopswo	ood Estates Ltd					25/09/2019	25/10/2019		
Depth			В	Blows/100mm					Torque
(m)		10 21	0	30	ſ	2	10	5	(Nm)
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Remarks				Fall Height	750	mm Cone Dia	meter 50	mm	
Dynamic pro with arisings	be borehole from ground lev on completion.	vel to completed depth. Back	filled	Hammer Weight	64	kg Final Dep	th 7.87	7 m	AGS
				Probe Type	DPSH-	-B			nao

ch	rucho								Pr	obe No.
<b>DLI</b>									D	P102
engineer	ring environments					_			Sh	eet 1 of 1
Project Name	e:					Project No:			H	ole Type
37 Broadw	ater Road, weiwyn Gar	den City				Co-ords		Level		Scale
Broadwate	er Road, Welwyn Garder	n City				524220.45 212561.85	E N	84.16m AOD		1:50
Client:	ad Estates I td					Start	Date	End		
BISHOPSWC						25/09/201	9	25/10/2019		
Depth			E	Blows/100mm						Torque
(11)	<b>0</b> 1	0 2	0	3	0		40		5	0
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Remarks				Fall Height	750 i	mm Cone I	Diame	eter 50	mm	·
Dynamic pro	be borehole from ground lev	el to completed depth. Back	filled	Hammer Weight	64	kg Final Γ	Depth	6 40	) m	
with arisings	on completion.			Probe Type		kg  ⊢inai Depth 6.40 				AGS
				i ione i àhe	0-34-	0				

Ch	rucho								Pr	robe No.
SU									D	P103
engineer	ring environments								Sh	eet 1 of 1
Project Name	e:					Proje	ct No:		H	ole Type
Location:	ater Road, weiwyn Gard	den City				5608	o-ords	Level		Scale
Broadwate	r Road, Welwyn Garder	n City				524 212	225.45 E 2560.18 N	84.16m AOD		1:50
Client: Bishonswo	od Estatos I td					25	Da Start	End		
Dishopswe						20	103/2013	23/10/2013		
Depth (m)			В	lows/100mm						Torque (Nm)
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Remarks				Fall Height	750 r	nm	Cone Dian	neter 50	mm	
Dynamic prol with arisings	be borehole from ground lev on completion.	el to completed depth. Backfi	illed	Hammer Weight	64 k	g	Final Dept	h 6.67	7 m	AGS
				Probe Type DPSH-						HIGHE

CH	ructo								P	robe No.
JU									D	P104
engineer	ring environments	S							Sh	eet 1 of 1
Project Name	e: vater Road, Welwyn Gar	den City				Proje	ect No: R		Н	ole Type
Location:						(	Co-ords	Level		Scale
Broadwate	er Road, Welwyn Garder	n City				212	2557.75 N Da	84.15m AOD	)	1:50
Bishopswo	ood Estates Ltd					26	Start 5/09/2019	End 26/09/2019		
Dauth				Blows/100mm		•				T
(m)			Ľ	Slows/Toomin						(Nm)
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Remarks			c.u. •	Fall Height	750	mm	Cone Dian	neter 5	0 mm	
with arisings	on completion.	med	lled Hammer Weight 64 kg		kg Final Depth 10.00		0.00 m	AGS		
			Probe Type DPSH		-В					

ch	rucho								Pr	obe No.
SLI									D	P105
engineer	ring environments	<u> </u>							She	eet 1 of 1
Project Name	e: vator Road, Wolwyn Gar	don City				Proje	ect No: R		Ho	ole Type סס
Location:	ater Koad, Welwyn Gar					5000	Co-ords	Level		Scale
Broadwate	er Road, Welwyn Garder	n City				21	4200.64 E 2544.69 N Da	84.23m AOD		1:50
Bishopswo	ood Estates Ltd					27	Start 7/09/2019	End 27/09/2019		
Donth			F	Blows/100mm						Torquo
(m)				Blows/Toomin						(Nm)
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Remarks				Fall Height	750	mm	Cone Dian	neter 50	mm	
Dynamic pro	be borehole from ground lev on completion.	vel to completed depth. Back	filled	Hammer Weight	64	kg	Final Dept	h 10.0	10 m	AGS
	,			Probe Type	DPSH	-В	•			AUO

