
Supplementary Site Investigation Report

at Phase 4, Toddington
Lane, North Littlehampton,
West Sussex, BN17 7PP

for Persimmon Homes
Thames Valley

Report Reference: LP2694

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EXECUTIVE SUMMARY

The site comprises an elongated rectangular shaped plot of land approximately 0.60 hectares in size, and is situated to the north of Toddington Lane, Littlehampton, BN17 7PP. It is proposed to redevelop the site for a residential land use comprising 28 No. two to four-bedroom, two storey houses and 18 No. apartments divided between two apartment blocks.

The site and surrounding land were historically a nursery, several commercial warehouses were present on land to the east of the site and greenhouses on land to the west. A historical reservoir, associated with the nursery was present immediate to the west of the central area. The historical features are no longer present and land to the west was developed for low rise residential housing in 2018. The northern part of the site was raised by circa 1.5-2.0 m above land to the east and south at the same time of the recent residential development to the west. We understand that a historical ditch was also infilled as part of the land raise in the northern half of the site. No information has been made available to LEAP with regards to the source of land raise or whether it had been placed to an engineering specification.

An earlier site investigation by LEAP identified made ground to 3.0 m in the northern half of the site, but only limited previous investigation was possible in the southern half of the site due to surface water flooding.

The site is mapped as being underlain by Raised Marine Deposits over Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated). In the northern half of the site ground conditions comprise made ground to around 3.0 m over clay to 2.50-5.0 m over chalk proven to 15.0 m. Buried topsoil 200-300 mm thick was identified at the base of the made ground layer in three locations. In the southern half of the site, topsoil to around 0.40 m over made ground to approximately 0.6 to 0.7 m, over clay to around 2.2 m, over chalk proven to 10.0 m. Groundwater was typically encountered at the top of the chalk aquifer between 2.5-3.5 m below ground level.

The site is mapped by the Environment Agency as within a Flood Zone 2 and 3.

Superficial soils are generally weak and ground levels are to be raised. As such, piled foundations will be required on site. Preliminary pile designs indicate that a 12m long 300mm diameter cfa pile could have a design compressive resistance of around 295kN, increasing to 465kN for a 400mm diameter pile.

Suspended floor slabs are recommended with piled foundations.

Clays of the Raised Marine Deposits are given a sulphate design class DS-I, and, assuming a mobile groundwater table, the ACEC class is AC-I.

The site is not suitable for soakaway drainage due to the high water table.

The raised made ground in the northern half of the site is not suitable to remain on site, as it includes anthropogenic material; does not appear to have been placed to an engineered specification; and overlies organic topsoil. Following removal site levels across the full development footprint will be raised to a specification.

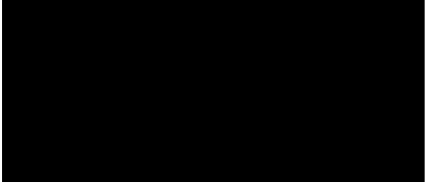
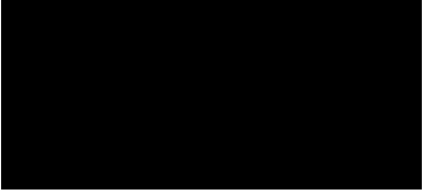
A geo-environmental risk assessment has been carried out. Contamination testing of the soils and groundwater did not identify significant land contamination, with the exception of a single elevated naphthalene result in a made ground sample in the northern section of the site. This will be removed as part of the earthworks.

The new land raise material will be tested as chemically compliant for residential land use with homegrown produce. The suitability of the material for other purposes, such as required planting depths, as a growing medium, or its aesthetic quality for use in gardens, should also be considered by the developer.

Three land gas monitoring visits have been carried out to date. Elevated methane and carbon dioxide concentrations above threshold levels were noted in one windowless sampler location. No positive gas flow rates were noted in any of the monitoring wells. Further land gas monitoring is recommended following the removal of the northern land raise material, as buried topsoil was identified that could be a land gas source, monitoring was not undertaken in falling or low atmospheric pressure conditions and further gas monitoring is required to adequately characterise the moderate land gas risk associated with the offsite infilled reservoir.

As with any redevelopment site, there is always the risk of hitherto undetected contamination and a discovery strategy will be required as part of the groundworks phase of the development.

The made ground soils on site will be expected to be classified as non-hazardous waste.

Signed:	 Adam Carr BSc MSc FGS
Countersigned:	 Martin Weil BSc MA C.WEM
Approved:	 Richard Brinkworth BEng CEng MICE Registered Ground Engineering Professional
Date :	15 October 2021
Revision:	Issue 1

A INTRODUCTION

1 Authority

Leap Environmental Ltd (hereafter referred to as **LEAP**) has been appointed by Persimmon Homes (Thames Valley) Ltd (PHTV) to undertake a supplementary Site Investigation of a site referred to as Phase 4, North Littlehampton Development Zone (NLDZ), Toddington Lane, BN17 7PP. The site location is highlighted in Figure 1, Appendix B. The instruction was given in an email dated 23/08/21 and signed by Jaclyn Murphy of PHTV.

2 Proposed Development

It is understood that prior to development of the Phase 4 area a ground raise is to be undertaken to reduce the risk of flooding to the proposed properties. The ground level will be raised in accordance with the Specification for Highway Works (SHW) to match that of the development parcel to the west and will be completed using site-won natural soils from elsewhere within the NLDZ.

Following the earthworks, it is proposed to redevelop the Phase 4 area with 46 No. residential dwellings comprising 28 No. two to four-bedroom, two storey houses and 18 No. apartments divided between two apartment blocks. Along with the dwellings the development will comprise an access road, a footpath and in the cases of the houses, private rear gardens. It is understood that the proposed structures are to be founded on piled foundations and as such the buildings will not directly load the fill material. The proposed development layout is shown in the client supplied drawing DRG No. 545_PL_101 attached in Appendix B.

The proposed development has been assessed in accordance with BS EN 1997¹, as being a Geotechnical Category 1 structure.

3 Background

Previous investigation across the wider NLDZ has been undertaken by **LEAP** and others. During **LEAP**'s previous works limited investigation was undertaken on site due to the southern part of the site being flooded. The investigation noted that the ground level in the northern portion of the site had been raised although no information on the material used or whether this material had been placed and compacted to a specification was available. The intrusive works encountered up to 3.0m of made ground over gravelly clays over chalk. One cable percussion borehole completed on site extended to 13.5m bgl where the borehole

¹ BS EN 1997-1(2004)+A1:2013 Eurocode 7:Geotechnical Design: General Rules

refused on hard chalk. Discussions with the groundworkers on site indicated that a ditch previously crossed the site and was aligned roughly north south and had been backfilled as part of the level raise. This was also evident on LiDAR imagery dated 2017. In addition, a reservoir associated with the former land use as a nursery was previously located to the immediate west of Phase 4 which was also backfilled as part of the earlier NLDZ works and the material used to backfill the reservoir was unknown.

It is understood that a property located on a land parcel ~165 m to the west of Phase 4 experienced subsidence and an investigation undertaken by LEAP identified that the foundations (piles) did not extend into the underlying chalk and instead terminated within the overlying soft clays. Whilst only limited thicknesses of these soft clays were encountered within the extent of Phase 4, significant thicknesses were encountered in the “Central Wetlands” area to the east.

4 Objective

The objectives of this report are to:

- Provide information on the geotechnical suitability of the ground present on the site for piled foundations;
- An assessment of whether the fill material in the north of the site is suitable for retention on site as part of the wider proposed earthworks;
- Investigate the consistency of the fill material within the area of the historical ditch;
- Assessment of groundwater and ground gas levels on the Phase 4 site.

5 Previous Studies

The wider NLDZ has been the subject of previous investigations by both LEAP and others. Only reports considered pertinent to the objectives of this investigation are listed below and the reader is referred to these earlier documents, which should be read in conjunction with this report.

- Merebrook Consulting Ltd Geo-Environmental Assessment Report, Ref, GEA-18426-14-69 dated Feb 2014.
- Idom Merebrook Remediation Strategy, North Littlehampton, West Sussex, Ref. RMS-18426C-14-288 dated Oct 2014.
- Phase III Site Investigation Report, Zone 1 and 2, Toddington Lane, North Littlehampton Ref. LP2128 Issued April 2020 by LEAP.

- Phase III Site Investigation Summary Report, Zone 1 and 2, Toddington Lane, North Littlehampton Ref. MW/20/LP2128 Issued December 2020 by LEAP.
- Pile Design for Phase 2 (Plot 123-126) North Littlehampton Ref. KT/20/LP2420 Issued December 2020 by LEAP.
- Earthworks Compaction Specification at Phase 4, Toddington Lane, North Littlehampton for Persimmon Homes Thames Valley Ref. LP2503 Issued April 2021.

6 Scope of Works

This report describes a two stage process whereby the site is investigated and risks are assessed. The terms geotechnical and geoenvironmental are referred to throughout the report.

Geoenvironmental refers principally to the chemical nature of the ground and the degree of soil, water and/or land gas contamination and the impact that contamination may have on current or future development and also on the wider environment.

Geotechnical refers to all other aspects of the ground conditions and the impact they may have on the physical construction of existing or future development, principally foundations, slope stability, drainage, pavement and road design and groundwater control.

6.1 Publicly Available Site Information

The following publicly accessible sources of information² have also been reviewed for information pertaining to the site:

- British Geological Survey (BGS) 1:50,000 Series Geological Map Sheet 317/332 Chichester and Bognor Solid and Drift ed.
- BGS 'Geology of Britain' online viewer accessed on 03/09/21.
- Defra 'MAGIC' website accessed on 03/09/21.
- Groundsure.io website accessed on 03/09/21.

² The report contains British Geological Survey materials ©UKRI 2019 and public sector information licensed under the Open Government Licence v3.0.

6.2 Intrusive Investigation Scope

These works comprise intrusive investigation, onsite monitoring and laboratory analysis. The results of this and previous investigation reports are used to validate and/or update the initial site conceptual model. This phase of site investigation comprised the following tasks:

- 3 No. cable percussion boreholes to 25m bgl to inform pile design;
- Trial pitting in the northern raised area to examine the composition of the fill and assess its suitability to be retained on site;
- Windowless sampling in the vicinity of the former reservoir and in the southern portion of the site where limited previous investigation had been undertaken;
- Super Heavy Dynamic Probing (DPSH) across the raised area and in the area of the former ditch;
- Installation of combined gas and groundwater monitoring wells within a selection of the windowless sampler boreholes and groundwater monitoring wells within the cable percussion boreholes;
- Geotechnical Laboratory Testing including Atterberg Limit Tests, Sulphate Tests and Soil Moisture Content; and
- Chemical Laboratory tests including 10 No. LEAP standard soil suite tests.

The intrusive works were completed by contractors who have been scrutinised and are on LEAP's approved contractor list. The cable percussion drilling was undertaken by RM Foster Drilling Ltd, the windowless sampling and DPSH testing were carried out by Oakland Site Investigation Ltd whilst the trial pits were excavated by a machine and operator supplied by HGH Groundworks. All works were supervised by LEAP.

Selected samples of soil were scheduled for laboratory testing for a wide range of potential contaminants including metals, non-metals, polyaromatic hydrocarbons and asbestos. The laboratory testing has been carried out by The Environmental Laboratory Ltd at its laboratories in East Sussex.

Selected soil samples have been classified by laboratory analysis for geotechnical design purposes. The laboratory testing has been carried out by Geolabs Ltd at its laboratories in Watford.

The final stage in the geoenvironmental assessment comprises a quantitative risk assessment and revision of the preliminary Conceptual Site Model. Preliminary recommendations for remediation have been provided, based on various development assumptions which are detailed in the following section and in the text of this report. The risk assessment has been

carried out in accordance with UK industry standards and in particular in accordance with LCRM³ and BS10175:2011+A2:2017.

The final stage of the geotechnical assessment is the provision of preliminary soil parameters for use in geotechnical design, and broad recommendations for appropriate foundation options. It is intended that the Geotechnical Information section of this report will fulfil the general requirements of the Ground Investigation Report as set out in Section 6 of BS EN 1997-2:2007⁴.

7 Limitations

This report has been prepared by Leap Environmental Ltd on the basis of information received from a variety of sources which Leap Environmental Ltd believes to be accurate. Nevertheless, Leap Environmental Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

Leap Environmental Ltd has used all reasonable skill, care and diligence in the design and execution of this report, taking into account the manpower and resources devoted to it in agreement with the Client. Although every reasonable effort has been made to obtain all relevant information, all potential contamination, environmental constraints or liabilities associated with the site may not necessarily have been revealed.

The conclusions reached in this report are necessarily restricted to those which can be determined from the information consulted and may be subject to amendment in the light of additional information becoming available. These conclusions may not be appropriate for alternative schemes.

This report is confidential to the Client, and Leap Environmental Ltd accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Leap Environmental Ltd beforehand. Any such party relies upon the report at their own risk.

Full details of the limitations are provided in Appendix A.

³ Environment Agency. Land Contamination Risk Management (LCRM), <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

⁴ BS EN 1997 Eurocode 7- Geotechnical Design- Part 2: Ground Investigation and Testing (2007)

B ENVIRONMENTAL SETTING

7.1 Site Location and Description

The site forms part of the wider North Littlehampton Development Zone (NLDZ) and is situated to the north of Toddington Lane, Littlehampton, West Sussex as shown in Figure 1, Appendix B. The area known as Phase 4 is elongated, extending along the western boundary of the proposed 'Wetlands' area and covers an area approximately 0.60Ha in size. The centre of the site has a grid reference of TQ 03528 04128.

The northern portion of the site lies at an estimated elevation of 3.0m Above Ordnance Datum (m AOD) and between 0 and 1m AOD in the south.

7.1.1 General Description and Boundaries

The site is an elongated approximately rectangular strip of land aligned roughly north to south. The southern portion of the site is relatively low lying and is noted to flood following wet weather. The natural ground level across the Phase 4 area is lower than the adjacent land to the west, which has been developed by PHTV as part of an earlier phase of NLDZ. The northern portion of the site has been raised by approximately 1.5m-2.0 m relative to land to the east. The ground in this portion of the site is bare earth except where the newly constructed Anderson Way crosses the site aligned east to west roughly two thirds of the way up the site. The southern portion of the site is lower lying and is capped by grasses and low shrubs. To the immediate east of the southern portion are several large willow trees which are to be retained as part of the development.

The client indicated that a high pressure (HP) gas main was recently installed on site. The route of the gas main crosses the central wetlands to the east along a northeast to southwest alignment. It then 'dog legs' at the eastern boundary of Phase 4 and aligned in a north to south direction along the eastern boundary. The gas main then routes westwards along the northern edge of Anderson Way where it enters the wider NLDZ to the west.

Phase 4 is bounded to the north by open fields (flood plains of the Black Ditch) and to the east by an area referred to as "the central wetlands" which is earmarked as an area of open green space in the proposed development plan. To the southwest, the site is bounded by an area of light commercial units and to the west by residential properties of the wider NLDZ.

7.2 Geology

The geology of the site has been ascertained by reference to the 1:50,000 British Geological Survey sheet 317/332, solid and drift edition, the BGS website (www.bgs.ac.uk). The site is mapped as being underlain by Raised Marine deposits over the White Chalk Sub-Group.

7.2.1 Superficial (Raised Marine Deposits)

Raised marine deposits are marine deposits which have been isostatically uplifted above high-water mark. The deposits are highly variable comprising gravel, sand, silt and clay and commonly charged with organic plant and shell debris.

7.2.2 Bedrock (Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated))

Chalk is a very fine-grained white limestone. It consists predominantly of the disaggregated skeletal remains of tiny planktonic algae, composed of almost pure calcium carbonate.

7.2.3 Solution Features

Chalk is particularly affected by its weathering, particularly the effects of dissolution. The top surface of the chalk is usually irregular and may include deep drift filled solution pipes for example.

Solution features generally occur where preferential weathering of the chalk occurs along discontinuities or joints. They are more common along geological boundaries, where surface water runoff from impermeable soils meets the more permeable underlying chalk. They are generally infilled with loose/soft soils, and can be visible at ground level due to surface depressions, although this may be masked by overlying superficial deposits. They may lie dormant for many years, and are generally reactivated by the introduction of water from, for example, a leaking drain, soakaway etc.

7.3 Hydrogeology

Table 1: Hydrogeology

Superficial Deposit	Raised Marine Deposits	Secondary A Aquifer
Bedrock	White Chalk Subgroup	Principal Aquifer
Source Protection Zone	None on site.	

The hydrogeology of the site has been ascertained from the Groundsure.io and Defra.Magic websites. The source of the data is reported to be the Environment Agency groundwater vulnerability mapping.

The superficial deposits mapped beneath the site are classified as a secondary A aquifer whilst the underlying Chalk is classed as a principal aquifer. The site is not situated within a Groundwater Source Protection Zone (SPZ).

7.4 Flooding

Much of the site is mapped and being within a Flood Zone 2 by the Environment Agency furthermore a smaller portion of the site associated with the now backfilled ditch is mapped a Flood Zone 3.

A Zone 2 floodplain estimates the annual probability of flooding as one in one thousand (0.1%) or greater from rivers and the sea but less than 1% from rivers or 0.5% from the sea.

A Zone 3 floodplain estimates the annual probability of flooding as one in one hundred (1%) or greater from rivers and a one in two hundred (0.5%) or greater from the sea.

8 Previous Investigations

The wider NLDZ has been the subject of several site investigation reports undertaken by LEAP and others for simplicity only information considered pertinent to the objectives of this investigation have been briefly summarised below. A site plan showing the position of previous site investigation locations is shown in Figure 2 Appendix B.

8.1 Previous Investigations across Phase 4, and the adjacent land parcels

Table 2: Summary of available desk study information pertaining to Phase 4

Subject	Details
Site history / previous site usage.	The historical mapping of the site indicates it was undeveloped from the earliest historical maps until the 1980s. From the 1980s a large depot is mapped in the south of the site and aerial imagery from 2001 shows two further depots in the north of the site. The buildings on site were demolished prior to 2018 by which point the land raise in the north of the site had taken place. A reservoir presumed associated with the former nursery land use was mapped to the immediate west of the site which has since been backfilled.
Potential on site contaminant sources	• Heavy metals and asbestos from the fabric of the previous buildings. • Heavy metals, asbestos, polycyclic aromatic and petroleum hydrocarbons within made ground. • Ground gases (CH₄ and CO₂) from degradable material within the made ground and the infilled reservoir.