CH	rucho								Pr	obe No.
<b>DL</b>									D	P106
enginee	ring environments								Sh	eet 1 of 1
Project Nam		1 O''				Project No:			H	ole Type
Location:	ater Road, weiwyn Gar	aen City				Co-ords		Level		Scale
Broadwate	er Road, Welwyn Garder	n City				524194.27 212545.78	E N	84.21m AOD		1:50
Client:						Start	Date	End		
Bisnopswo						27/09/2019	1	27/09/2019		
Depth			E	Blows/100mm						Torque
(m)		0 20	)	30	0		40		5	(Nm) 0
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Bomorke	9				750			tor 50		
Dynamia pro	the horehole from ground low	al to completed depth. Beels	filled	rail Height	750		Jiame	eler 50	mm	
with arisings	s on completion.		filled Hammer Weight 64		kg Final Depth 10.00		00 m	AGS		
				Probe Type DPSH-B						

CH	rucho								Pr	obe No.
<b>SU</b>									D	P107
enginee	ring environments	S							She	eet 1 of 1
Project Nam	e: vator Road, Wolwyn Gar	don City				Proje	ect No:		Ho	ole Type
Location:	ater Road, Weiwyn Car						Co-ords	Level		Scale
Broadwate	er Road, Welwyn Garder	n City				212	2545.72 N	84.28m AOD		1:50
Bishopswo	ood Estates Ltd					27	Start 7/09/2019	End 27/09/2019		
				2 January / 1 0 0 mm						-
Depth (m)				Slows/Toomin						Iorque (Nm)
	0 1	10 20	0	30	0		4	0	5	0
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	7									
-	2 1 2									
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- 5	3									
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Ē	18 17 15									
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Ē	13 14									
Remarks		·		Fall Height	750	mm	Cone Dian	neter 50	mm	
Dynamic pro	be borehole from ground lev	vel to completed depth. Back	filled	Hammer Weight	64	ka	Final Dept	h 10 (	)0 m	
with arisings	on completion.					4 kg  Final Depth 10.0			AGS	
				горе туре	DR2H	-D				

Ch	rucho								Pr	obe No.
SU									D	P108
enginee	ring environments								She	eet 1 of 1
Project Name	e:	_				Proje	ect No:		Ho	ые Туре
37 Broadw	ater Road, Welwyn Gar	den City				5608	3	Level		DP Scale
Broadwate	er Road, Welwyn Garder	n City				524 212	4181.16 E 2549.81 N	84.38m AOD		1:50
Client:							Da Start	ites End		
Bishopswo	ood Estates Ltd					27	7/09/2019	27/09/2019		
Depth			E	Blows/100mm						Torque
(m)		0 20	h	30	h		4	n	5	(Nm)
-		22								
	18	37								
E	4 3									
E										
	3									
-	2									
-										
- 2	2									
-	6 6 6									
-	7 7 7									
	8 8									
- - 3	9 7 7 7									
-	10									
	7									
F	<u>5</u> 4 5									
- - 4 -	5									
E	8 7									
-	<u>3</u> 5 8									
-	7 9									
5 	3									
-	<u>3</u> 3									
-	3									
- - -	5 5 4									
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	11 10 15									
	15	28				_				
- - 7		34 37								
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-										
E										
9										
F										
E										
-										
Remarks				Fall Height	750	mm	Cone Dian	neter 50	mm	
Dynamic pro	be borehole from ground lev	el to completed depth. Backl	filled	Hammer Weight	64	kg	Final Dept	h 7.00	) m	
with arisings	on completion.			Probe Type	DPSH.	-В				AGS
1					2. 011	-				

ch	rucho								Pr	obe No.
SU									D	P109
engineer	ring environments								Sh	eet 1 of 1
Project Name	e:					Projec	t No:		H	ole Type
37 Broadw	ater Road, Welwyn Gard	den City				5608 C	o-ords	Level		DP Scale
Broadwate	r Road, Welwyn Garder	City				5241 2125	185.84 E 553.09 N	84.30m AOD		1:50
Client:						:	Da Start	tes End		
Bishopswo	Dod Estates Ltd					27/0	09/2019	27/09/2019		
Depth			E	Blows/100mm						Torque
(m)	0 1	0 20	0	3	D		40	)	5	(Nm) 0
		33					_			
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Ę	<u>4</u> <u>2</u> 2									
	2									
	2									
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E	5 6									
2	6 5 5									
	5									
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— 3 —	7 9									
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E	6 6 6									
- 4	7 6 5									
	3									
	5									
E	6 4									
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Ē	3									
- - -	4 4 5									
-	<u>5</u> 5 6									
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- 7	13	23								
-		28 32 32								
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-										
8										
F										
F										
- 9										
Ē										
F										
E										
-									T	
Remarks				Fall Height	750 r	mm (	Cone Diam	neter 50	mm	
Dynamic pro with arisings	be borehole from ground lev on completion.	el to completed depth. Back	filled	Hammer Weight	64 I	kg F	Final Deptl	n 7.40	) m	AGS
				Probe Type	DPSH-	В				

	rucho								P	robe No.
SU							D	P110		
engineer	ring environments	ò							Sh	eet 1 of 1
Project Name	9:					Proje	ect No:		н	ole Type
37 Broadw	ater Road, Welwyn Gar	den City				5608	B Co-ords	ا مربعا		DP
Broadwate	r Road, Welwyn Garder	n City				52 21	4193.34 E 2563.49 N	84.13m AOD		1:50
Client:							Da Start	ites End		
Bishopswo	ood Estates Ltd					25	5/09/2019	25/09/2019		
Depth			E	3lows/100mm						Torque
(m)	0 1	0 20	0	30	)		40	0	ŧ	(Nm) 50
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	1									
-	2									
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E										
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	1									
E	1									
-	1 1 1									
- 5	1									-
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E	1 1 1									
-	1									
- - 6 -	1									-
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-	1									
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E	1									
F	1									
- - - 8										-
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F	1 2									
E	1									
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E	2 3									
F	3									
Ē	2 2 2 2									
Remarke	2	1		Fall Height	750	mm	Cone Diam	neter 50	) mm	1
Dynamic pro	be borehole from around lev	el to completed depth. Back	filled		64	ka	Finel Dan		, , , , , , , , , , , , , , , , , , ,	
with arisings	on completion.				04	кд	rinai Depti	n 10	1.UU M	AGS
				Probe Type	DPSH	-В				

CH									Pr	obe No.
DLI								D	P111	
engineer	ring environments								Sh	eet 1 of 1
Project Name	e:					Proje	ect No:		He	ole Type
37 Broadwa	ater Road, Welwyn Garo	den City				5608	3 Co-ords	l evel		DP Scale
Broadwate	r Road, Welwyn Garder	n City				52 21	4207.05 E 2553.14 N	84.25m AOD		1:50
Client:							Da Start	ites End		
Bisnopswo	Dod Estates Ltd					2/	//09/2019	27/09/2019		
Depth			В	Blows/100mm						Torque
(m)	<b>0</b> 1	0 20	0	30	)		4	0	5	(NM) 0
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	2 4 7									
Ē	5 3									
F	5									
- 2	5 6									
	6									
-	5									
	4									
- - 3	4									
-	<u>4</u> 5 6									
	5									
E	6 6									
- 4	6 3 7									
E	5									
E	5 5 5									
F	4									
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	3 3 3									
F	4									
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E	4 5 6									
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- - 7 -										
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F										
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Remarks				Fall Height	750	mm	Cone Dian	neter 50	mm	
Dynamic prot	be borehole from ground lev	el to completed depth. Back	filled	Hammer Weight	64	kg	Final Dept	h 6.8	0 m	ACS
ansings	en sompietion.			Probe Type	DPSH-	-В	1			AUD