During previous investigations a total of nine trial holes were located within the Phase 4 area, two during Merebrook 2014 investigation and seven during LEAP's 2020 investigation of the wider NLDZ. It is noted that the Merebrook 2014 investigation was completed prior to the level raise in the northern portion of the site. Additionally, two boreholes were completed in 2020 within the footprint of Plots 123 to 126 on the adjacent Phase 2 land parcel located to the immediate west of the subject site.

During the walkover undertaken as part of LEAP's 2020 investigation it appeared, based on relative ground levels, that the northern portion was raised by ~1.5 – 2.0m in comparison to ground levels to the south and east. The ground conditions encountered within Phase 4 varied significantly between the north and south. The northern portion (where levels had been raised) were found to comprise made ground to depths in excess of 3.0m in one location over

silty gravelly clay, over chalk at depth. During the investigation TPI01 in the north area encountered considerable amounts of anthropogenic material including timber, plastic and glass within the land raise made ground. In the south the made ground was not present and the investigation encountered topsoil over silty clay over chalk. Merebrook TPI8 (located to the south of the land raise) encountered a thin layer of chalk fill overlaying the clays. Although chalk fill was not encountered elsewhere within Phase 4 it was noted that significant thicknesses of chalk fill were encountered in the wetlands area to the immediate east of Phase 4. It was however noted that information on the ground conditions in the northern portion of Phase 4 was minimal due to limited intrusive investigation in this portion of the site.

BH103 located in the northern portion of Phase 4 encountered made ground to 1.1m depth over soft brown and grey clays to 3.3m bgl, which were interpreted to represent the raised marine deposits. These clays were not encountered within any of the other excavations within the Phase 4 area. However, significant thicknesses of these soils were encountered in the wetlands area to the east and as such the potential for soft soils to encroach onto the Phase 4 zone cannot be discounted. The clays were underlain by highly weathered chalk becoming less weathered with depth. SPT N values within the chalk were low at shallow depths $N = <10$ to 6.0m, but N values of $N=50$ were recorded below 10.5m bgl and BH103 was terminated at 13.5m bgl.

Boreholes BH1 and BH2 to the immediate west of the subject site encountered made ground to depths of between 0.9m and 2.25m over soft becoming firm brown to reddish brown gravelly clay to 3.0m and 5m respectively over chalk. SPT N values recorded exceeded $N = 50$ below 15m in BH1 and 9m in BH2. BH2 was terminated at 10m bgl.

C INTRUSIVE INVESTIGATION

9 Investigation Rationale

The objectives of this intrusive investigation was to provide further information of the ground and groundwater conditions at depth for pile design, an assessment of the suitability of the existing raised land for retention on site, an assessment of ground conditions in the infilled ditch area and an assessment of groundwater and ground gas levels across the site.

To achieve the investigation rationale, the scope of works comprised a total of 24 investigation locations across the site. This included 5 No. machine excavated trial pits to a maximum depth of around 3.0m, 3 No. cable percussion boreholes to a proposed depth of 25m, 6 No. windowless sampler boreholes to 4.0m bgl and 10 No. Super heavy dynamic probes (DPSH) to depths between 7.0m and 8.0m.

The scope of the cable percussion and windowless sampling investigation in the southern part of the site was non-targeted to provide additional coverage and, in accordance with BS10175, took into consideration the proposed development plans and the findings of the previous investigations. The window sampler locations in the northern part of the site were to enable land gas monitoring wells in the vicinity of the infilled reservoir to the west. The trial pits were targeted on the northern portion of the site where the ground level had been raised to assess the composition of the placed soils. The DPSH tests were targeted on the area of the backfilled ditch to assess the compaction and the depth of any potential loose material.

The spacing of the investigation locations across the various phases of intrusive works are consistent with the recommended density of 25 to 50m for an exploratory investigation after BS10175 Section 7.7.

The site investigation locations undertaken as part of this investigation as well as those from previous phases of investigation are presented in Figure 2, Appendix B and Table 3 provides a summary of the rationale, proposed scope and what was achieved in the field:

Table 3 Rationale and Scope for Investigation Locations

Trial Hole/Test Location	Rationale	Proposed Depth (m bgl)	Achieved Depth (m bgl)	Additional Comments
BH301 -- BH303	Provide information on ground conditions for pile design. Provide location for groundwater monitoring well.	25	15 -- BH301 11 -- BH302 & BH303	All boreholes were terminated at shallower depths (BH301 at 15.0 m; BH302 at 11.0 m; and BH303 at 10 m bgl) due to very slow progress through hard chalk. Boreholes were terminated only after at least 3 hours of chiselling.

Trial Hole/Test Location	Rationale	Proposed Depth (m bgl)	Achieved Depth (m bgl)	Additional Comments
WS301 – WS303	Provide information on the ground conditions and locations for ground gas monitoring wells in the vicinity of the infilled reservoir.	4	1.5 – 4.0	All locations achieved target depth with the exception of WS302 which terminated at 1.5 m due to an obstruction
WS304 – WS306	Provide additional information on the ground conditions in the southern part of the site and enable sampling for geotechnical and environmental laboratory testing	4	4	
TP301 – TP305	To enable an assessment of the composition of the made ground across the northern portion of the site and enable sampling for chemical and geotechnical testing if required.	3	3.3 to 3.5	
DPT301 – DPT310	Assess the degree of compaction of the raised levels in the vicinity of the backfilled ditch and the quality of the chalk immediately beneath the fill.	7.0	7.0 to 8.0	DPT309 was not undertaken due to close proximity to newly installed gas main

In addition to the findings of this investigation, this report draws on the findings of:

- BHI and BH2 completed to immediate west of the subject site and extending to 20m and 10m bgl respectively;
- BHI03 completed within the subject site extending to 13.5m bgl;
- MTP17 and MTP18 completed within or immediately to the east of the subject site and extending to 3.0m bgl; and
- TPI01 completed within the subject site and extending to 3.0m bgl.

10 Site Work

10.1 Date and Weather Conditions

This intrusive investigation was undertaken in a several phases between the 23rd of August and the 6th of September:

- Cable percussion drilling (23rd – 27th of August 2021).

- Trial pitting (31st of August 2021).
- Windowless sampler drilling (3rd of September 2021).
- DPSH testing (6th September 2021).

Photographic records are provided as Appendix C.

At the time of the investigations, the weather was dry but overcast. The Met Office Climate Summaries indicate that in the southeast of England the summer of 2021 experienced broadly average temperature but was particularly wet with almost double the seasonal average rainfall.

10.2 Site Work Methods

10.2.1 Borehole Drilling

The deep boreholes were drilled using a cable percussion rig whilst the shallow boreholes were drilled using a windowless sampler rig. The deep boreholes were excavated at 200mm diameter, reducing to 150mm with depth. The borehole logs are attached in Appendix D.

10.2.2 Windowless Sampler

The Windowless sampling rig consists of a tracked barrow with a sampling unit mounted on the top. When in the required position, the mast was raised to a height allowing a mechanised drop weight to fall repeatedly onto an anvil, and drive attached sample tubes or probe rods into the ground to produce reasonably intact continuous samples which were then extracted using the integrated hydraulic ram.

To reduce any tendency of the tubes to stick in the ground, a succession of smaller diameters may be used to obtain full depth. Excavated soils were placed aside for inspection and sampling.

On completion the trial hole was backfilled with excavated material, placed in reverse order, and the surface reinstated unless otherwise specified.

10.2.3 Trial Pitting

Trial pits were dug by Tracked Machine supplied by HGH. The trial pits had a target depth of 3.0m bgl and were typically 1.0m wide by 3.0m long. Trial pit logs are included as Appendix D. Spoil was replaced in reverse order.

10.2.4 Soil Logging and Sampling

Soil samples were recovered from the boreholes and trial pits for field screening, logging and sampling.

Boreholes were logged in general accordance with the requirements of BS 5930:⁵ and BS EN ISO 14688⁶. Borehole logs are presented in Appendix D.

Visual and olfactory evidence of contamination was noted if encountered. These observations were used to aid scheduling of samples for chemical laboratory analyses, and are included on the borehole logs in Appendix D and summarised in Section 11.1.4.

Samples were collected by hand (using dedicated nitrile gloves for each sampling location). Samples were placed into laboratory supplied sampling containers, specific to the type of analyses required.

All sample containers were sealed and labelled with a unique location identity, depth and date of sampling.

10.2.5 Monitoring Well Installation

5 No. monitoring wells were installed during this investigation. 2 No. were installed within the cable percussion boreholes, and 3 No. were installed within the windowless sample boreholes. The monitoring wells were constructed of 50mm diameter HDPE pipe. The response zone was typically targeted to intercept the groundwater surface and was surrounded by washed filter gravel. The plain zone was surrounded with bentonite to provide a seal. The monitoring wells were finished with bungs with gas taps. The deep wells were finished at surface with raised steel covers whilst the shallow wells were finished with flush mounted covers. Monitoring well installations are shown on the borehole logs and summarised in the following table.

Table 4: Borehole installation details

Borehole	Targeted Medium	Installed Depth (m bgl)	Response Zone (m bgl)	Bentonite Seal (m bgl)	Targeted Stratum
BH301	Groundwater	5.0	2.0 – 5.0	0.0 – 2.0	Chalk
BH303	Groundwater	11	1.0 – 11	0.0 – 1.0	Chalk
WS301	Gas	3.0	1.0 – 3.0	0.0 – 1.0	MADE GROUND
WS302	Gas	1.5	1.0 – 1.5	0.0 – 1.0	MADE GROUND
WS303	Gas	1.5	1.0 – 1.5	0.0 – 1.0	MADE GROUND

⁵ BS5930:2015+A1:2020 Code of Practice for Ground Investigation

⁶ BS EN ISO 14688 Parts 1-2 (2018) Geotechnical Investigation and Testing. Identification and classification of soil

10.3 Sampling and Field Tests

10.3.1 Soil Sampling

Geoenvironmental soil samples were selected from the trial pits in the northern area of the site and windowless sampler boreholes in the south where limited previous investigation was undertaken.

Geotechnical soil samples were selected from the southern portion of the site where limited previous investigation was undertaken.

10.3.2 Standard Penetration Tests

Standard penetration tests (SPTs) were undertaken in the cable percussion boreholes at 1.0m centres to 5.0m bgl and 1.5m centres thereafter in accordance with BS EN ISO 22476-3:2005. SPTs were completed at 1.0m centres in the windowless sampler boreholes. Uncorrected blow counts, 'N values', are recorded on the borehole logs in Appendix D.

10.3.3 Dynamic Probing

9 No. dynamic probe (super heavy) tests were undertaken across the site, in accordance with BS EN ISO 22476-2:2005 +A1;2011. The results are attached in Appendix E.

10.4 Ground Gas and Groundwater Monitoring

Ground gas monitoring wells were installed in WS301 to WS303 which were located in the vicinity of the previously backfilled reservoir. The nature of the material utilised to backfill the reservoir is unknown. As such the reservoir presents a potential source of ground gas should the backfill material have contained significant quantities of putrescible material.

Additionally deeper monitoring wells were installed in BH301 and BH303 located in the north and south of Phase 4 respectively.

10.4.1 Ground Gas

3 No. preliminary rounds of ground gas monitoring have been commissioned as part of this investigation. The placement of the gas monitoring wells was considered based on the following potential areas of concern:

- Deep made ground containing putrescible material previously identified in the northern area of the site.
- Infilled reservoir to the west.

And

- Proposed new residential properties.

Further monitoring is likely to be required following an assessment of the initial data collected.

10.5 Laboratory Analysis

10.5.1 Geotechnical Laboratory Testing

Selected samples of the soils have been classified by laboratory analysis for geotechnical design purposes. The laboratory testing has been carried out by Geolabs Ltd at its laboratories in Watford, in accordance with BS1377⁷ and BS EN ISO17892⁸. The sampling technique, type, storage and transport and the number of laboratory tests have been undertaken where possible in accordance with BS EN 1997-2:2007 and BS EN ISO 22475⁹.

The following laboratory tests across both LEAP investigations have been undertaken:

Table 5 Geotechnical Laboratory Testing

Test	Number of tests		
	Made Ground	Raised Marine Deposits	Chalk
Moisture Content	1	4	-
Atterberg Limit Test	1	4	-
Saturated Moisture Content	-	-	6
Sulphate Determination	1	2	-
pH	1	2	-

The geotechnical laboratory test results are provided in Appendix F.

10.5.2 Chemical Soil Analysis

Selected samples of soil subjected to laboratory testing. The suite of soil contaminant analysis took into account the potential contaminants of concern identified in the CSM (heavy metals, PAHs and asbestos). Soil samples were also analysed for pH and total organic carbon (TOC) to support the selection of assessment criteria in the subsequent quantitative risk assessment (QRA) for human health.

Sampling techniques and storage have been undertaken as per BS 10175:2011+A2:2017 Code of Practice for Investigation of Potentially Contaminated Sites. The laboratory testing was

⁷ BS1377 Parts 1-9:1990 Methods of test for Soils for Civil Engineering Purposes

⁸ BS EN ISO 17892 Parts 1-12 Geotechnical Investigation and Testing. Laboratory testing of soil

⁹ BS EN ISO 22475 Parts 1-3 Geotechnical Investigation and Testing. Sampling methods and groundwater measurements

carried out by The Environmental Laboratory Ltd at its laboratories in East Sussex. Where available, the tests for soils procedures were UKAS and MCERTS accredited.

The following analyses were completed on selected soil samples based on field observations and for general vertical and lateral coverage:

- 10 No. metals (As, Cd, Cr, CrVI, Cu, Pb, Hg, Ni, Se, Zn)
- 10 No. USEPA 16 PAHs
- 10 No. Asbestos identification in Made Ground only
- 10 No. pH
- 10 No. TOC

The laboratory test results are summarised in Section F and Appendix G, and the laboratory analytical certificates are provided in Appendix H.

11 Ground Conditions

The ground conditions are described in detail in the logs attached in Appendix D. The ground conditions on site have been summarised below based on the findings of this investigation along with the findings of previous investigations on site and on the adjacent land parcel. The ground conditions varied between the northern portion of the site where levels had been raised and the southern section.

11.1.1 Northern Half of Phase 4

Table 6: Summary of soils encountered in the north of the site (BH301-302, WS301-WS302, TP301-305)

Depth From (m)	Depth To (m)	Soil Type	Description
0.0	1.70 / 3.0	MADE GROUND	Brown sandy gravelly clayey MADE GROUND. Gravel comprises brick, flint, chalk and occasionally plastic, tile and glass
1.7 / 2.70	1.9 / 3.0	TOPSOIL (buried)	Dark brown sandy clayey buried TOPSOIL with abundant rootlets. Wood fragments noted in TP302 (WS301, TP301 and TP302 only)
1.80 / 2.90	2.50 / 5.0	CLAY	Firm to stiff brown mottled grey and reddish brown sandy silty CLAY.
2.50	3.60	SAND (BH301 only)	Loose orange brown clayey gravelly SAND
2.50 / 3.60	4.00 / 6.40	CHALK	Extremely weathered pale brownish white to white CHALK recovered as gravelly silt. Grade Om.
4.0 / 5.0	11 / 15	CHALK	Off white to white CHALK recovered as silty gravel.

The investigation indicates that the northern portion of Phase 4 is underlain by made ground which varied in thickness between 1.7m and 3.0. The made ground comprises gravelly clay and clayey gravel with the gravel comprising of flint, chalk and variable quantities of anthropogenic material including brick, tile, glass, plastic and wood. The made ground is underlain by firm to stiff slightly sandy silty clays to depths ranging between 2.5m and 5.0m bgl. The thickness of the clay varied significantly, where present, ranging from 0.1m to 2.75m. Additionally clay was absent in several locations with the made ground directly overlaying the chalk, notably in WS301-303 and TP304. BH301 reported a loose clayey gravelly sand from 2.5 to 3.6 m bgl. The depth to chalk varied from 2.5m to 3.6m bgl and was found to be relatively weathered within the upper 2m to 3m becoming less weathered with depth. The chalk below 10m was found to be very dense.

The clays were found to generally comprise firm to stiff brown clay. However, MTP17 and BHI03 both encountered soft grey to dark brown clays, which likely represent the margin of the more alluvial clays present on the central wetlands area to the east.

A ~200mm thick layer of buried topsoil with an organic odour was encountered at the base of the made ground within three locations namely WS301, TP301 and TP302. WS302 refused at 1.50 m on an obstruction.

11.1.2 Southern Half of Phase 4

Table 7: Summary of soils encountered in the south of the site (BH303, WS304-WS306).

Depth From (m)	Depth To (m)	Soil Type	Description
0.0	0.40	TOPSOIL	Orange, brown slightly clayey silty sandy TOPSOIL with rootlets. (WS304 and MTP18 only)
0.0	0.60 / 0.70	MADE GROUND	Brown sandy silty gravelly MADE GROUND. Gravel is fine to coarse flint, brick, concrete and wood.
0.40 / 0.70	2.10 / 2.20	CLAY	Firm brown slightly gravelly very silty CLAY. Gravel is fine sub-angular flint and fine to medium chalk.
0.60 / 2.20	10	CHALK	Off white CHALK recovered as slightly gravelly silt.

The ground conditions in the south of the site comprise either topsoil or made ground over firm clays. The made ground was encountered in WS305 and WS306 only and comparatively shallow compared to the north of the site extending to a maximum depth of 0.7m bgl. As with the northern area the clay thickness varied significantly with between 1.4 and 1.8m of clay encountered in WS304 and WS306 whilst WS305 encountered no clays with the made ground immediately overlaying the chalk bedrock. The upper 3m of the chalk was found to be relatively weathered becoming less weathered with depth and very dense below 7m bgl.