CH	rucho								Pr	obe No.
DLI								D	P112	
engineer	ring environments								She	eet 1 of 1
Project Name	e:					Projec	ct No:		Ho	ole Type
37 Broadw	ater Road, weiwyn Gard	den City				5608 C	o-ords	Level		Scale
Broadwate	r Road, Welwyn Garder	n City				5242 2125	217.33 E 542.94 N	84.30m AOD		1:50
Client:						07/	Da Start	End		
DISTIOPSWC						27/	09/2019	27/09/2019		
Depth			E	Blows/100mm						Torque
(11)	0 1	0 20	0	30	)		40	0	5	0
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	4 4									
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	4									
- 3	4									
-	5 4 5									
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-	5									
4										
-	5 5 5									
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-	2									
5 	3									
-	3 3 3									
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E	13	23 23								
- 7	2	22 0 21								
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Remarke				Fall Height	750	mm (	Cone Diar	peter 50	mm	
Dynamic pro	be borehole from around lev	el to completed depth_Back	filled		130					
with arisings	on completion.				04	кg I	rınai Depti	1.60	, m	AGS
1				Probe Type	DPSH	-В				

	rucho								P	robe No.
SU									D	P113
engineer	ring environments	i i							Sh	eet 1 of 1
Project Name	e:					Proje	ect No:		н	lole Type
37 Broadw	ater Road, Welwyn Garo	den City				560	8 Co-ords	Level		DP Scale
Broadwate	r Road, Welwyn Garder	City					00 0140	2000		1:50
Client:							Da Start	ates End		
BISNOPSWO	Dod Estates Ltd					2	7/09/2019	27/09/2019	9	
Depth			E	Blows/100mm						Torque
(m)	↓ 1	0 20	0	30	)		4	0	:	(NM) 50
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-	6 6 5									
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	7 7 7									
F.	4 5 7									
- 3	7 5 5									
Ē	5									
E	6 4									
- - 4	4 4 6									_
	3									
F	2									
— 5 -	4 4 6									-
F	6 6 7									
-	7 7 6									
- 6	6 6 7									
E	7 7 7									
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-	10 10									
- 7	9 17									_
E	2	33 37								
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E										
- 8 -										-
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9										_
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F										
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Remarks	he herebels for or 11		<b>6</b> 11!	Fall Height	750	mm	Cone Diar	neter s	50 mm	
with arisings	on completion.	ei io completed depth. Back	IIIIEd	Hammer Weight	64	kg	Final Dept	h	7.40 m	AGS
				Probe Type	DPSH	I-B				

CH	rucho								Pr	obe No.
JU									D	P114
enginee	ring environments								Sh	eet 1 of 1
Project Name	e:	1 O't				Proje	ect No:		H	ole Type
37 Broadw	ater Road, weiwyn Gar	den City				5608	<b>b</b> Co-ords	Level		Scale
Broadwate	er Road, Welwyn Garder	n City								1:50
Client:	ad Fatataa L td						Da Start	End		
BISHOPSWO						23	5/09/2019	25/09/2019		
Depth			E	Blows/100mm						Torque
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-	5 4									
- 1	2 2									
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E	5 5 5									
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	4									
-	3									
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E	2 3 3									
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	5 4 8									
Ē'	10 9 8									
-	8 10 11									
Ē	10									
- 8	8 8 9									
-	9 7 8									
F	7 6 6									
E	8 7 7									
9	7									1
E	5									
F	4 5 5									
	5 6									
Remarks				Fall Height	750	mm	Cone Diar	neter 50	mm	
Dynamic pro with arisinos	be borehole from ground lev on completion.	el to completed depth. Backt	filled	Hammer Weight	64	kg	Final Dept	h 10.	00 m	AGS
				Probe Type	DPSH	-В				Auto

CH	rucho									Probe No.
SU										DP115
enginee	ring environments	S								Sheet 1 of 1
Project Nam	e:					Proj	ect No:			Hole Type
37 Broadw	ater Road, Welwyn Gar	den City				560	8 Co-ords	l evel		DP Scale
Broadwate	er Road, Welwyn Garder	n City					00 0100	Lovoi		1:50
Client:							Da Start	ates End		
Bisnopswo	DOD ESTATES LTD					2	5/09/2019	25/09/20	)19	
Depth			E	Blows/100mm						Torque
(m)		10 2	20	30	D		4	0		(NM) 50
	1									
E	2									
F	2 2									
- - - 1	2									
	<u> </u>									
-	5 6 5									
E	5									
2	7									
E	6 5 9									
-	6 6 7									
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— 3 _	7									
F	8 7 5									
Ē	7 6 6									
- 4	7									
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- - 5 -	2									
E	4 4									
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— 6 _	10 9									
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F	15 16									
- - - 7	2	20 27 25								
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- 8										
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9										
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Ē										
Remarks	•			Fall Height	750	mm	Cone Diar	neter	50 mr	n <b></b>
Dynamic pro	be borehole from ground lev	vel to completed depth. Back	filled	Hammer Weight	64	kg	Final Dept	h	7.10	
with ansings				Probe Type	DPSI	H-B	1			AUD
L										