11.1.3 Groundwater

Groundwater strikes were recorded in the following trial holes:-

Table 8: Groundwater Strikes

Trial Hole	Date of water strike	Depth to Groundwater strike (mbgl)	Comments
BH103	24/01/2020	4.60	-
BH301	23/08/21	3.60	Groundwater rose by 100mm after 20minutes.
BH302	25/08/21	2.60	Groundwater rose by 200mm after 20minutes.
BH303	26/08/21	2.50	Groundwater rose by 900mm after 20minutes.
TP301	31/08/21	3.00	Slow groundwater seepage noted at 3.0m bgl.
TP302	31/08/21	3.40	Rapid groundwater seepage at 3.4m bgl.
TP303	31/08/21	3.35	Slow groundwater seepage at 3.35m bgl.
TP304	31/08/21	3.50	Rapid groundwater seepage at 3.5m bgl.
TP305	31/08/21	3.30	Slow groundwater seepage at 3.30m bgl.
WS301	03/09/21	3.00	Groundwater strike water did not rise
WS303	03/09/21	2.00	Groundwater strike water did not rise
WS304	03/09/21	2.60	Groundwater strike rising to 1.0 m after 5 minutes
WS305	03/09/21	1.50	Groundwater strike rising to 0.70 m after 5 minutes
WS306	03/09/21	3.00	Groundwater strike rising to 0.50 m after 5 minutes

Groundwater monitoring results are summarised as follows:-

Table 9: Groundwater Monitoring Results

Monitoring well	Depth to groundwater (mbgl)		
	20/09/21	27/09/21	04/10/21
BH301	2.28	2.29	Not accessible, as surrounding land flooded
BH303	0.72	0.72	0.48
WS301	2.70	2.71	1.76
WS302	Dry	Dry	Dry
WS303	Dry	1.54	1.36

The full monitoring results are provided in Appendix I. It should be noted that the third groundwater monitoring visit was undertaken during a period of heavy rain, as such it was not possible to access BH301.

11.1.4 Visual and Olfactory Evidence of Contamination

Visual and olfactory evidence of contamination noted during this phase of investigation works is summarised in the following table.

Table 10: Visual and Olfactory Evidence of Contamination

Location	Depth (m bgl)	Olfactory Evidence	Visual Evidence
BH301	0 - 1.0	-	Plastic and metal fragments observed
TP101	0.0 - 2.0	-	Blacktop, plastic bags and plastic piping and fragments of glass and timber noted.
	0.5	Faint ammonia odour	-
	2.8	Faint hydrocarbon odour	-
TP301	0.7	-	Fragments of plastic noted in the made ground.
	0.7 - 1.7	Organic odour	-
	1.7 - 1.9	Organic odour	Buried topsoil layer encountered.
TP302	0.6 - 1.9	-	Rare glass fragments
	1.9 - 2.1	Organic odour	Buried topsoil layer containing wood fragments.
TP303	0.0 - 0.9	-	Plastic fragments
	0.9 - 2.9	Organic odour	Black staining
TP304	0 - 2.4	-	Fragments of blacktop and wire.
TP305	0 - 1.1	-	Plastic fragments
	1.1 - 1.8	Organic odour	Black staining and tile fragments.
WS301	0.0-0.25	-	Blacktop gravel.
	1.3-2.7	Slight organic odour	-
	2.7-3.0	Organic odour	Black silty topsoil
WS302	0.0-0.5	-	Brick and blacktop gravel.
WS305	0.0-0.6	-	Whole bricks and brick gravel.

The raised area in the northern portion of the site is underlain by made ground significant quantities of anthropogenic material including, brick, concrete, blacktop and metal and plastic fragments. Additionally rare fragments of wood / timber were encountered. Trials pits TP301, TP302 and in window sampler WS301 a layer of possible buried topsoil was encountered,

with abundant rootlets noted in the trial pits at depth. Furthermore, organic odours were noted in five of the six trial pits and one of the windowless sampler locations.

D GEOTECHNICAL INFORMATION

12 Strata Encountered

12.1 Made Ground

The northern portion of the site is underlain by made ground land raise extending to a maximum proven depth of 3.0m bgl. The made ground generally comprises brown gravelly clays and clayey gravels with variable amounts of anthropogenic material including bricks, concrete, tile and some putrescible materials e.g. wood. Shallow thicknesses of made ground were also encountered in the southern section of Phase 4. However, these were less laterally extensive and were not present in some excavations.

Made ground or fill is by nature highly variable in both composition and bearing capacity, and can be subject to large differential settlements when loaded. It is therefore generally unsuitable for use as a bearing stratum. In addition, made ground may contain contaminated and/or putrescible material. It can therefore be potential source of contamination and landfill gas.

Table 11: Summary of Geotechnical Test Results for Made Ground

Test	Range
SPT 'N value'	5 - 11
DPT Blow Counts (blows per 100mm)	0 - 14 ^a
Moisture Content (%)	20 ^a
Liquid Limit (%)	34 ^a
Plastic Limit (%)	20 ^a
Plasticity Index (%)	14 ^a
W/S sulphate Content (g/l)	0.31 ^a
pH	10.2 ^a

^aBH103 at 1.00 m ^aexcluding isolated elevated reading from DPT310 at 2.9m (presumed to be rubble in made ground)

12.2 Topsoil

A layer of buried topsoil was encountered underlying the made ground in the north of the site. The layer was noted to contain organic material including rootlets and wood fragments and to give off an organic odour. Topsoil is not suitable as a load bearing stratum due to their compressibility along with the presence biodegradable material which has the potential to lead to longer term settlement.

12.3 Clay

The made ground/topsoil was generally underlain by firm to stiff clays, although softer clays were noted in places (WS304 and WS306). The results of the geotechnical laboratory testing are summarised in Table 12 below.

Table 12: Summary of Geotechnical Test Results for Clay

Test	Range
SPT 'N value'	0 - 11
DPT Blow Counts (blows per 100mm)	0 - 5
Moisture Content (%)	23 - 29.5
Liquid Limit (%)	30 - 51
Plastic Limit (%)	15 - 23
Plasticity Index (%)	10 - 33
Sulphate Content (g/l)	0.054-0.18
pH	8.1-8.8

12.4 Chalk

The clays and in some locations the made ground were underlain by Chalk to the full depth of investigation. The results of the geotechnical laboratory testing completed on the chalk are summarised in Table 13 below.

Table 13: Summary of Geotechnical Test Results for Chalk

Test	Range
SPT 'N' value	0 - 50
DPT Blow Counts (blows per 100mm)	0 - 15
Saturated Moisture Content (%)	14 - 22

Classification of the chalk to CIRIA C574¹⁰ was not possible due to the disturbed nature of the samples recovered from the cable percussion and windowless sampler boreholes. However, Standard Penetration Tests undertaken in the chalk returned SPT blow counts ranging from N=0 to N= >50, indicating highly weathered, structureless becoming intact chalk with depth. Low N values indicative of highly weathered chalk were generally only encountered to shallow depths <3.0m bgl noting that in WS306 N values were reported 0 at 2.0 m (at interface between clay and chalk) and at 3.0 m and in BH103 where an N value of 3

¹⁰ CIRIA C574 Engineering in Chalk (2002)

was recorded at 6m bgl. Below this weathered upper surface the chalk returned N values generally in excess of 15 and were generally found to exceed N=50 below 10m. The chalk returned intact dry densities of 1.69 – 1.97 Mg/m³, indicating the chalk encountered is medium to very high density, but typically high density. A plot of the SPTs vs depth is shown in Figure 3 Appendix B.

E GEOTECHNICAL APPRAISAL

13 Geotechnical Design

The foregoing geotechnical appraisal does not constitute a Geotechnical Design Report in accordance with BSEN1997. The following recommendations are for preliminary design purposes only.

For the detailed design, the short-term and long-term design situations must be considered. Where relevant, the following limit states should be considered:-

- Loss of equilibrium of the structure or the ground, considered as a rigid body, in which the strengths of structural material and the ground are significant in providing resistance (EQU)
- Internal failure or excessive deformation of the structure or structural elements in which the strength of structural materials is significant in providing resistance (STR)
- Failure or excessive deformation of the ground, in which the strength of soil or rock is significant in providing resistance (GEO)
- Loss of equilibrium of the structure or the ground due to uplift by water pressure or other vertical actions (UPL)
- Hydraulic heave, internal erosion and piping in the ground caused by hydraulic gradients (HYD)

The following factors should also be considered.

- Overall stability and ground movements
- Nature and size of the proposed construction including the design life
- Conditions with regards to the surroundings (e.g. neighbouring structures, traffic, utilities, vegetation, contamination etc.)
- Ground and groundwater conditions
- Influence of the environment.

14 Geotechnical Appraisal

14.1 Existing Raised Land

The northern section of the site is underlain by an area of made ground which ranges in thickness from 1.7m to >3.0m. It is understood that this made ground was placed in order to raise on site levels. The made ground generally comprised sandy clayey gravelly with variable portions of anthropogenic material including brick, concrete, tile, plastic and fragments of putrescible material including wood. In addition, three excavations encountered a 200mm thick layer of buried topsoil underlaying the fill material, which had a strong organic odour.

Given the presence of the topsoil at the base of the made ground along with the presence of degradable material within the made ground there is the potential for settlement should the existing fill be used as a load bearing stratum. DPT tests within the northern half of the site generally identified loose soils from GL to approximately 3.5 m bgl, and deeper (to 5.5 m and 6.0 m) in DPT307 and DPT310 respectively. Therefore, existing fill material is not considered suitable to be retained on site as part of the permanent works and should be removed prior to the commencement of development.

In addition, the buried topsoil and wood fragments noted present a potential source of combustible ground gas were they to remain in place.

14.2 Swelling and Shrinkage

Based on the laboratory test results in Section D, an overall classification of NHBC **MEDIUM** Volume Change Potential (VCP) is recommended for the clay soils.

Foundations will therefore require deepening in accordance with NHBC Chapter 4.2 where clay soils are encountered near trees. Foundation depths should be calculated based on the mature height of the tree, however, the existing height is relevant for trees which are to be removed.

14.3 Sulphates

2 No. samples of the clay were tested for sulphate content and pH. In accordance with the BRE¹¹ methodology and the number of samples tested, the site has been classified on the highest measured sulphate content.

Based on the results detailed in Section D and the above, the soils are classified by the BRE as sulphate design class DS-I, and, assuming a mobile groundwater table, the ACEC class is AC-I.

14.4 Groundwater

The groundwater monitoring results/observations are given in Section C11.1.3. Monitoring has recorded groundwater levels at between 0.48m and 2.71m bgl with the shallow depth to water noted in the south of the site, where ground levels have not been raised. On the basis of these results, groundwater at about 0.50 m below natural ground level should be anticipated during winter months, noting that it is proposed to raise ground levels for the proposed development.

¹¹ Building Research Establishment Special Digest 1: 2005. Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment.

Long term groundwater monitoring was beyond the scope of works and would be required to fully assess the groundwater regime.

14.5 Bearing Capacity and Foundations

14.5.1 Piling

For the ground conditions encountered on site, driven, bored or continuous flight augered (cfa) piles may be considered. However, given the proximity of adjacent buildings to the west, driven piles may be excluded due to the vibrations induced during installation and the effect these may have on existing buildings. Therefore, conventional bored or cfa piles may be more suitable. For the purposes of this preliminary pile design, it has been assumed that the existing raised levels will be removed. The proposed final site levels have not been made available and as such a thickness of 3m of compacted granular fill has been assumed across the site to enable design.

If trees are to be removed, particularly in the southern portion of the site then consideration of the effects of swelling of the clay soils and the potential for uplift should be considered. Allowance should be made for reinforcement of the upper half of the piles if uplift forces are anticipated.

Allowance should be made for negative skin friction loads where ground levels are to be raised.

Discussions should be held with the specialist piling contractors to assess the technical and financial merits of their various systems for the ground conditions encountered, and the depth and size of pile required, with an adequate safety margin.

The final pile design will be determined by the selected piling contractor as the method of pile formation will affect the bearing capacity. For the purpose of preliminary design, the following soil model may be adopted:

Table 14: Soil model for preliminary pile design

Depth to base (m)	Soil Type	Characteristic Shear Strength (kPa) / angle of shearing resistance (°) / SPT N-Value (Shaft resistance)	Characteristic Shear Strength (kPa) / angle of shearing resistance (°) (Base resistance)
3	MADE GROUND (FILL)	IGNORED IN DESIGN	IGNORED IN DESIGN
5	CLAY	3	-
8.5	Weathered CHALK	11	-
20.0	Intact CHALK	SPT N - 30 (50 below 12m)	SPT N - 30 (50 below 12m)

The fill material has been assumed to offer no shaft resistance. Adopting the above model and using the pile design methodology outlined in CIRIA C574, example calculations suggest that a 12m long 300mm diameter cfa pile could have a design compressive resistance of around 295kN, increasing to 465kN for a 400mm diameter pile of the same length and 495kN for a 300mm diameter pile to 15m. The final design must be carried out by the specialist contractor in accordance with their preferred method of formation.

Where a risk of dissolution features has been identified, this must be considered in the pile design. Dissolution features are rarely vertical and may be evident under significant thicknesses of intact chalk. On that basis, care must be taken to not rely on end bearing piles.

The investigations to date have identified very low strength soils at the upper surface of the chalk which may be indicative of some dissolution effects, but these have not been found to have propagated to surface nor extend significantly into the chalk. However, the construction of piles can have a destabilising effect on loosely infilled solution features if encountered, due to disturbance from both vibrations and the use of flush, and this in turn may affect the shaft integrity of cfa and cast-in place piles and should be taken into account in the final design.

14.6 Floor Slabs

With reference to NHBC Standard 5.2, suspended floor slabs are recommended:-

- Where the depth of fill exceeds 600mm
- Where foundations are deepened below 1.5m in accordance with NHBC Standards Chapter 4.2
- Where desiccated soils are encountered
- Where vibratory ground improvement techniques have been used
- On sloping sites
- Where foundations have been piled.

Given the intention to raise levels across Phase 4 and to pile the proposed structures suspended floor slabs are therefore recommended on site.

14.7 Excavations

Excavations in made ground and loose superficial soils are likely to be unstable and subject to collapse. Excavations in the silty clays and underlying chalk should be stable in the short term. However, excavations extending below the water table at approximately 0.48m bgl will require dewatering. Excavations will therefore be unstable in the long term and should be backfilled as soon as possible.

Appropriate Health and Safety precautions must be adhered to where man entry into excavations is required. Even stiff clay soils at shallow depth can collapse, particularly following wet weather. Alternative foundation methods may need to be adopted where trench footings cannot be safely or satisfactorily constructed.

14.8 Filling

It is understood that the ground levels across the site are to be raised prior to development. Further information pertaining to the level raise can be found in the Earthworks Compaction Specification LP2503. As outlined above prior to any filling/level raise taking place on site, the existing fill material in the north of the site along with the buried topsoil beneath should be removed. Placement of fill over the existing material would likely induce significant settlement, which could adversely affect foundation design, drainage etc.

14.9 Settlement

Based on the presumed bearing resistance given in Section 14.5 and the intention to pile foundations to the intact chalk at depth, settlements of proposed structures should be within typical tolerable limits for the low-rise development proposed.

Settlement of the loose/soft superficial soils should be anticipated where levels are raised. It is noted that in the north of the site the pre-existing land raise will have expected to have given rise to settlement already and hence there could be a more notable differential settlement between this area and the proposed area of new raise in the south of the site.

14.10 Heave and Uplift

In accordance with NHBC Standards Chapter 4.2, precautions against heave should be used where foundations are within the influence of trees and the resulting foundation depth is greater than 1.5m. Compressible material must be provided against the inside faces of all external wall foundations greater than 1.5m in depth. For pier and beam foundations, additional voids are required below ring beams.

For piled foundations, the effect of uplift induced by heave must be included in the pile design. Piles should be reinforced for the length of pile governed by the heave design, and allowance should be made for the inclusion of void former or similar on the underside of ground beams.

14.11 Solution Features

The site is situated within an area at risk of solution features. The investigations to date have identified very low strength soils at the upper surface of the chalk which may be indicative of some dissolution effects, but these have not been found to have propagated to surface nor extend significantly into the chalk. This report provides recommendations for precautions for the design of foundations on a site at risk of solution features and swallow holes. The precautions recommended within this report, if designed and constructed correctly, will minimise the risk to the proposed foundations and structures.

The risk of swallow holes opening within the wider site, away from structures, remains the same. As such the potential for swallow holes to occur on site cannot be discounted or designed against and the reputational (and possibly financial) impact of any such occurrence

should not be underestimated. It is essential that **all efforts to minimise surface water migration into the ground are adhered to**. In particular, the design of water supply and sewer pipes should take into account the potential for relatively large settlements to occur where ground levels are raised and be designed accordingly. Where possible, ground level raises should be avoided.

F GEO-ENVIRONMENTAL QUANTITATIVE RISK ASSESSMENT

15 Revised Conceptual Site Model

15.1 Introduction

The preliminary conceptual site model in Section C of the LEAP 2020 investigation report identified the land raise in the northern part of the site as the main onsite source of contamination. Potential off-site sources of contamination were identified as historical commercial land uses in the wetlands areas to the east, including above ground fuel storage, stockpiled demolition waste. An infilled reservoir to the immediate west (which may partially extend onto site) of the central part of the Phase 4 development could also be a potential source of land gas.

Following completion of the investigation no revisions to the CSM are considered necessary before carrying out the generic quantitative risk assessment (GQRA).

15.2 Distribution of Contamination

The exploratory logs are provided in Appendix D and a summary of the laboratory analytical results in Appendix G.

In the northern half of the site, made ground comprising grey brown to orange brown gravelly silty sandy clay was encountered to ~3.0 m with varying amounts of anthropogenic material. Possible 200-300 mm thick degraded topsoil was encountered below the made ground in places. Black staining and organic odours was noted within this made ground layer and a decomposing topsoil at depth. One trial pit location (TP101) from the previous investigation noted faint hydrocarbon odours at 2.8 m bgl. The previous investigation by LEAP did not identify elevated concentrations of potential contaminants in the land raise area, above screening criteria for a residential land use. Asbestos containing materials were not observed in the soils during the investigation.

The southern half contained a shallower made ground layer without evidence of gross contamination i.e. asbestos containing material, discoloured soils or visual/olfactory evidence of hydrocarbon contamination.

The distribution of exploratory holes was to enable better coverage of the southern half of Phase 4 area and also to provide gas monitoring wells in the vicinity of the infilled pond, which may be a land gas source.

15.3 Human Health

Given the nature of the contaminants encountered, plausible contaminant linkages for exposure to future residents and groundworkers at the site are confirmed as follows:

- Ingestion of contaminated soils.
- Inhalation of contaminated soil particles/dust and asbestos fibres.
- Dermal contact with contaminated soils.
- Ingestion of homegrown produce (future residents only).

As no evidence of VOCs was encountered, the inhalation of soil and groundwater-derived vapours was excluded as a plausible contaminant linkage.

15.4 Controlled Waters

The previous LEAP ground investigation did not identify a soil source that would pose a significant risk to controlled waters within the Phase 4 area. Earlier groundwater monitoring by others also did not report significantly elevated concentrations of potential contaminants of concern within groundwater samples across the wider NLDZ

15.5 Ground Gases

In the northern half of the site a 200-300 mm layer of degraded topsoil was encountered beneath the land raise in TP301, TP302 and WS301 during the intrusive investigation and as such the material could be a ground gas generation source.