	rucho								P	robe No.
SU									D	P116
engineer	ring environments	5							Sh	eet 1 of 1
Project Name	e:					Proje	ect No:		н	ole Type
37 Broadw	ater Road, Welwyn Gar	den City				560	B			DP
Location: Broadwate	r Road, Welwyn Garder	n City					Co-ords	Level		Scale 1:50
Client: Bishopswo	ood Estates Ltd					2!	Da Start 5/09/2019	ates End 25/09/2019	9	
Depth (m)			E	Blows/100mm						Torque (Nm)
	0 1	0 2	0	30	)		4	0		50 
Ē	2 2									
E	5 3									
-	1									
- 1	1 1									-
E	2									
	5									
-	<u>4</u> <u>4</u> 4									
- - 2 -	4 5									-
E	5 5 4									
F	<u>5</u> 5									
E	7 4									
— 3 -	5 5 5									-
	5 3									
E	4 4 4									
Ę	7 4 4									
- 4	2									-
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-	2									
- - -	2 1									
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F	1									
6	2									_
	2 2									
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	2 7									
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E	5 6 7									
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8	10 9									-
E	9 9 10									
F	10	l								
Ē	8									
9	7 7 7							<u> </u>		1
Ē	5 7 10									
E	12 12 11									
F	8									
Remarks			•	Fall Height	750	mm	Cone Diar	neter	50 mm	±
Dynamic pro	be borehole from ground lev	el to completed depth. Back	filled	Hammer Weight	64	ka	Final Dent	h	10.00 m	
with arisings	on completion.			Droho Turco		е е				AGS
				горе Туре	DPSF	л-Ы				

	rucho								P	robe No.
DL							P117			
enginee	ring environments	ò							Sł	neet 1 of 1
Project Name	9:					Proje	ect No:		F	lole Type
37 Broadw	ater Road, Welwyn Gar	den City				5608	8			DP
Location: Broadwate	r Road, Welwyn Garder	n Citv					Co-ords	Level		Scale
Client:						-	Da	ates End		1.00
Bishopswo	ood Estates Ltd					27	7/09/2019	27/09/20	19	1
Depth			F	Blows/100mm						Torque
(m)			-							(Nm)
	0 1	0 20		3	0		4	0		50
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E	2 2									
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F	1 1									
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F	2									
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F	1									
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9	2 2									1
E	2									
E	2									
Ē	2									
Remarke		1		Fall Height	750	mm	Cone Dian	neter	50 mm	1
Dynamic pro	be borehole from around lev	el to completed depth. Backfi	illed		64	ka	Einel Day		10.00	
with arisings	on completion.				04	~y			10.00 111	AGS
				Probe Type	DPSH	1-B				_

Ch	rucho									Probe No.
SU										DP118
engineer	ring environments	<u>.</u>								Sheet 1 of 1
Project Name	e:					Proje	ct No:			Hole Type
37 Broadw	ater Road, Welwyn Gar	den City				5608	}			DP
Location: Broadwate	r Road, Welwyn Garder	n Citv				0	Co-ords	Leve	el I	Scale 1·50
Client:		lony					D	l ates End	1	1.00
Bishopswo	ood Estates Ltd					27	/09/2019	27/09/2	019	
Depth				Blows/100mm						Torque
(m)										(Nm)
	¢ 1	0 2	0	30	)		4	40		50
Ē	1									
-	4 3 3									
E	2									
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-	<u>3</u> <u>2</u> 2									
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-	<u>1</u> 1									
-	2									
-	<u>1</u> 1									
E	1									
F _	2									
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F	$\frac{4}{4}$									
E	5 4									
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-	10 10 9									
E	9									
-	10 9 10									
- 8	9									
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E	9									
ŧ	11 11 13									
9	17							1		
F	16									
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È	17	21								
Pomarka	2				750	mm	Coro Di-	motor	50	<del></del>
Dynamic pro	he borehole from ground low	rel to completed depth. Back	filled							
with arisings	on completion.	or to completed deptill. DBCK	meu	Hammer Weight	64	kg	Final Dep	oth	10.00 r	<sup>™</sup> AGS
				Probe Type	DPSH	-В				