The historical nursery reservoir adjacent to the west was also identified as a gas generating source in the revised CSM. BS8576:2013 suggests that ponds less than 15 m in diameter that were infilled +70 years ago have a very low gas generating potential. The reservoir was infilled ~2018 and is ~68 m x 63 m in size and was 2-3 m deep, based on LiDAR imagery dated 2017. Given the size and the unknown materials used to backfill the reservoir it is assigned a moderate gas generating potential. The site investigation encountered silty clayey gravelly made ground layer over chalk in land to the immediate south, north and east of the infilled reservoir, which is unlikely to significantly limit land gas migration, if the made ground extends into the reservoir area.

New utility service routes that extend across the reservoir into Phase 4 area may also act as preferential pathways for gas migration.

In the northern part of the site the shallow monitoring wells were generally not saturated to ~1.50 m depth, thus groundwater is not anticipated to limit gas migration through permeable stratum from shallow sources such as the buried topsoil layer. However, below these depths the chalk aquifer was fully saturated and where superficial deposits were present the clay soils appeared to act as a confining layer for the aquifer, which would retard gas migration.

However, due to the proximity of the historical infilled reservoir to the Phase 4 area, and the possibility of made ground extending to the reservoir and preferential pathways (new utility service routes) the migration of ground gases into the new buildings under extreme weather conditions cannot be discounted and this is retained as conservative but plausible contaminant linkage.

16 Human Health Risk Assessment

16.1 Rationale and Approach

The generic quantitative risk assessment (GQRA) for human health was conducted in line with the CLEA methodology by comparing the soil analytical results from both LEAP ground investigation across Phase 4 with Generic Assessment Criteria (GAC). The GACs were selected using the rationale and assumptions provided in Appendix J

Sets of soil GACs are available for SOMs of 1%, 2.5% and 6%. In this case, TOC in the Made Ground samples that were analysed ranged from 0.08 to 3.2%. Using the conversion of $SOM = TOC \times 1.72$, this equates to a SOM range of 0.14 to 5.5%, with an average of 1.64%. 1% SOM was considered to be appropriate to maintain conservatism.

For some contaminants of concern, direct contact will be the dominant pathway for exposure. In order to support with development options, human exposure to all unsaturated soils, irrespective of depth, has been considered for the purpose of this assessment. This will maximise the information available to the design team on the suitability of all unsaturated material and can support with their materials management options.

The risk assessment did not include statistical analysis. CL:AIRE 2020¹² provides guidance on the appropriate sample sizes for particular statistical distributions of data and non-targeted soil sampling approaches. The number of soil samples collected in the site investigation indicates that statistics are not appropriate to use in this case.

Future residents were determined in the revised CSM to be at potential risk from ground gases (carbon dioxide and methane). The quantitative assessment of these risks is provided as part of the wider evaluation of ground gases in Section 18.2.

16.2 Evaluation of Potential Risks to Future Residents

The soils that were analysed comprised made ground, topsoil and clay. The laboratory analytical results were assessed to determine the potential risks to future site users under a

¹² CL:AIRE, 2020 'Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.' CL:AIRE, Buckinghamshire. ISBN 978-1-905046-35-5.

generic residential land use scenario assuming that homegrown produce is consumed (resi HGP). The topsoil and clay samples were included with made ground soil samples, as statistical analysis is not being undertaken and only one sample of topsoil and one sample of clay was analysed. The quantitative risk assessment is provided in Appendix G and the laboratory certificates are provided in Appendix H. A summary table is provided in Table 15 below. Only detected compounds have been included within the table.

Table 15: Summary of Soil Contamination Test Results

Determinand	Number of samples	Number >LOD	Maximum Conc. (mg/kg unless otherwise stated)	Generic Assessment Criteria (mg/kg)	Number of Exceedances
METALS					
Arsenic	14	14	31.3	37	0
Cadmium	14	13	0.6	22	0
Chromium	14	14	34.8	910	0
Copper	14	14	65.6	2,400	0
Lead	14	14	47	200	0
Nickel	14	14	49.6	130	0
Zinc	14	14	192	3,700	0
ASBESTOS					
Asbestos	14	0	Not detected	Presence	0
HYDROCARBONS					
Benzo(a)pyrene ²	14	8	4.4	5.0	0
Naphthalene	14	1	6.5	2.3	1 TP304 at 0.5 m
Total PAHs	14	11	73.6	n.v.	-
Total petroleum hydrocarbons	2	2	15.7	Various (by carbon fraction)	0 for any carbon fraction

Notes to table

1. Assessment criterion based on inorganic mercury
 2. As a surrogate marker for genotoxic PAH
 3. As a marker compound for threshold PAH
- n.v. – no appropriate value

The laboratory testing only identified one potential contaminant of concern at concentrations above screening criteria, namely naphthalene in TP304 at 0.50 m. TP304 is located within the northern land raise area. The trial pit for TP304 log describes brown silty sandy clayey gravelly made ground with fine to coarse blacktop gravels throughout the made ground layer, which was proven to 2.40 m bgl.

A slight hydrocarbon odour was noted in TP101 at 2.90 m during the 2020 ground investigation, but a soil sample collected from this location did not detect petroleum hydrocarbons at concentrations above screening criteria.

Made ground samples from the southern half of the Phase 4 area did not identify potential contaminants of concern at concentrations above assessment criteria.

Asbestos was not identified in any of the soil samples tested.

16.3 Evaluation of Potential Risks to Groundworkers

There is a legal duty for employers to ensure that suitable health and safety controls should be in place to protect groundworkers and they should evaluate the potential for exposure including using data provided in this report which should be included in any future Health and Safety file for the site under The Construction (Design and Management) Regulations 2015.

In this case, employers should consider, amongst others: exposure to loose asbestos fibres, inhalation of gases in confined spaces such as excavation.

17 Controlled Waters Risk Assessment

Specific groundwater testing has not been carried out as part of this investigation. Concentrations of potential contaminants of concern in on site soils are generally low and were previously reported as generally in line with normal background concentrations for arsenic, cadmium, copper, mercury, nickel, lead and benzo(a)pyrene. Groundwater monitoring undertaken by Merebrook in 2014 did not identify significantly elevated concentrations of potential contaminants of concern in groundwater samples collected from across the wider NLDZ.

On the basis of the generally low concentrations of potential contaminants in made ground soils within the Phase 4 land area a significant risk to controlled waters has not been identified.

18 Ground Gas Risk Assessment

18.1 Rationale and Approach

An initial assessment has been made using the method outlined in BS8485:2015+AI:2019. Gas concentrations and borehole flow rate are combined to provide Gas Screening Values for both Carbon Dioxide and Methane. In this assessment steady state gas readings have been combined with steady state flow readings to provide a gas screening value for each borehole.

A Gas Screening Value is assigned to the site in conjunction with the conceptual site model and typical gassing levels associated with the identified source to characterise the gassing regime. Appropriate design protection measures are recommended in line with BS8485:2015.

18.2 Evaluation of Potential Risks from Ground Gas

18.2.1 Gas monitoring results

The gas monitoring results are summarised in Table 16 below:

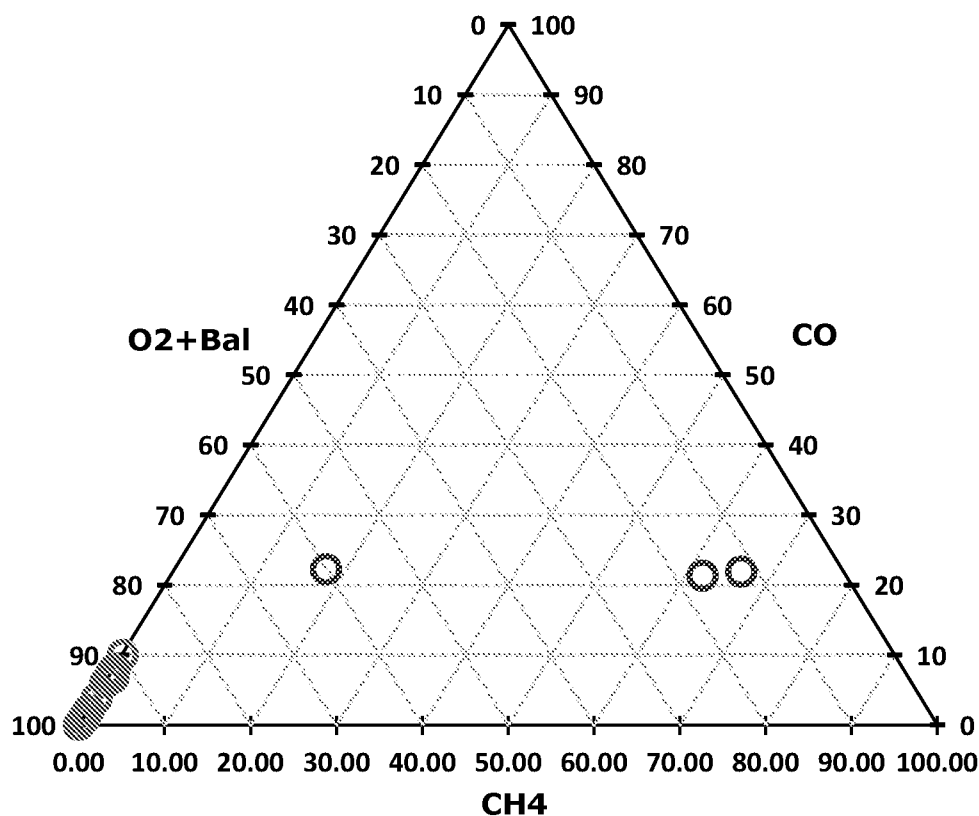
Table 16: Summary of land gas monitoring results

Monitoring Well Ref	Steady-State Recorded Concentration*						
	CO ₂ (%)	CH ₄ (%)	CO (%)	O ₂ (%)	Flow rate (l/hr)	Atmospheric Pressure (mB)	Was response zone flooded?
20/09/21							
WS301	3.9 (8.0)	0.2	1 (9)	18.6 (15.6)	0	1024	No
WS302	15.0 (21.2)	37.4 (62)	2 (6)	7.2 (0.9)	0	1023	No
BH301	6.8	0.2 (0.3)	1	6.8	0	1023	Partially
21/09/21							
WS302	5.1 (6.0)	0.1	0	17.8	0	1032	No
WS303	8.9 (10.6)	0.1 (5.7)	0	14.8 (13.5)	0	1032	No
BH303	0.1	0.1 (0.8)	0	21	0	1032	Flooded
27/09/21							
WS301	5.5 (7.3)	0.2	0	16.9 (15.6)	0	1011	No
WS302	16.6 (21.9)	43.3 (66.2)	1 (2)	5.4 (0.9)	0	1011	No

WS303	9.6 (10)	0.2	0	14.4	0	1011	No
BH301	6.5 (6.7)	0.7	0	11.8 (10.9)	0	1011	Partially
BH303	1.1 (1.9)	0.1	0	19.6 (18.8)	0	1011	Flooded
04/10/21							
WS301	2.1	0.1	0	18.4	-5.9 (-17)	1011	Flooded
WS302	2.4 (17.7)	0.6 (22.2)	0 (1)	19.9 (1.6)	0	1011	No
WS303	3.3 (3.7)	0.2	0	18.2	0	1011	Partially
BH301	Well inaccessible due to surface water flooding						
BH303	0.1 (1.0)	0.2	0 (1)	20.5 (17.7)	0.0 (-0.2)	1011	Flooded

* With the exception of oxygen which is recorded as minimum; value in parenthesis is maximum value if > steady state

A ternary plot of the monitoring data has been produced as provided below:



Note: Symbols in blue correspond to WS302 monitoring location.

We note that within BH303 the response zone was flooded on all monitoring rounds monitoring rounds, as such the results are not representative of land gases at the site. The response zone for WS301 was flooded on the third monitoring round, as such the results are also not representative for that round.

With the exception of WS302 methane was not detected at high concentrations in any of the monitoring wells. WS301, WS303 and BH301 reported steady state carbon dioxide at concentrations ranging between 0.2% to 8.9% without any corresponding flow rates. Gas ratios from WS301, WS303 and BH301 cluster in an area associated with aerobic soil respiration, which is reported¹³ as common in natural soils and low generation potential made ground, where concentrations of carbon dioxide above 5% may be expected. The gas monitoring results for WS302 fall within a zone associated with landfill gas migration on the ternary plot. No flow rates were reported in any of the monitoring wells.

18.2.2 Data base review

Three monitoring wells were installed within the made ground land raise to the north of the site and adjacent to the historical reservoir. The response zones of these wells were sufficiently located to target the made ground and the historical reservoir. Notably WS301 was in the northeast corner of the reservoir, WS302 was ~15 m east of the reservoir and WS303 ~15 m southeast of the reservoir.

The response zones within BH301 and BH303 were screened to intercept the groundwater within the chalk Aquifer. However, BH301 was sufficiently screened to allow gas monitoring of the chalk aquifer, which is considered to have low gas generation potential.

All readings were collected during high atmospheric pressure conditions. Pressure trends for 20-21st and 27th September and 4th October were high or rising high pressure events. None of the monitoring visits coincided with rapidly falling or low (<1000mB) atmospheric pressure trends.

Adopting figure 6 of BS8576:2013 gas monitoring over two to six months is suggested for moderate gas generating sources. Currently, land gas monitoring has been undertaken over a three week period.

Based on the above the current data set is inadequate to characterise the land gas risk from the identified sources due to the low number of monitoring rounds and absence of monitoring in low or falling atmospheric conditions.

¹³ “Using ternary plots for interpretation of ground gas monitoring results” Ground Gas Information Sheet No.1 Wilson *et al* 30/7/2018 © Ambisense Ltd and EPG Ltd

18.2.3 Derivation of gas situation values (GSV)

Adopting the methods described in section 18.1, and assuming a gas flow rate of 0.1 L/hr and the reported steady states value for each monitoring well the GSVs were calculated and the results presented below:

Table 17: Calculated Gas Screening Values

Monitoring well reference	GSV	
	Carbon Dioxide L/hr	Methane L/hr
20-21/09/21		
WS301	0.0039	0.0002
WS302	0.013	0.0374
WS303	0.0089	0.0001
BH301	0.0068	0.0002
27/09/21		
WS301	0.0053	0.0002
WS302	0.0166	0.0433
WS303	0.0094	0.0002
BH301	0.0063	0.0007
04/10/21		
WS301	0.0021	0.0001
WS302	0.0024	0.0006
WS303	0.0033	0.0002

A worst case check was undertaken using maximum flow (0.1 l/hr) and maximum gas readings for each stratum (made ground and chalk). Based on current readings, for made ground, the worst case GSV is 0.0219 L/hr for carbon dioxide and 0.0662 for methane. For chalk the worst case GSV is 0.0068 L/hr for carbon dioxide and 0.0008 for methane.

The steady state readings give a preliminary land gas risk classification of very low. However, for the reasons given in 18.2.2 the dataset is insufficient to give a meaningful gas risk characterisation at this stage, as there are a low number of monitoring rounds and lack of data during falling or low atmospheric pressure conditions. It is noted, however, that the existing made ground and underlying topsoil (which may be a source of the elevated readings) are to

be removed and reinstated with engineered fill. Monitoring is planned to recommence following that reinstatement, following which a more accurate characterisation can be made.

19 Waste Disposal

The existing raised area is not suitable geotechnically and it is anticipated that it will need to be removed from site as part of the construction process.

Where soils are to be disposed off-site, it is the duty of the waste producer, in this case Persimmon Homes (Thames Valley) Ltd, to ensure that all waste is disposed of appropriately and that any that is sent to landfill is sent to an appropriately licensed one. All waste sent to landfill must be classified and must be pre-treated. There are various forms of pre-treatment that are acceptable. In this case it could include “reduction in volume”, which could be achieved by segregating the Made Ground and re-using part of it on site.

Where made ground soil is to be re-used on site then it is recommended that this is carried out under the CL:AIRE Definition of Waste Industry Code of Practice (DoWCoP) for re-use of soils¹⁴.

A preliminary waste classification using the HazWasteOnline™ tool indicates the soil samples tested are characterised as non-hazardous. Asbestos containing material was not identified in any of the laboratory results for Phase 4 nor was it observed during site works.

Further testing and inspection of soils will be required to confirm waste classification of material leaving the site.

It is strongly advised that detailed discussions be held with remediation/groundworks contractors and that receiving landfill sites are identified in advance of commencing any waste removal.

20 Geo-Environmental Conclusions

20.1 Ground Conditions

The works to date have not identified any significant contamination with respect to identified human health receptors, with the exception of one sample collected from TP304 at 0.50 m where elevated naphthalene was identified. TP304 is located in northern land raise area, and blacktop gravels were identified through out the made ground at this location.

¹⁴ The Definition of Waste: Development Industry Code of Practice. Version 2 2011. CL:AIRE

We understand that the full extent of the made ground material in the northern land raise area will be removed, as it is not placed to a geotechnical specification. The removal of the made ground soil will remove the risk to future land users from naphthalene in soil at this location.

20.2 Groundwater

A risk to groundwater was not identified in the made ground or natural soils tested to date, based on the generally low concentrations of potential contaminants identified. Groundwater sampling has not been undertaken as it was outside of the scope works. Earlier investigations by others undertaken across the wider development zone did not identify significant groundwater contamination.

20.3 Ground Gases

The assessment of ground gases detected in the recent monitoring programme identified steady state concentrations of methane ranging from 0.1% to 43.3% in made ground soils and 0.2-0.7% in the upper chalk. Steady state carbon dioxide concentrations in made ground soils ranged from 2.1% to 16.6% and 3.3% to 6.8% in the upper chalk. Flow rates were not detected in any of the monitoring well locations.

The highest methane and carbon dioxide readings were noted in WS302, where the monitoring well was installed in made ground ~15 m east of the historical reservoir. WS301, which was installed within the northeast corner of the historical reservoir and WS303 which was located ~15 m southeast of the reservoir did not record methane or carbon dioxide in the same ranges as WS302. The ternary plot for gas readings from WS301, WS303 and BH301 suggest that the readings are typical of microbial respiration from 'typical' made ground or natural soils. The ternary plot of gas readings from WS302 were more associated with a zone for landfill gas migration. Given the low flows it is possible that the gases around WS302 are associated with localised decomposition of buried organic material or decomposing topsoil. The absence of similar methane and carbon dioxide readings in WS301 appears to rule out the historical reservoir as a potential significant gas generating source.

However, it is not possible to adequately assess the gas risk to the proposed development, based on the limited number of gas monitoring rounds and the absence of gas monitoring during falling or low atmospheric pressure conditions.

21 Geoenvironmental Recommendations

We understand that the made ground in the northern half of the site will be removed as part of the development, as it does not meet the required geotechnical design standards for the site. Any replacement soil will need to be compliant with chemical testing criteria for the proposed end-use as residential with home grown produce.

The suitability of material in the land raise for other purposes, such as required planting depths, as a growing medium, or its aesthetic quality for use in gardens, will also be considered by the developer prior to the placement of the material, with due consideration to applicable guidance and standards (for example BS 3882:2015¹⁵ and BS8601:2013¹⁶).

Stripping, handling, stockpiling and placing of site-won soils for reuse will be carried out in accordance with suitable methods to be determined by the earthworks contractor to ensure that the material is suitable for use, based on current best practice and guidelines, for example BS 3882:2015, BS8601:2013 and BS 6031:2009¹⁷.

During the made ground removal if high organic content waste or decomposing topsoil is encountered this should be removed, as it poses a potential land gas generating source. The formation level should be inspected by the contractor's geoenvironmental consultant following made ground removal to confirm the removal of deleterious material.

Monitoring wells WS301-303 should be maintained for future land gas monitoring during made ground removal in the northern area.

If WS301-303 cannot be maintained during the made ground removal then they should be replaced as soon as it is feasible to do so. We recommend that an additional six gas monitoring round are completed at weekly intervals and at least three of the rounds must be in low (<1000mb) or rapidly falling atmospheric pressure conditions.

Provision should also be made for dealing with further localised hotspots of contamination which may come to light during construction. Any such soils should be inspected by the validation engineers and appropriate remedial action taken as necessary.

Re-use of made ground at the site, as well as importation of uncontaminated natural materials will require a Materials Management Plan (MMP) to be produced and a declaration made to CL:AIRE under DoWCoP. The declaration is required before any material movements are made and requires an RMS to have been approved through planning.

Discussions should be held with remediation/groundworks contractors and that receiving landfill sites are identified in advance of commencing any waste removal.

This report should be included in the Health and Safety file for the development.

¹⁵ BS3883:2015 Specification for topsoil

¹⁶ BS8601:2013 Specification for subsoil and requirements for use

¹⁷ BS6031:2009 Code of practice for earthworks

APPENDIX A – Limitations

Limitations

LIMITATIONS

This report is confidential to the Client, and Leap Environmental Ltd accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Leap Environmental Ltd beforehand. Any such party relies upon the report at their own risk. Unless explicitly agreed otherwise in writing, this report has been prepared under LEAP's standard terms and conditions, as included in the quotation for this works.

This report has been prepared by Leap Environmental Ltd on the basis of information received from a variety of sources which Leap Environmental Ltd believes to be accurate. Nevertheless, Leap Environmental Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

Leap Environmental Ltd has used all reasonable skill, care and diligence in the design and execution of this report, taking into account the manpower and resources devoted to it in agreement with the Client. Although every reasonable effort has been made to obtain all relevant information, all potential contamination, environmental constraints or liabilities associated with the site may not necessarily have been revealed. LEAP cannot be held responsible for any disclosures or changes in regulation that are provided post production of this report, and will not automatically update the report.

The conclusions reached in this report are necessarily restricted to those which can be determined from the information consulted, and may be subject to amendment in the light of additional information becoming available. These conclusions may not be appropriate for alternative schemes.

The extent of the exploratory holes, laboratory testing and monitoring undertaken may have been restricted due to a number of factors including accessibility, the presence of buried or overhead services, current development and site usage, timescales or clients specification. The exploratory holes only assess a small proportion of the site area with respect to the site as a whole, and as such may only provide an overall assessment of ground conditions on site. The presence of hotspots of undisclosed contamination or exceptional and unforeseen ground conditions cannot be discounted.

Eurocode 7 gives guidance on the type of sampling, sample quality, number and spacing of intrusive investigations, and number of laboratory tests required. It is intended that the Geotechnical Information section of this report will fulfil the general requirements of the Ground Investigation Report as set out in section 6 of Eurocode7¹⁸, although this is subject to the restrictions imposed on the investigation as listed above. For geotechnical design, Eurocode 7 requires the Geotechnical Design Report to address both the geotechnical and

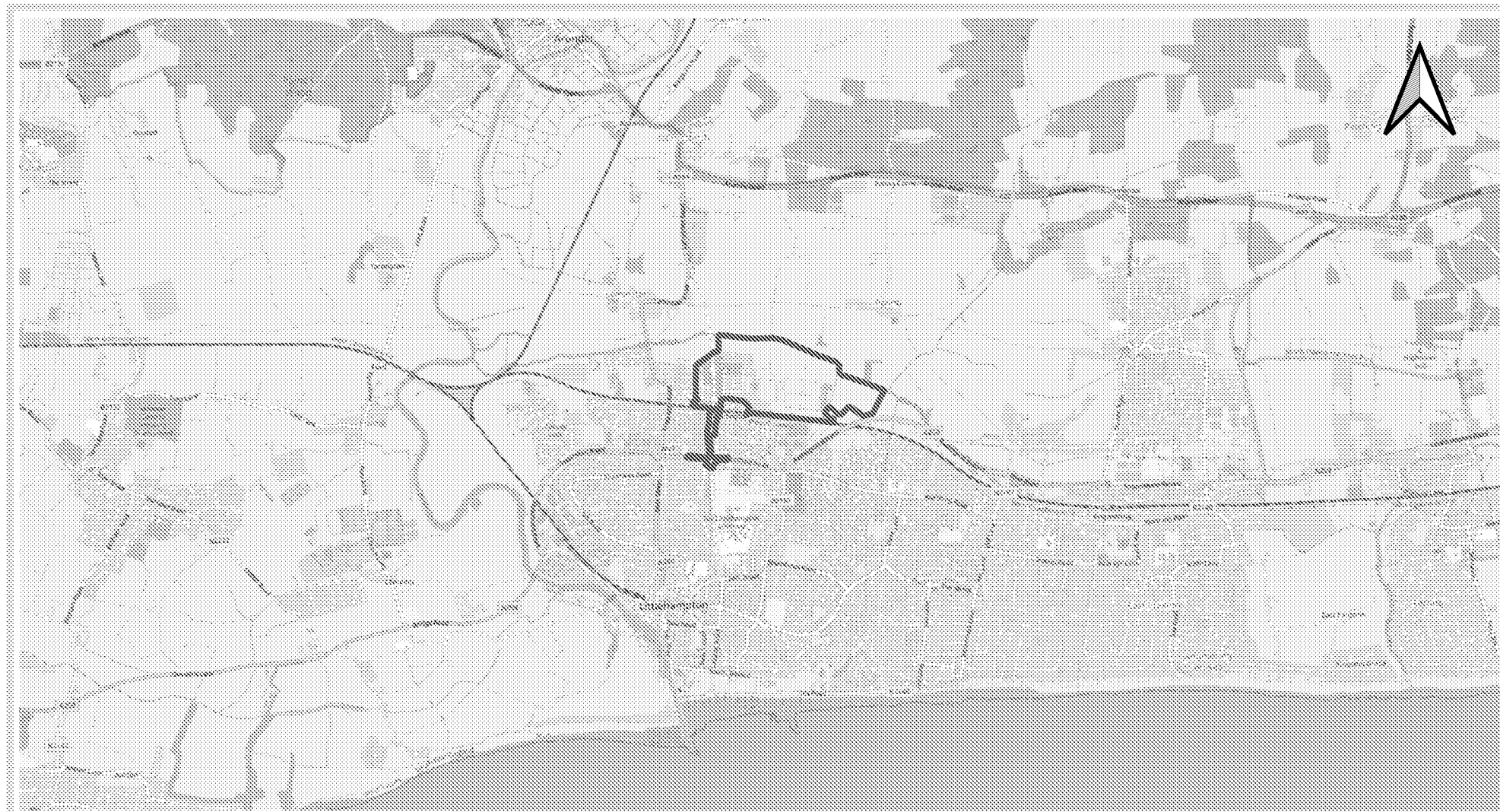
¹⁸ BS EN 1997 Eurocode 7- Geotechnical Design - Part 1: General Rules (2004) and Part 2: Ground Investigation and Testing (2007)

structural aspects of the geotechnical design for both the limit and serviceability states. The Geotechnical Appraisal section of this report will not meet the requirements of a Geotechnical Design Report (GDR), and should therefore be used for preliminary guidance only.

The presence of asbestos may be noted during the site walkover survey, intrusive investigations and/or from the results of contamination testing. However, this report does not constitute an asbestos survey. On this basis, the presence of asbestos on site cannot be discounted and a full asbestos survey should be undertaken.

APPENDIX B – Figures and Drawings

Figures and Drawings



Basemap: © OpenStreetMap contributors

 Site boundary

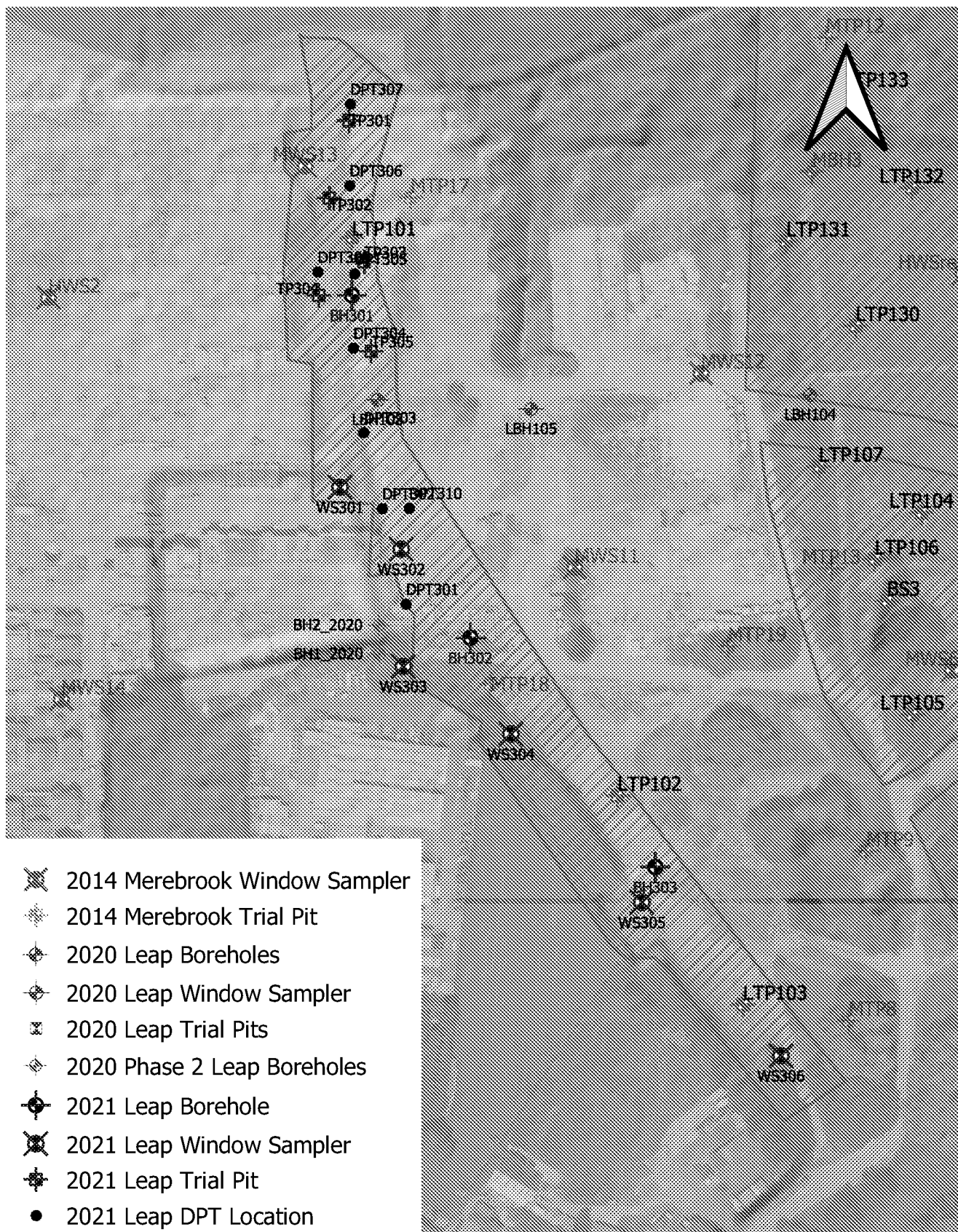


Client: Persimmon Homes
(Thames Valley) Ltd

Title: Site Location Plan Project ID: LP02694

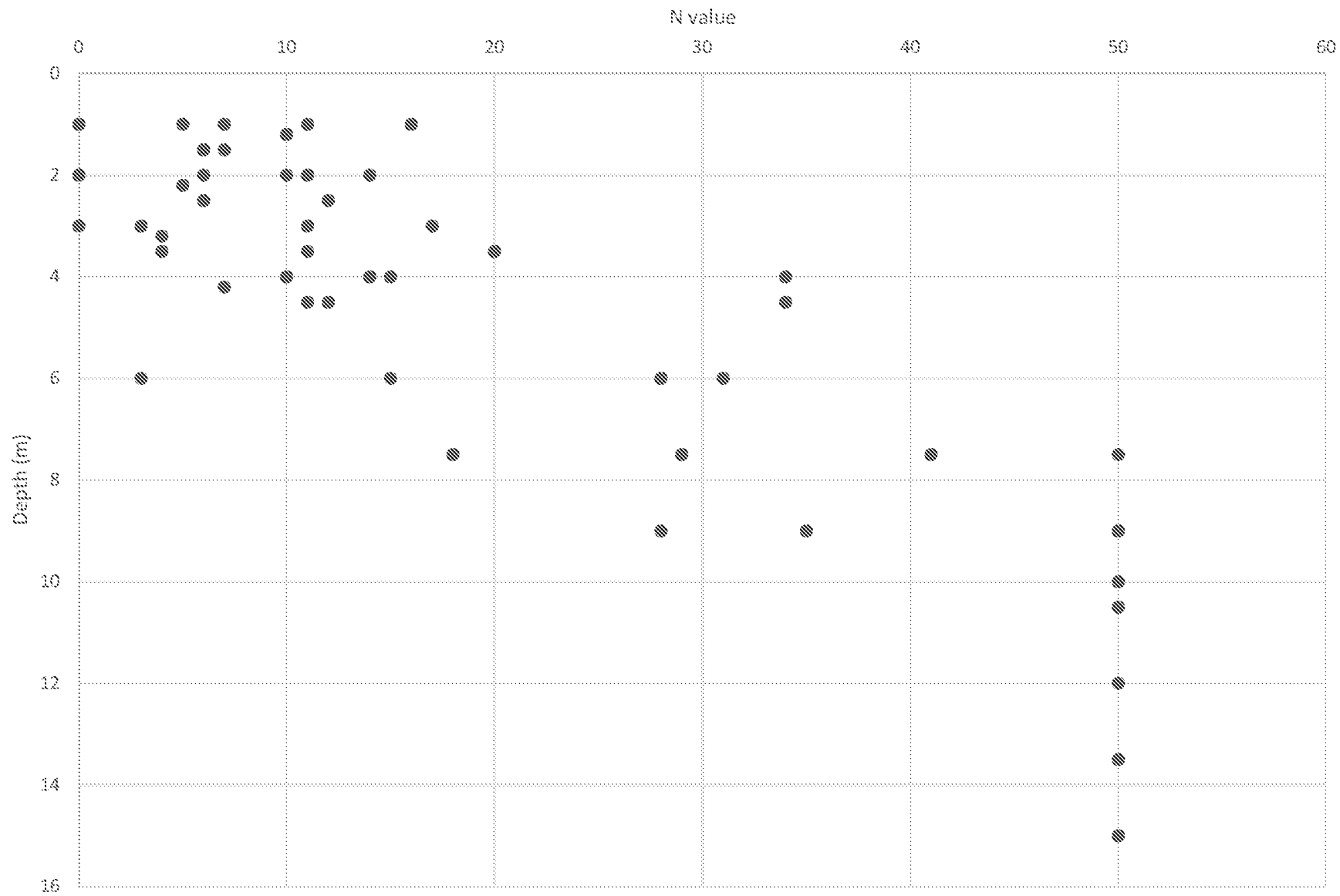
Project: Phase 4 Land Parcel

Date: 12/10/21 Figure No. 01



Basemap: © Bluesky International Limited and content available under the Open Government licence v3.0 unless otherwise stated © Crown Copyright 2020
 Note: 2021 locations set out by site engineer using hand held GPS equipment and should only be taken as approximate. Exploratory holes shown are not to scale. Elevations not shown

	Client:	Persimmon Homes (Thames Valley) Ltd	Title:	Exploratory Hole Plan	Project ID:	LP2694
	Project:	Phase 4 Land Parcel	Date:	12/10/21	Figure No.	02



	Client:	Persimmon Homes (Thames Valley) Ltd	Date:	12 th October 2021	Project ID:	LP2694
	Project:	North Littlehampton Phase 4	Title:	SPT-N vs Depth	Fig. No.	3