	rucho								P	robe No.
									D	P119
enginee	ring environments					Sh	eet 1 of 1			
Project Nam	e:					Proje	ect No:		н	ole Type
37 Broadw	ater Road, Welwyn Gar	den City				560	B	1		DP
Location: Broadwate	er Road, Welwyn Garder	n City					Co-ords	Level		Scale 1:50
Client:							Da Start	End		
Bishopswo	bod Estates Ltd					27	7/09/2019	27/09/2019		
Depth (m)			E	Blows/100mm						Torque (Nm)
	1	0 20	0	30	0		4	0		50 ` ´
	1									
E	2									
F	3									
- 1	<u>4</u> <u>3</u>									_
-	<u>5</u> 4									
E	6									
- - 2	<u>5</u> 4									_
	4 4									
-	<u>5</u> <u>4</u> 5									
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	3									
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E	2									
E	3									
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-	2 2									
	2 4									
- 7 -	<u>3</u> <u>3</u>									-
E	3									
F	6 5									
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È	7 7 7 7 7 7									
Remarks		<u> </u>		Fall Height	750	mm	Cone Diar	neter 50	) mm	<u>+</u>
Dynamic pro	be borehole from ground lev	rel to completed depth. Back	filled	Hammer Weight	64	ka	Final Dent	h 10	) 00 m	
with arisings	on completion.			Probo Turos		a				AGS
				Prope Type	DPSI	п-В				

Ch	rucho						Pi	obe No.
							D	P120
enginee	ring environments	5					Sh	eet 1 of 1
Project Nam	e:				Project No:		H	ole Type
37 Broadw	ater Road, Welwyn Gar	den City			5608	Loval	-	DP
Broadwate	er Road, Welwyn Garder	n City			Co-orus	Levei		1:50
Client:					D	ates End		
Bishopswo	ood Estates Ltd				27/09/2019	27/09/2019		1
Depth			Blows/100mm					Torque
(m)		0 20	30	ſ	2	10	F	(Nm)
-	1							-
	2							
F	<u> </u>							
	1							
- 1 -								
	5							
F	6 7							
E	7							
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-	4							
E	3							
— 3 -	6 10							-
	9 8							
-	<u>4</u> 6							
E	5							
4	3							
-	4 4 5							
	3							
F	$\frac{2}{2}$							
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	$\frac{2}{3}$							
-	5 5							
6	5							
F	5 5 5							
F	6 6 7							
E	5							
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F	6 7							
	8							
-	11 11 12							
8	13 13							
F	12							
F	18	0						
F	16 17 16							
9	16 16							
F	17 13 13							
Ē	14 16							
F		22 37						
<b></b>								
Remarks			Fall Height	750	mm Cone Dia	meter 50	mm	
Dynamic pro with arisings	be borehole from ground lev on completion.	el to completed depth. Backfillec	Hammer Weight	64	kg Final Dep	th 9.9	90 m	AGS
			Probe Type	DPSH	-В			nee

37 BROADWATER ROAD, WELWYN GARDEN CITY | GROUND INVESTIGATION

## APPENDIX C

## GEOTECHNICAL LABORATORY TEST DATA

GSTL	NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX ( BS 1377 : Part 2 : 1990 Method 5 )	
Contract Number	45963	
Site Name	37 Broadwater Road, Welwyn Garden City	
Date Tested	10/10/2019	
	DESCRIPTIONS	