APPENDIX C – Photographic Record

Photographic Record

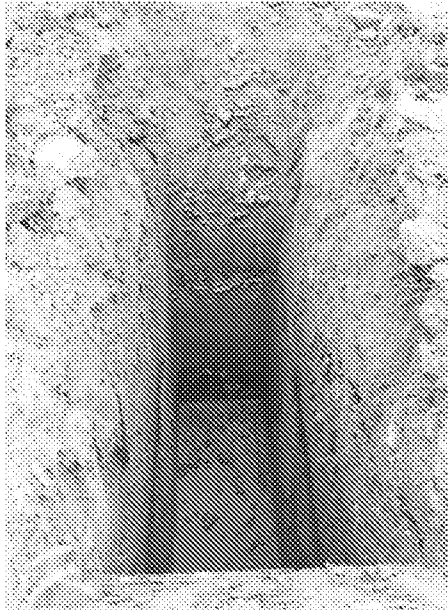


Plate 1 -- TP301



Plate 2 -- TP302

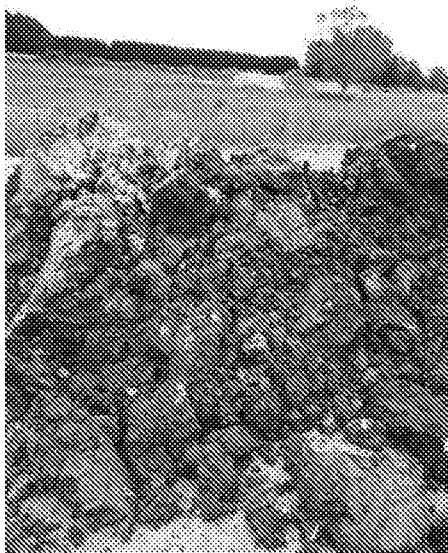


Plate 3 -- TP303 arisings

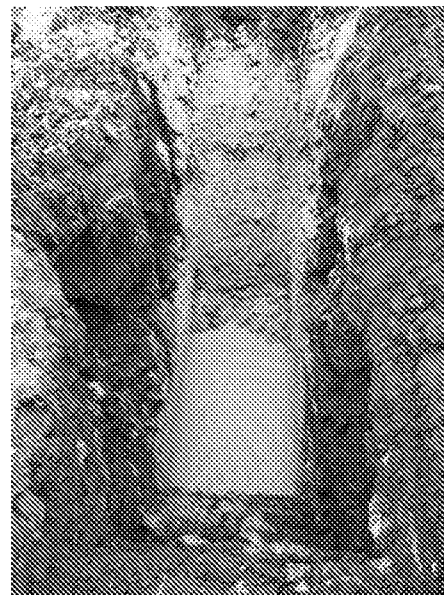


Plate 4 -- TP304



Plate 5 -- TP305 Arisings



Plate 6 -- TP305 facing north



Plate 7 -- WS303 location



Plate 8 -- WS303 Arisings



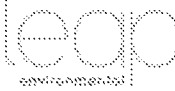
Plate 9 -- WS302 arisings

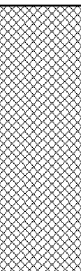


Plate 10 -- WS301 facing east

APPENDIX D – Exploratory Logs

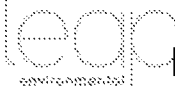
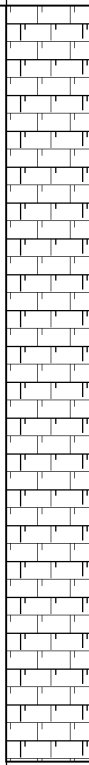
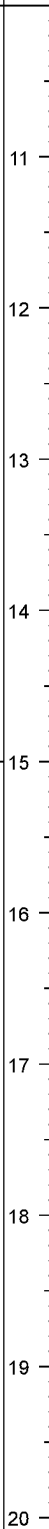
Exploratory Logs

 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. BH301 Sheet 1 of 2	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type CP	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:50			
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 23/08/2021 - 24/08/2021		Logged By KT			

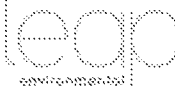
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	D					Brown sandy gravelly clayey MADE GROUND with occasional rootlets. Gravel is fine to coarse rounded to angular flint and rare fine brick. Iron nail and strip of black plastic membrane also noted.	1
		0.50	D						
		1.00	D						
		1.50	D						
		1.50	D						
		1.80	D	N=6 (1,0/1,2,1,2)	1.80			Firm brown mottled orange brown silty slightly sandy CLAY.	2
		2.10			2.10				
		2.50	D		2.50			Orange brown sandy slightly gravelly CLAY. Gravel is rare fine to medium sub-rounded to sub-angular chalk.	
		2.50	SPTL						
		2.50	S	N=6 (1,1/1,2,1,2)				Orange brown clayey gravelly SAND. Gravel is fine to coarse angular to sub-rounded flint and fine to medium sub-rounded chalk.	3
		3.00	B						
		3.50	SPTL		3.60			Pale brownish white weathered CHALK recovered as gravelly silt. Gravel is fine to coarse angular to sub-rounded medium dense chalk.	4
		3.50	S	N=4 (1,2/1,1,1,1)					
		4.00	B					Pale brownish white CHALK recovered as silty sandy gravel. Gravel is fine to coarse angular to sub-angular dense chalk.	5
		4.50	SPTL						
		4.50	S	N=11 (3,1/2,2,4,3)				Pale brownish white CHALK recovered as silty sandy gravel. Gravel is fine to coarse angular to sub-angular dense chalk.	6
		5.50	D						
		6.00	SPTL		6.40			Pale brownish white CHALK recovered as silty sandy gravel. Gravel is fine to coarse angular to sub-angular dense chalk.	7
	6.00	S	N=15 (11,11/5,3,3,4)						
	7.00	D					Pale brownish white CHALK recovered as silty sandy gravel. Gravel is fine to coarse angular to sub-angular dense chalk.	8	
	7.50	SPTL							
	7.50	S	N=41 (3,3/5,7,6,23)				Pale brownish white CHALK recovered as silty sandy gravel. Gravel is fine to coarse angular to sub-angular dense chalk.	9	
	8.50	D							
	9.00	SPTL					Pale brownish white CHALK recovered as silty sandy gravel. Gravel is fine to coarse angular to sub-angular dense chalk.	10	
	9.00	S	N=35 (4,5/8,11,9,7)						
	10.00	D				Continued on next sheet			

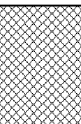
Remarks
 Install comprised plain pipe and bentonite to 2m and slotted pipe and gravel to 5m. Drilled to 4.5m in 200mm then reduced to 150mm and drilled to 15m.



 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. BH301 Sheet 2 of 2	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type CP	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:50			
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 23/08/2021 - 24/08/2021		Logged By KT			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	SPTL	50 (25 for 145mm/50 for 222mm)	15.00				
		10.50	S						
		11.50	D						
		12.00	SPTL	50 (25 for 120mm/50 for 122mm)					
		12.00	S						
		13.00	D						
		13.50	SPTL	50 (25 for 146mm/50 for 105mm)					
		13.50	S						
		14.50	D						
		15.00	SPTL	50 (11,8/50 for 99mm)					
	15.00	S							
End of borehole at 15.00 m									
Remarks Install comprised plain pipe and bentonite to 2m and slotted pipe and gravel to 5m. Drilled to 4.5m in 200mm then reduced to 150mm and drilled to 15m.									

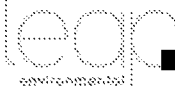


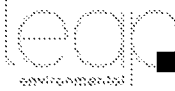
 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com		Borehole Log			Borehole No. BH302 Sheet 1 of 2	
Project Name: Phase 4 North Littlehampton		Project No. LP2694		Co-ords: -		Hole Type CP
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP		Level:		Scale 1:50		
Client: Persimmon Homes (Thames Valley) Ltd		Dates: 25/08/2021 - 25/08/2021		Logged By KT		

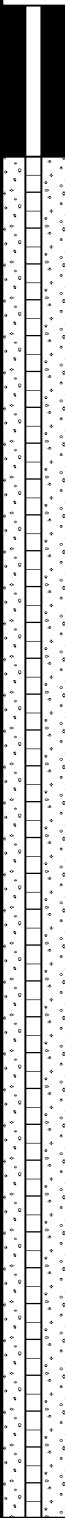
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	D				 Brown silty sandy gravelly clayey MADE GROUND. Gravel is fine to coarse sub-rounded to angular flint, medium sub-rounded chalk, rare fine brick, rare glass fragments, and rare fine clinker.	1	
		0.50	D						
		1.00	D		0.80				
			1.50		N=6 (1,2/2,1,2,1)	1.40	 White CHALK FILL comprising medium to coarse angular to sub-rounded dense chalk gravel.	2	
		2.00	D						
		2.50	D		2.50				
		2.50	SPTL				 Brownish white weathered CHALK recovered as clayey gravelly silt. Gravel is fine to cobble sized sub-rounded to sub-angular dense chalk.	3	
		2.50	S		N=6 (1,1/1,1,2,2)				
		3.00	D						
			3.50	SPTL			 Dark grey staining noted in chalk putty with organic odour.	4	
		3.50	S		N=11 (2,2/3,3,3,2)				
		4.00	D		4.00				
			4.50	SPTL			 White CHALK recovered as silty gravel. Gravel is fine to coarse angular to sub-rounded dense chalk.	5	
		4.50	S		N=12 (1,2/2,3,3,4)				
		5.50	D						
			6.00	SPTL			 White CHALK recovered as silty gravel. Gravel is fine to coarse angular to sub-rounded dense chalk.	6	
		6.00	S		N=28 (3,4/4,9,7,8)				
		7.00	D						
		7.50	SPTL			 White CHALK recovered as silty gravel. Gravel is fine to coarse angular to sub-rounded dense chalk.	7		
	7.50	S		N=29 (5,3/4,9,8,8)					
	8.50	D							
		9.00	SPTL			 White CHALK recovered as silty gravel. Gravel is fine to coarse angular to sub-rounded dense chalk.	8		
	9.00	S		N=50 (4,9/50 for 297mm)					
	10.00	D							
		10.00	D					10	

Remarks Borehole was backfilled with arisings		Continued on next sheet
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 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. BH302 Sheet 2 of 2	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type CP	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:50			
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 25/08/2021 - 25/08/2021		Logged By KT			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	SPTL	50 (25 for 143mm/50 for 142mm)	11.00				11
		10.50	S						
		11.00	D						
									12
									13
									14
									15
									16
									17
									18
									19
									20
Remarks Borehole was backfilled with arisings									

 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. BH303 Sheet 1 of 2	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type CP	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:50			
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 26/08/2021 - 27/08/2021		Logged By KT			

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	D					Brown sandy gravelly clayey MADE GROUND. Gravel is fine to coarse angular to sub-angular flint. Strip of black plastic membrane noted.	
		0.50	D		0.50			Brown mottled red brown sandy gravelly CLAY. Gravel is fine to coarse angular to sub-angular flint and rare fine chalk.	
		1.00	D						1
		1.20	D		1.20				
		1.50	SPTL					Pale brownish white weathered CHALK recovered as gravelly silt. Gravel is fine to medium sub-angular to sub-rounded chalk.	
		1.50	S	N=7 (1,2/2,2,1,2)					
		2.00	D		2.00			White CHALK recovered as silty gravel. Gravel is fine to cobble-sized sub-rounded to sub-angular dense chalk	2
		2.50	SPTL						
		2.50	S	N=12 (3,3/3,3,3,3)					
		3.00	D						3
		3.50	SPTL						
		3.50	S	N=20 (3,3/4,4,6,6)					
		4.00	D						4
		4.50	SPTL						
		4.50	S	N=34 (1,5/4,4,11,15)					
		5.50	D						5
		6.00	SPTL						
		6.00	S	N=31 (1,2/6,7,9,9)					
	7.00	D						7	
	7.50	SPTL							
	7.50	S	N=50 (5,8/50 for 252mm)						
	8.50	D						8	
	9.00	SPTL							
	9.00	S	N=50 (2,4/50 for 243mm)						
				10.00				9	
								10	

Continued on next sheet

Remarks Drilled to 7.5m in 200mm then reduced to 150mm and drilled to 11m. Install comprised plain pipe and bentonite to 1m and slotted pipe and gravel with some arisings to 11m.		
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Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP301 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: - Level:		Date 31/08/2021	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP						Dimensions (m): Depth 3.30		Scale 1:25 Logged KT	
Client: Persimmon Homes (Thames Valley) Ltd									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼	0.05	ES		0.70			Brown sandy clayey gravelly MADE GROUND. Gravel is fine to cobble-sized brick, fine to coarse angular to sub-angular flint, fine to coarse sub-rounded to angular chalk, with rare strips of black plastic membrane.	1
	0.50	B					Dark grey brown slightly sandy gravelly clayey MADE GROUND with organic odour throughout. Gravel is fine to cobble-sized brick, fine to cobble-sized angular to sub-angular flint, rare fine to medium sub-rounded to sub-angular chalk.	
	1.20	B					Dark brown sandy clayey TOPSOIL with abundant roots and rootlets. Organic odour throughout.	
	2.00	D		1.90		Stiff becoming firm brown mottled grey silty CLAY.	2	
						Hand Pen at 2.3m = 250kPa		
	3.30	D		3.30			Very slow seepage on eastern wall at 3m.	3
							End of pit at 3.30 m	
							5	

Remarks:	Very slow seepage noted at 3m on the eastern wall of the pit. Trial pit remained stable and was backfilled with arisings.	
Stability:	Stable	

Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP302 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: - Level:		Date 31/08/2021	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP						Dimensions (m): Depth 3.40		Scale 1:25	
Client: Persimmon Homes (Thames Valley) Ltd								Logged KT	

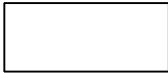
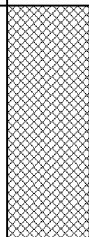
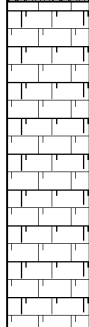
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼	0.10	ES		0.60			Brown sandy silty gravelly slightly clayey MADE GROUND. Gravel is fine to coarse brick, fine to coarse rounded to sub-angular chalk, fine to coarse angular to sub-rounded flint.	1
	0.70	B					Brown slightly sandy clayey gravelly MADE GROUND with occasional black staining throughout. Gravel is fine to cobble-sized brick, fine to coarse rounded to sub-angular chalk, fine to coarse angular to sub-rounded flint, with rare medium glass fragments.	
	1.50	B		1.90 2.10		Dark brown sandy clayey TOPSOIL with abundant roots, rootlets, and wood fragments. Organic odour throughout.	2	
	1.95	ES				Stiff brown mottled grey silty CLAY. Hand Pen at 2.3m = 260kPa		
	2.70	D		3.00 3.40		Extremely weathered pale brownish white CHALK comprising gravelly silt. Gravel is fine to coarse rounded to sub-angular medium dense to dense chalk. Grade Dm.	3	
	3.40	B				Rapid seepage at base of pit. End of pit at 3.40 m		
								4
								5

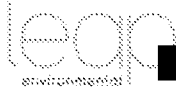
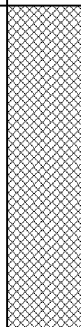
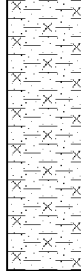
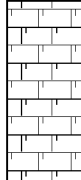
Remarks: Rapid seepage noted at the base of the pit. Trial pit remained stable and was backfilled with arisings.		
Stability: Stable		

Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP303 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: - Level:		Date 31/08/2021	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP						Dimensions (m): Depth 3.35		Scale 1:25	
Client: Persimmon Homes (Thames Valley) Ltd								Logged KT	

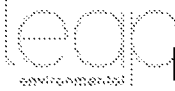
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.80	B		0.90		[Pattern]	Brown sandy clayey silty gravelly MADE GROUND with frequent rootlets throughout. Gravel is medium to cobble-sized concrete, fine to cobble-sized brick, fine to cobble-sized angular to sub-rounded flint, and rare plastic fragments.	1
	1.00	ES				[Pattern]	Brown mottled dark grey clayey slightly sandy gravelly MADE GROUND. Gravel is fine to cobble-sized brick, fine to coarse angular to sub-rounded flint, rare fine to coarse sub-rounded to sub-angular chalk. Frequent black stains with organic odour present throughout.	
	1.70	B				[Pattern]		2
	2.00	ES				[Pattern]		
	2.95	D		2.90 3.00		[Pattern]	Firm brown mottled grey sandy silty CLAY. <i>Hand Pen at 2.95m = 105kPa</i> Extremely weathered pale brownish white CHALK comprising gravelly silt. Gravel is fine to coarse rounded to sub-rounded medium dense to dense chalk. Grade Dm.	3
3.35	B		3.35		[Pattern]	<i>Slow seepages at base of pit within chalk.</i> End of pit at 3.35 m	4	
								5

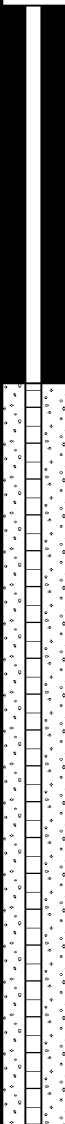
Remarks:	Multiple slow seepages were noted at the base of the pit within the chalk. Trial pit remained stable and was backfilled with arisings.	
Stability:	Stable	

 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP304 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: - Level:		Date 31/08/2021	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP						Dimensions (m): Depth 3.50		Scale 1:25	
Client: Persimmon Homes (Thames Valley) Ltd								Logged KT	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.50 0.60	ES B		0.80			Brown silty sandy slightly clayey gravelly MADE GROUND. Gravel is fine to cobble-sized concrete, fine to medium angular to sub-angular flint, abundant medium to coarse blacktop.		
							Brown slightly sandy clayey gravelly MADE GROUND. Gravel is fine to coarse angular to sub-rounded flint, occasional fine to medium blacktop, and fine to boulder-sized concrete, with occasional fragments of wire. <i>Tabular concrete block between 1 and 1.1m.</i>		
	2.50	B		2.40			White CHALK comprising silty gravel. Gravel is medium to cobble-sized angular to sub-angular dense chalk.		
	3.50	B		3.50			Reddish brown weathering observed on chalk joint surfaces between 2.4 and 3.5m. <i>Rapid water ingress from base of pit within chalk.</i> End of pit at 3.50 m		
Remarks: Rapid water ingress was noted from the base of the pit within the chalk. The water level rose to 3.1 m in 5 minutes. The east and west walls of the pit collapsed within the chalk. Trial pit was backfilled with arisings. 									
Stability: Unstable									

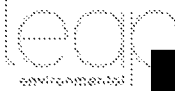
 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP305 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: - Level:		Date 31/08/2021	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP						Dimensions (m): Depth 3.30		Scale 1:25	
Client: Persimmon Homes (Thames Valley) Ltd								Logged KT	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.90	B		1.10			Brown sandy silty gravelly MADE GROUND. Gravel is fine to coarse sub-rounded to sub-angular chalk, fine to coarse angular to sub-rounded flint, fine to cobble-sized brick, fine to medium concrete, with rare plastic fragments.		
	1.50	ES					Brown slightly sandy clayey gravelly MADE GROUND with organic odour and black staining throughout. Gravel is fine to coarse brick, fine to boulder-sized concrete, occasional fine to medium sub-rounded chalk, fine to medium angular to sub-rounded flint, and rare tile fragments.		
	1.60	B		1.80			Stiff orange brown mottled grey sandy silty CLAY with occasional dark grey staining. <u>Hand Pen at 1.9m = 230kPa</u>		
	2.00	D					Weathered pale greyish white CHALK comprising silty gravel. Gravel is fine to cobble-sized angular to rounded dense chalk. <u>Reddish brown weathering observed on chalk joint surfaces between 2.7 and 3.3m.</u>		
	3.30	B		3.30			<u>Minor seepage at base of pit within chalk.</u> End of pit at 3.30 m		
Remarks: Minor seepage was noted at the base of the pit within the chalk. Trial pit remained stable and was backfilled with arisings.									
Stability: Stable									