Sample/Hole Reference	Sample Number	Sample Type	D	epth (r	n)	Descriptions
BH101	3	D	1.20	-	1.65	Brown fine to medium gravelly sandy silty CLAY
BH102	3	D	1.50	-		Brown fine to medium gravelly silty sandy CLAY
BH102	7	D	3.50	-		Brown clayey silty sandy fine to coarse GRAVEL
BH102	21	D	10.50	-		Off white fine to medium gravelly chalky CLAY
BH103	6	D	2.50	-		Brown fine to coarse silty sandy CLAY
BH104	4	D	1.50	-		Brown fine to coarse gravelly sandy silty CLAY
BH104	12	D	5.50	-		Brown clayey silty sandy fine to coarse GRAVEL
				-		
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Operators	Checked	15/10/2019	Wayne Honey (Administrative/Quality Assistant)
Daniel Bassett	Approved	15/10/2019	Paul Evans (Quality/Technical Manager)







Project / Site name: 37 Broadwater Road, Welwyn Garden City

Lab Sample Number				1323392	1323393	1323394	1323395	1323396
Sample Reference				BH101	BH101	BH101	BH101	BH101
Sample Number				D3	D7	D10	D15	D27
Depth (m)				1.50	3.50	5.00	7.50	13.50
Date Sampled		Deviating	Deviating	Deviating	Deviating	Deviating		
Time Taken		None Supplied	None Supplied	None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	13	12	15	13	14
Total mass of sample received	kg	0.001	NONE	1.2	1.2	0.37	1.4	1.1
General Inorganics					<b></b>			
pH - Automated	pH Units	N/A	MCERTS	7.9	7.8	7.7	7.7	7.9
Tatal Culmhata as CO	0/		MCEDIC		0.010	0.001		

Total Sulphate as SO <sub>4</sub>	%	0.005	MCERTS	0.054	0.019	0.021	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	g/l	0.00125	MCERTS	0.095	0.043	0.0096	0.016	0.022
Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	mg/l	1.25	MCERTS	94.9	42.8	9.6	-	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	11	6.2	4.4	-	-
Total Sulphur	%	0.005	MCERTS	0.016	0.008	0.007	-	-
Ammonium as NH <sub>4</sub>	mg/kg	0.5	MCERTS	< 0.5	< 0.5	< 0.5	-	-
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	< 2.0	-	-

Magnesium (water soluble)	mg/kg	5	NONE	6.6	< 5.0	< 5.0	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	3.3	< 2.5	< 2.5	-	-





Project / Site name: 37 Broadwater Road, Welwyn Garden City

Lab Sample Number				1323397	1323398	1323399	1323400	1323401
Sample Reference				BH101	BH102	BH102	BH102	BH102
Sample Number				D39	D1	D5	D28	D34
Depth (m)		22.00	0.30	2.50	14.50	19.00		
Date Sampled		Deviating	Deviating	Deviating	Deviating	Deviating		
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	22	10	14	21	19
Total mass of sample received	kg	0.001	NONE	0.71	1.1	0.84	1.0	1.3
General Inorganics								

## pH - Automated Total Sulphate as SO pH Units

Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	g/l	0.00125	MCERTS	0.020	0.33	0.066	0.031	0.023
Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	mg/l	1.25	MCERTS	-	334	65.8	-	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	-	14	12	-	-
Total Sulphur	%	0.005	MCERTS	-	0.175	0.013	-	-
Ammonium as NH <sub>4</sub>	mg/kg	0.5	MCERTS	-	15	< 0.5	-	-
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	-	1.53	< 0.05	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	-	< 2.0	< 2.0	-	-

8.4

N/A 0.005

%

MCERTS MCERTS

9.7 0.364

8.2 0.031

8.3

8.4

Magnesium (water soluble)	mg/kg	5	NONE	-	< 5.0	5.7	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	< 2.5	2.8	-	-





Project / Site name: 37 Broadwater Road, Welwyn Garden City

Lab Sample Number				1323402	1323403	1323404	1323405	1323406
Sample Reference				BH103	BH103	BH103	BH103	BH103
Sample Number				D1	D10	D26	D32	D37
Depth (m)		0.50	4.50	12.50	16.00	20.00		
Date Sampled		Deviating	Deviating	Deviating	Deviating	Deviating		
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	6.6	9.8	24	27	22
Total mass of sample received	kg	0.001	NONE	1.1	1.2	0.79	1.1	1.0
General Inorganics								

pH - Automated	pH Units	N/A	MCERTS	9.4	8.6	8.5	8.1	8.4
Total Sulphate as SO <sub>4</sub>	%	0.005	MCERTS	0.449	-	0.042	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	g/l	0.00125	MCERTS	1.3	0.11	0.020	0.027	0.036
Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	mg/l	1.25	MCERTS	1320	-	19.5	-	-
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	26	-	4.5	-	-
Total Sulphur	%	0.005	MCERTS	0.193	-	0.017	-	-
Ammonium as NH <sub>4</sub>	mg/kg	0.5	MCERTS	1.5	-	< 0.5	-	-
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	0.15	-	< 0.05	-	-
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	-	< 2.0	-	-

Magnesium (water soluble)	mg/kg	5	NONE	7.2	-	< 5.0	-	-
Magnesium (leachate equivalent)	mg/l	2.5	NONE	3.6	-	< 2.5	-	-





Project / Site name: 37 Broadwater Road, Welwyn Garden City

Lab Sample Number				1323407	1323408	1323409	1323410	
Sample Reference		BH104	BH104	BH104	BH104			
Sample Number				D1	D5	D14	D43	
Depth (m)				0.30	2.00-2.45	6.50	23.50	
Date Sampled	Deviating	Deviating	Deviating	Deviating				
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	6.6	7.3	13	23	
Total mass of sample received	kg	0.001	NONE	0.91	0.31	0.75	1.2	

#### General Inorganics

pH - Automated	pH Units	N/A	MCERTS	10.9	7.6	7.7	8.3	
Total Sulphate as SO <sub>4</sub>	%	0.005	MCERTS	0.352	0.027	-	-	
Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	g/l	0.00125	MCERTS	0.17	0.053	0.028	0.028	
Water Soluble SO4 16hr extraction (2:1 Leachate								
Equivalent)	mg/l	1.25	MCERTS	169	52.5	-	-	
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	34	4.3	-	-	
Total Sulphur	%	0.005	MCERTS	0.142	0.013	-	-	
Ammonium as NH <sub>4</sub>	mg/kg	0.5	MCERTS	< 0.5	1.2	-	-	
Ammonium as NH4 (10:1 leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	0.12	-	-	
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0	-	-	

Magnesium (water soluble)	mg/kg	5	NONE	< 5.0	5.1	-	-	
Magnesium (leachate equivalent)	mg/l	2.5	NONE	< 2.5	2.5	-	-	





#### Project / Site name: 37 Broadwater Road, Welwyn Garden City

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1323392	BH101	D3	1.50	Light brown clay and sand with gravel.
1323393	BH101	D7	3.50	Light brown clay and sand with gravel.
1323394	BH101	D10	5.00	Light brown clay and sand with gravel.
1323395	BH101	D15	7.50	Light brown clay and sand with gravel.
1323396	BH101	D27	13.50	Light brown sandy clay with gravel.
1323397	BH101	D39	22.00	Beige clay and sand with chalk.
1323398	BH102	D1	0.30	Brown sandy clay with gravel.
1323399	BH102	D5	2.50	Brown clay and sand with gravel.
1323400	BH102	D28	14.50	White chalk with gravel.**
1323401	BH102	D34	19.00	White chalk with gravel.**
1323402	BH103	D1	0.50	Brown sandy clay with rubble and gravel
1323403	BH103	D10	4.50	Brown clay and sand with gravel.
1323404	BH103	D26	12.50	Beige clay and sand with chalk.
1323405	BH103	D32	16.00	Beige clay and sand with chalk.
1323406	BH103	D37	20.00	White chalk.**
1323407	BH104	D1	0.30	Brown sand with gravel.
1323408	BH104	D5	2.00-2.45	Brown clay and sand with gravel.
1323409	BH104	D14	6.50	Brown clay and sand with gravel.
1323410	BH104	D43	23.50	Beige clay and sand with chalk.

\*\* NON MCERTS MATRIX





Project / Site name: 37 Broadwater Road, Welwyn Garden City

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammonium as NH4 in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	w	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP- OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP- OES.	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE

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

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

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