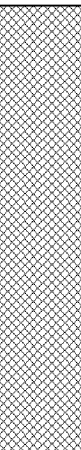
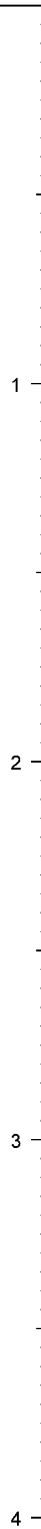
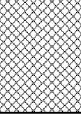


 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. WS301 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type WS	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:20			
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 03/09/2021 - 03/09/2021		Logged By CW			

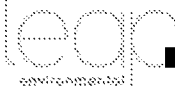
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.25		MADE GROUND: Light brown silty gravel, gravel is flint, concrete and blacktop.	1	
		0.40	ES						MADE GROUND: Brown silty sandy clayey gravel, gravel is fine to coarse angular flint, brick and concrete.
		1.00		N=11 (1,2/3,2,3,3)	1.30		Becoming very clayey below 1.2m.		
		1.50	D				MADE GROUND: Dark grey brown gravelly clay with gravel of fine to medium rounded flint, brick and chalk. Slight organic smell.		
		1.60	ES		2.70		Hand Pen at 1.5m = 400kPa		
		2.00		N=6 (1,1/1,1,2,2)			Recovery between 2-3m approx. 50%.		
		2.50	D		3.00		Hand Pen at 2.6m = 420kPa	3	
		3.00		N=3 (2,1/1,0,1,1)			MADE GROUND: Black silty clayey topsoil with organic smell.		
	3.50	D		4.00		Orange and offwhite CHALK recovered as very silty clayey structureless chalk with gravel of fine to medium, medium density chalk clasts.	4		
	4.00		N=15 (3,2/3,2,5,5)			Recovery between 3-4m approx. 40%.			
End of borehole at 4.00 m									

Remarks Borehole was cased to 4m with groundwater seep at 3m. Installation of groundwater and ground gas monitoring well with 1m plain pipe with bentonite surround and 2m slotted pipe with gravel surround, backfill with arisings between 3-4m. Poor recovery between 2-3m and 3-4m.	
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 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA		Borehole Log				Borehole No. WS302 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton		Project No. LP2694		Co-ords: -		Hole Type WS	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP		Level:		Scale 1:20		Logged By CW	
Client: Persimmon Homes (Thames Valley) Ltd		Dates: 03/09/2021 - 03/09/2021					

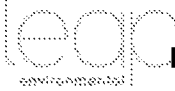
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES				MADE GROUND: Light brown slightly clayey sandy very silty gravel, gravel is fint to coarse angular brick, blacktop and chalk.		
		0.70	ES						
		1.00		N=7 (2,2/2,1,2,2)	1.20				
		1.40	D						
	1.50	ES		1.50			MADE GROUND: Dark grey brown mottled red silty gravely clay, gravel is fine to coarse angular brick and flint.		
End of borehole at 1.50 m									

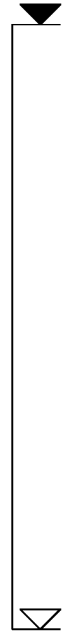
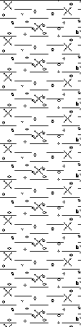
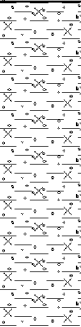
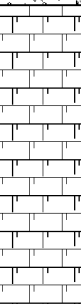
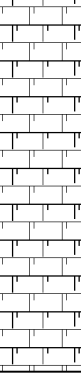
Remarks Borehole remained dry and stable with a refusal at 1.5m. Installation of groundwater and ground gas monitoring well with 1m plain pipe with bentonite surround and 0.5m slotted pipe with gravel surround.	
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 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log			Borehole No. WS303 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type WS
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:20		
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 03/09/2021 - 03/09/2021		Logged By CW		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.15		MADE GROUND: Grey brown sandy very silty gravel, gravel is fine to coarse angular flint and concrete.		
		0.35	ES				MADE GROUND: Brown, orange brown mottled black slightly gravelly silty clay, gravel is fine to medium angular flint.		
					0.70				
		1.00		N=5 (1,1/1,1,1,2)				MADE GROUND: Black and white silty gravel, gravel is fine to coarse offwhite chalk clasts. <u>No recovery between 1-2m.</u>	1
		2.00		N=10 (3,3/2,2,3,3)	2.00			Offwhite stained brown and grey CHALK recovered as: slightly gravelly very silty clayey structureless chalk with fine orange silt partings. Gravel is fine to medium chalk clasts and fine to medium angular flint. <u>Hand Pen at 2.5m = 320kPa</u>	2
		2.70	D						
		3.00		N=17 (5,4/4,3,4,6)				<u>No recovery between 3-4m.</u>	3
					4.00			<u>End of borehole at 4.00 m</u>	4

Remarks Borehole was collapsing below 1.5m, with groundwater strike at 2m. Groundwater did not rise. Installation of groundwater and ground gas monitoring well with 1m plain pipe with bentonite surround and 0.5m slotted pipe with gravel surround, backfill with arisings between 1.5-4m. No recovery between 1-2m and 3-4m.	
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 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com		Borehole Log			Borehole No. WS304 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton		Project No. LP2694		Co-ords: -		Hole Type WS
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP		Level:		Scale 1:20		
Client: Persimmon Homes (Thames Valley) Ltd		Dates: 03/09/2021 - 03/09/2021		Logged By CW		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.40				
		1.00 1.00	D	N=0 (0,0/0,0,0,0)	1.30			1	
		2.00 2.00	D	N=11 (2,3/3,5,2,1)	2.20			2	
		3.00		N=11 (3,3/4,3,2,2)				3	
		4.00		N=10 (3,3/2,3,3,2)	4.00			4	

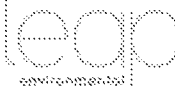
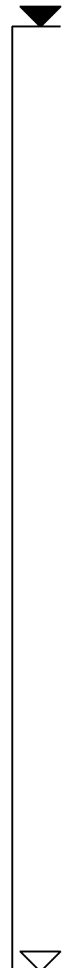
Remarks Borehole remained stable but with poor recovery between 3-4m. Groundwater strike at 2.6m rising to 1m in 5 minutes. Backfilled with arisings. Poor recovery between 3-4m.	
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Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. WS305 Sheet 1 of 2	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type WS	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:20			
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 03/09/2021 - 03/09/2021		Logged By CW			

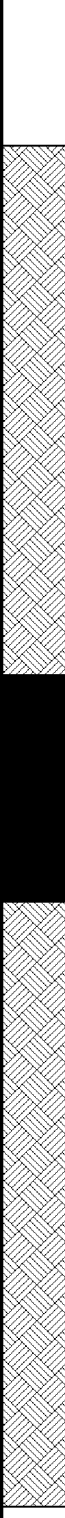
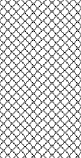
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES				MADE GROUND: Brown sandy silty gravel, gravel is fine to coarse brick and whole brick.		
		0.30							
	0.50	ES					MADE GROUND: Brown and white silty gravel, gravel is fine to coarse angular brick, fine to coarse chalk clasts and medium to coarse angular flint.		
	0.60								
	1.00 1.00	D	N=16 (3,2/4,3,5,4)				Offwhite CHALK recovered as very silty gravelly clayey structureless chalk with gravel of fine to coarse medium dense chalk clasts.	1	
2.00 2.00	D	N=14 (3,6/3,3,4,4)					2		
3.00									
		3.00		N=17 (3,4/4,6,4,3)			Becoming more gravelly in recovery below 3m.	3	
		4.00	D		4.00			4	

Continued on next sheet

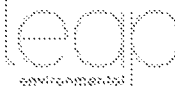
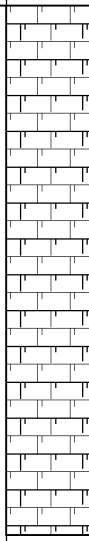
Remarks
Borehole remained stable with a groundwater strike at 1.5m rising to 0.7m in 5 minutes. Backfilled with arisings.

 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. WS306 Sheet 1 of 1	
Project Name: Phase 4 North Littlehampton				Project No. LP2694		Co-ords: -		Hole Type WS	
Location: Phase 4 North Littlehampton, West Sussex BN17 7PP				Level:		Scale 1:20			
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 03/09/2021 - 03/09/2021		Logged By CW			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.30		MADE GROUND: Brown sandy silty gravel, gravel is medium to coarse brick, flint and concrete with abundant wood.	1 2 3 4	
		0.40	ES				MADE GROUND: Grey brown slightly gravelly silty clay, gravel is occasional fine to coarse angular flint.		
		0.80	ES				Firm grey and brown mottled orange silty CLAY with ironstaining and rootlets. <u>Hand Pen at 0.7m =220kPa</u> <u>Hand Pen at 0.8m =250kPa</u>		
		1.00	D	N=0 (0,0/0,0,0,0)	2.10		<u>Becoming softer with depth below 1.5m.</u> <u>Hand Pen at 1.6m =120kPa</u>		
		1.00							
		2.00	D	N=0 (0,0/0,0,0,0)					
		2.00							
			3.00	D	N=0 (0,0/0,0,0,0)	4.00			Brown white CHALK recovered as slightly gravelly very silty structureless chalk, gravel is fine to coarse medium dense chalk clasts. <u>Hand Pen at 3m =330kPa</u>
		3.00							
		4.00							
	4.00								
		4.00		N=14 (4,3/5,4,3,2)	4.00		End of borehole at 4.00 m		
Remarks Borehole remained stable with a groundwater strike at 3m rising to 0.5m in 5 minutes. Backfilled with arisings.									

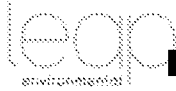
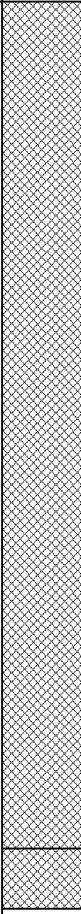


 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. BH103 Sheet 1 of 2	
Project Name: North Littlehampton				Project No. LP2128		Co-ords: -		Hole Type CP	
Location: Land near Wick, North Littlehampton, West Sussex, BN17 7PP				Level:		Scale 1:50			
Client: Persimmon Homes Thames Valley				Dates: 23/01/2020 - 27/01/2020		Logged By OA			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		1.00 1.20	B	N=10 (1,0/1,3,3,3)	1.10		 Brown to dark brown silty sandy gravelly clay MADE GROUND with gravel subangular to subrounded of fine to coarse and cobbles of flint.	1	
		2.00 2.20	B	N=5 (1,1/1,1,2,1)	2.10		 Dark brown gravelly CLAY with gravel of subangular to subrounded fine to coarse and cobbles of flint.	2	
		3.00 3.20 3.20 3.50	B SPTL S B	N=4 (1,0/1,1,1,1)	3.30		 Dark brown to dark grey gravelly CLAY with gravel of subangular to subrounded fine to coarse and cobbles of flint.	3	
		4.20 4.20	SPTL S	N=7 (1,0/2,1,2,2)			 Off white to cream silty clayey gravelly CHALK with gravel of subangular to subrounded fine to coarse and cobbles of chalk and flint.	4	
		5.50	B					5	
		6.00 6.00 6.00	B SPTL S	N=3 (1,0/1,0,1,1)				6	
		7.00	D					7	
		7.50 7.50	SPTL S	N=18 (2,4/5,4,4,5)				8	
		8.50	D					9	
		9.00 9.00	SPTL S	N=28 (8,12/9,5,7,7)				9	
	10.00	B					10		
Continued on next sheet									
Remarks									



 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. BH103 Sheet 2 of 2		
Project Name: North Littlehampton				Project No. LP2128		Co-ords: -		Hole Type CP		
Location: Land near Wick, North Littlehampton, West Sussex, BN17 7PP				Level:		Scale 1:50				
Client: Persimmon Homes Thames Valley				Dates: 23/01/2020 - 27/01/2020		Logged By OA				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		10.50	SPTL	N=50 (2,7/50 for 297mm)	13.50				11	
		10.50	S							
		11.50	D	50 (12,11/50 for 218mm)						12
		12.00	SPTL							
		12.00	S							
		13.00	D							
	13.50	D	14							
End of borehole at 13.50 m								15		
								16		
								17		
								18		
								19		
								20		
Remarks										



 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP101 Sheet 1 of 1	
Project Name: North Littlehampton				Project No. LP2128		Co-ords: 503485 - 104241 Level: 3.58		Date 04/12/2019	
Location: Land near Wick, North Littlehampton, West Sussex, BN17 7PP						Dimensions (m):		Scale 1:25	
Client: Persimmon Homes Thames Valley						Depth 3.00		Logged OA	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.10	ES	N=11				Brown to greyish light brown silty sandy clayey gravelly MADE GROUND with gravel of subangular to surrounded fine to coarse and cobbles of flint, brick, concrete and chalk and occasional cobbles of blacktop cobbles, plastic bags, plastic pipe, fine to coarse fragments of glass and timber.		
	0.60	ES					<i>Faint to moderate ammonia odour encountered during excavation at 0.5m</i>		
	1.80	ES							
	2.90	ES		2.80 3.00	0.78 0.58		Dark grey silty sandy gravelly CLAY with gravel of subangular to subrounded fine to coarse flint, brick and chalk.		
							<i>Faint hydrocarbon odour detected at 2.8m.</i> End of pit at 3.00 m		
Remarks: Trial pit remained dry and stable.									
Stability: Stable									

1
2
3
4
5

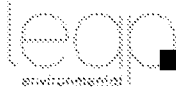


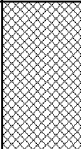
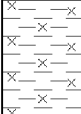
Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP102 Sheet 1 of 1	
Project Name: North Littlehampton				Project No. LP2128		Co-ords: 503626 - 104168 Level: 2.21		Date 10/12/2019	
Location: Land near Wick, North Littlehampton, West Sussex, BN17 7PP						Dimensions (m):		Scale 1:25	
Client: Persimmon Homes Thames Valley								Logged OA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.15	ES	N=14	0.30	1.91		Grass over brown to reddish brown silty clayey TOPSOIL with frequent rootlets and debris of tree branches.	1
	0.40	ES					Firm brown to light brown silty CLAY with occasional coarse fragments of chalk.	
	1.00	D					Hand Pen at 0.8m = 86.66kPa	2
	2.80	D				Off white weathered poorly consolidated silty clayey medium to high density CHALK. Dc grade. Frequent chalk cobbles encountered below 2.3m.		
				3.00	-0.79	End of pit at 3.00 m		3
								4
								5

Remarks: Fast flowing seepage encountered at 2.5m. Water level arose to 1.8m after 10 minutes.

Stability: Major collapse below 2.1m.

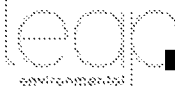
 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Trial Pit Log				Trialpit No TP103 Sheet 1 of 1	
Project Name: North Littlehampton				Project No. LP2128		Co-ords: 503627 - 103962 Level: 2.00		Date 10/12/2019	
Location: Land near Wick, North Littlehampton, West Sussex, BN17 7PP						Dimensions (m): Depth 3.00		Scale 1:25	
Client: Persimmon Homes Thames Valley								Logged OA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES	N=7	0.50	1.50		Moss over grey to dark grey sandy gravelly MADE GROUND with gravel of fine to coarse and cobbles of flint and concrete and occasional fine to coarse blacktop, whole bricks and metal fragments.	1
	0.60	ES					Firm to stiff yellowish light brown mottled silty CLAY. <u>Hand Pen at 0.8m = 233.33kPa</u>	
	1.00	D		1.50	0.50		Off white weathered poorly consolidated silty clayey high to medium density CHALK. <u>Frequent chalk cobbles encountered below 2m.</u> <u>Moderate density chalk encountered below 2.2m.</u>	2
	2.80	D	3.00			-1.00	End of pit at 3.00 m	
								4
								5

Remarks: Fast flowing seepage encountered at 2.4m. Water level arose to 1.2m after 5 minutes.

Stability: Unstable due to flooding.

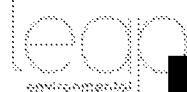


 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com				Borehole Log				Borehole No. BH1 Sheet 2 of 2	
Project Name: Plots 123-126 North Littlehampton				Project No. LP2420		Co-ords: -		Hole Type CP	
Location: Plots 123-126, Land off Toddington Lane, Littlehampton, BN17 7SH				Level:				Scale 1:50	
Client: Persimmon Homes (Thames Valley) Ltd				Dates: 09/12/2020 - 09/12/2020				Logged By KT	
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50 10.50	D	N=43 (6,7/9,10,12,12)				Thin dark brown striations noted on a chalk block at 10.5m	11
		11.50	D						12
		12.00 12.00	D	N=45 (6,8/9,11,11,14)					13
		13.00	D					Orangish brown striations noted on some chalk surfaces at 13m	14
		13.50 13.50	D	N=49 (7,9/10,12,13,14)					15
		14.50	D						16
		15.00 15.00	D	N=50 (8,9/10,14,16,10)				Chak gravel is mostly fine and angular at 15m	17
		16.00	D					Gravel is fine to cobble sized from around 16m	18
		16.50 16.50	D	N=49 (6,10/9,12,15,13)					19
		17.50	D					Joint set with spacing of ~20mm observed at 17.5m	20
		18.00 18.00	D	50 (11,13/50 for 150mm)					
		19.00	D						
	19.50 19.50	D	50 (15,10/50 for 150mm)						
	20.00	D		20.00			End of borehole at 20.00 m		
Remarks Water struck at 0.85m and 3.2m. Water rose to 2.9mbGL after 20 minutes. Hole was backfilled with arisings.									

Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA www.leapenvironmental.com					Borehole Log			Borehole No. BH2 Sheet 1 of 2		
Project Name: Plots 123-126 North Littlehampton					Project No. LP2420		Co-ords: -		Hole Type CP	
Location: Plots 123-126, Land off Toddington Lane, Littlehampton, BN17 7SH					Level:				Scale 1:50	
Client: Persimmon Homes (Thames Valley) Ltd					Dates: 10/12/2020 - 10/12/2020				Logged By KT	

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	D		0.30		Brown silty clayey gravelly MADE GROUND. Gravel is fine to medium brick, fine sub-angular to angular flint, and rare fine concrete. <i>Possible asbestos fibres at 0.15m within made ground</i>	1	
		0.50	D						
	1.00 1.00 - 1.45	D U	Ublow=42						
		2.00	D		2.25		Dark brown slightly silty gravelly clayey MADE GROUND. Gravel is fine to coarse angular flint, rare fine sub-rounded brick, and fine rounded chalk. Dark brown sandy REWORKED CLAY with occasional rootlets. Rare gravel of fine sub-angular flint and fine sub-rounded chalk. <i>Single fine brick fragment noted at 2m</i>	2	
		2.50 2.50	SPTL S	N=7 (1,1/1,2,2,2)					
		3.50	D						
		4.50 4.50	SPTL S	N=11 (2,2/2,3,3,3)	5.00		Firm reddish brown slightly sandy CLAY with rare fine sub-rounded chalk gravel. Mixed with chalk recovered as soft clay with gravel of fine to coarse rounded to sub-rounded dense chalk. <i>Hand Pen at 2.5m = 140kPa</i> <i>Clay is very soft at 3.5m</i>	3	
		5.50	D						
		6.00 6.00 6.00 - 6.50	D B	N=29 (3,5/6,6,8,9)					
		7.00	D		7.50		Very high density pale brownish white CHALK recovered as slightly silty sandy gravel. Gravel is fine to cobble-sized angular to sub-rounded chalk. Grade Dc	4	
		7.50 7.50	D	N=37 (3,5/7,7,11,12)					
		8.50	D						
		9.00 9.00	D	50 (10,13/50 for 225mm)	10.00		Continued on next sheet	5	
		10.00	D						

Remarks Water struck at 3.5m. This rose to 2.8mbGL after 20 minutes. Water level was 2mbGL at the end of drilling. Hole was backfilled with arisings		
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Leap Environmental Ltd
The Atrium, Curtis Road
Dorking, Surrey RH4 1XA

Borehole Log

Borehole No.

BH2

Sheet 2 of 2

Project Name: Plots 123-126 North Littlehampton Project No. LP2420 Co-ords: - Hole Type CP

Location: Plots 123-126, Land off Toddington Lane, Littlehampton, BN17 7SH Level: Scale 1:50

Client: Persimmon Homes (Thames Valley) Ltd Dates: 10/12/2020 - 10/12/2020 Logged By KT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00		N=40 (5,9/6,9,12,13)				End of borehole at 10.00 m	
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks
Water struck at 3.5m. This rose to 2.8mbGL after 20 minutes. Water level was 2mbGL at the end of drilling. Hole was backfilled with arisings



APPENDIX E – DPT Results

DPT Results

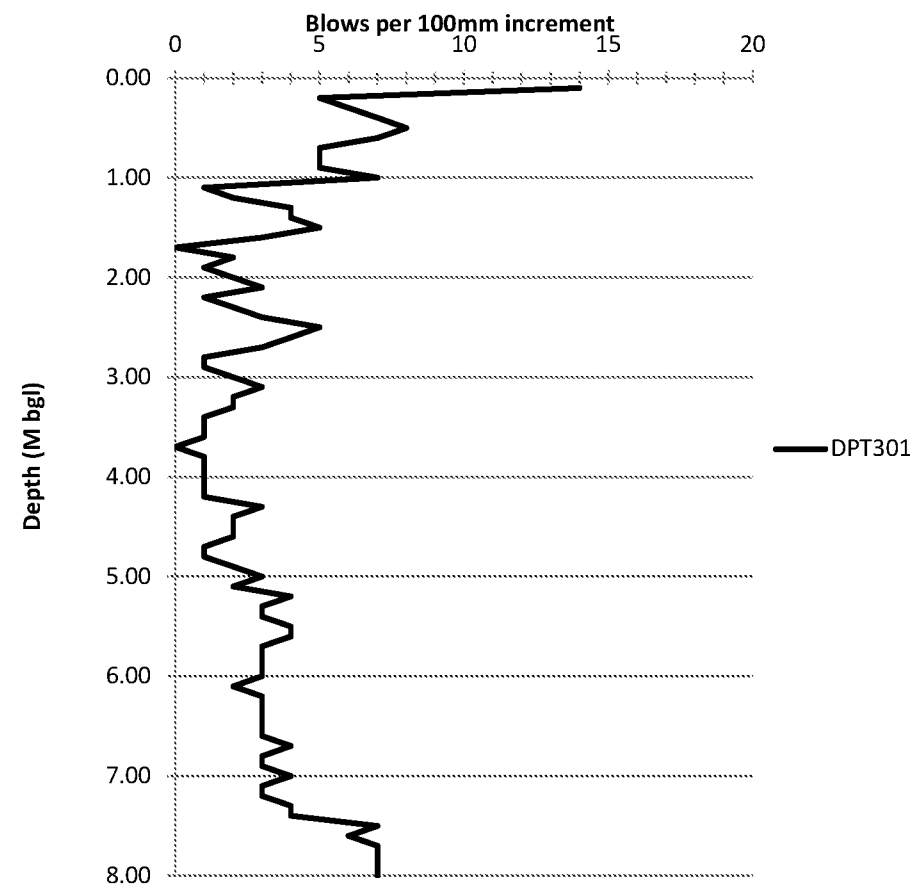
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT301

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	14	5	6	7	8	7	5	5	5	7	
1 - 2m	1	2	4	4	5	3	0	2	1	2	
2 - 3m	3	1	2	3	5	4	3	1	1	2	
3 - 4m	3	2	2	1	1	1	0	1	1	1	
4 - 5m	1	1	3	2	2	2	1	1	2	3	
5 - 6m	2	4	3	3	4	4	3	3	3	3	
6 - 7m	2	3	3	3	3	3	4	3	3	4	
7 - 8m	3	3	4	4	7	6	7	7	7	7	
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT301



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
 Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

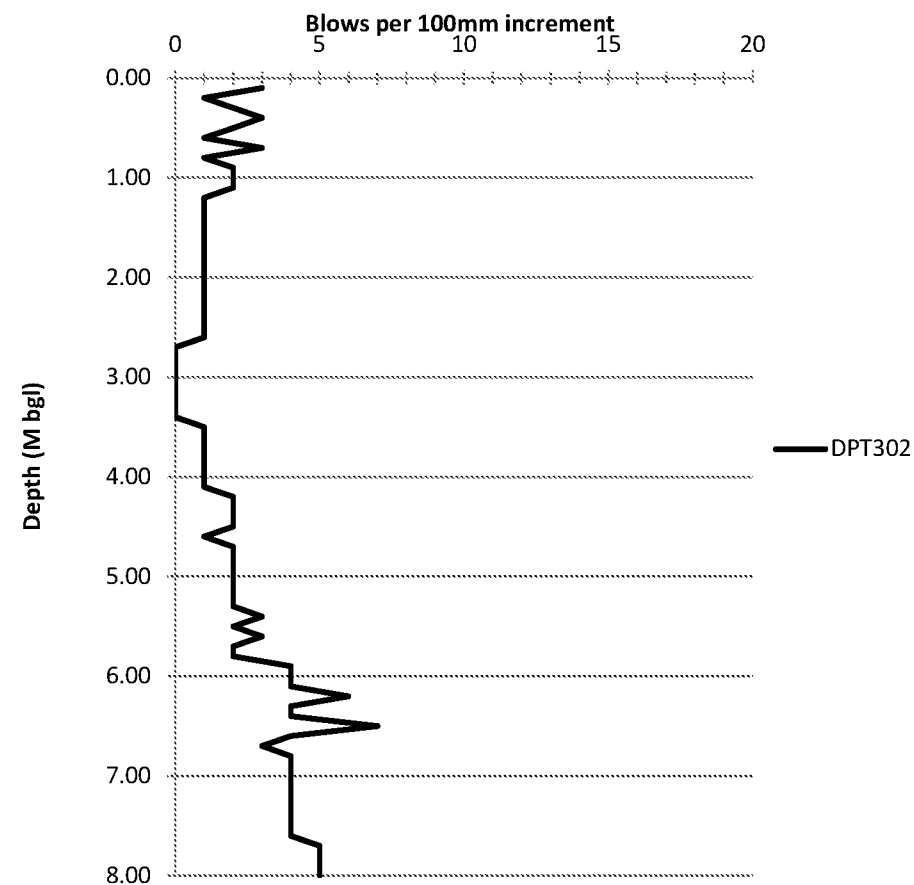
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT302

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	3	1	2	3	2	1	3	1	2	2	
1 - 2m	2	1	1	1	1	1	1	1	1	1	
2 - 3m	1	1	1	1	1	1	0	0	0	0	
3 - 4m	0	0	0	0	1	1	1	1	1	1	
4 - 5m	1	2	2	2	2	1	2	2	2	2	
5 - 6m	2	2	2	3	2	3	2	2	4	4	
6 - 7m	4	6	4	4	7	4	3	4	4	4	
7 - 8m	4	4	4	4	4	4	5	5	5	5	
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT302



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

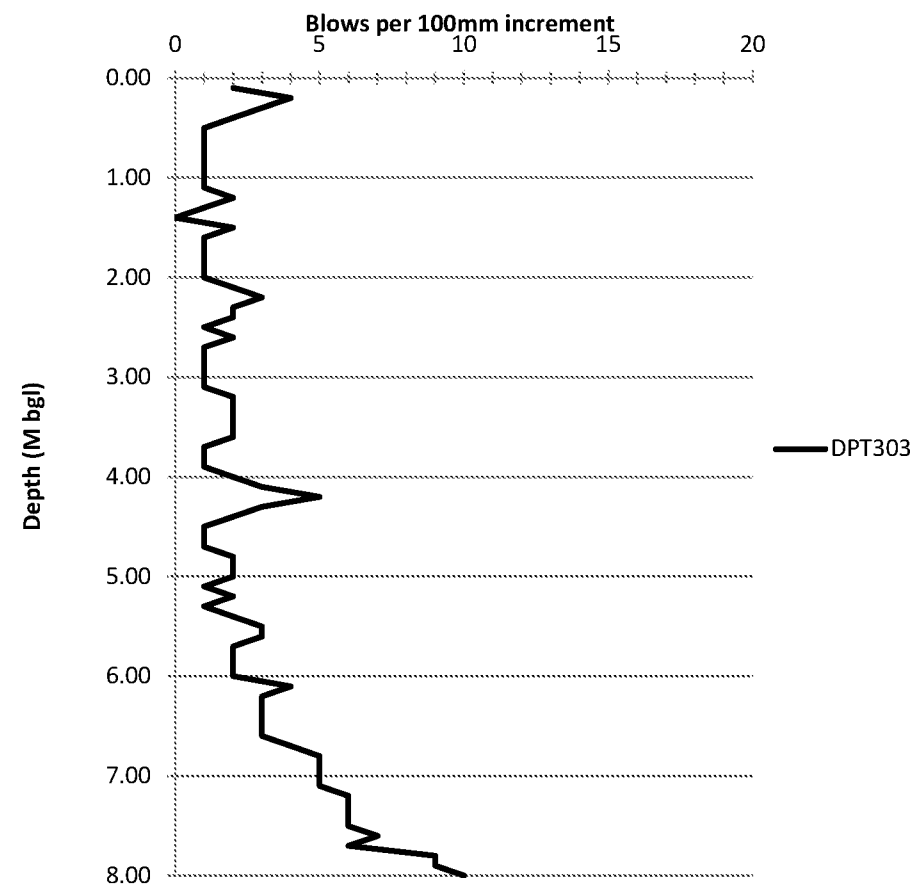
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT303

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	2	4	3	2	1	1	1	1	1	1	
1 - 2m	1	2	1	0	2	1	1	1	1	1	
2 - 3m	2	3	2	2	1	2	1	1	1	2	
3 - 4m	1	2	2	2	2	2	1	1	1	2	
4 - 5m	3	5	3	2	1	1	1	2	2	2	
5 - 6m	1	2	1	2	3	3	2	2	2	2	
6 - 7m	4	3	3	3	3	3	4	5	5	5	
7 - 8m	5	6	6	6	6	7	6	9	9	10	
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT303



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

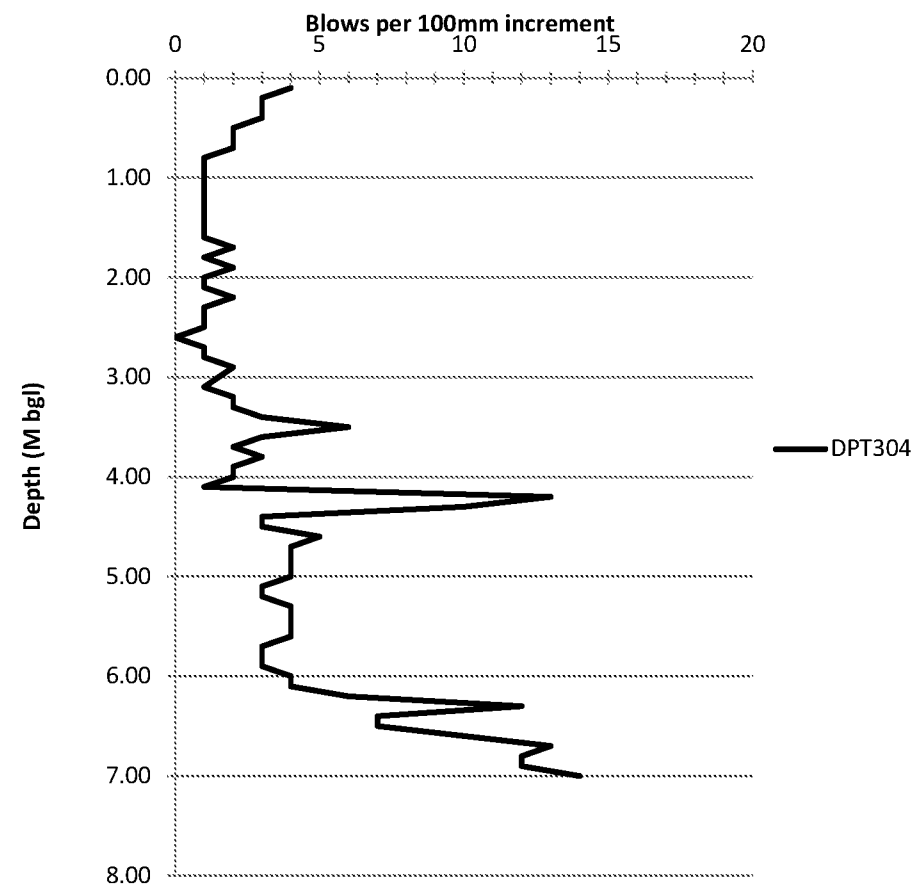
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT304

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	4	3	3	3	2	2	2	1	1	1	
1 - 2m	1	1	1	1	1	1	2	1	2	1	
2 - 3m	1	2	1	1	1	0	1	1	2	1	
3 - 4m	1	2	2	3	6	3	2	3	2	2	
4 - 5m	1	13	10	3	3	5	4	4	4	4	
5 - 6m	3	3	4	4	4	4	3	3	3	4	
6 - 7m	4	6	12	7	7	10	13	12	12	14	
7 - 8m											
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT304



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

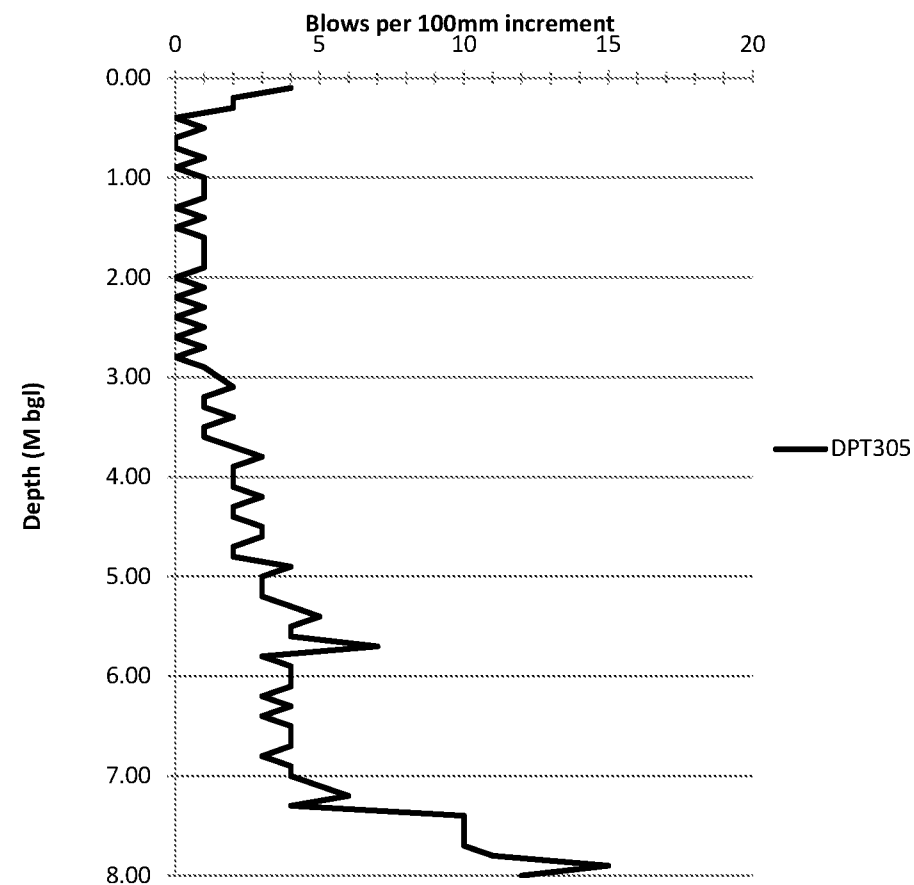
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT305

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	4	2	2	0	1	0	0	1	0	1	
1 - 2m	1	1	0	1	0	1	1	1	1	0	
2 - 3m	1	0	1	0	1	0	1	0	1	1	
3 - 4m	2	1	1	2	1	1	2	3	2	2	
4 - 5m	2	3	2	2	3	3	2	2	4	3	
5 - 6m	3	3	4	5	4	4	7	3	4	4	
6 - 7m	4	3	4	3	4	4	4	3	4	4	
7 - 8m	5	6	4	10	10	10	10	11	15	12	
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT305



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

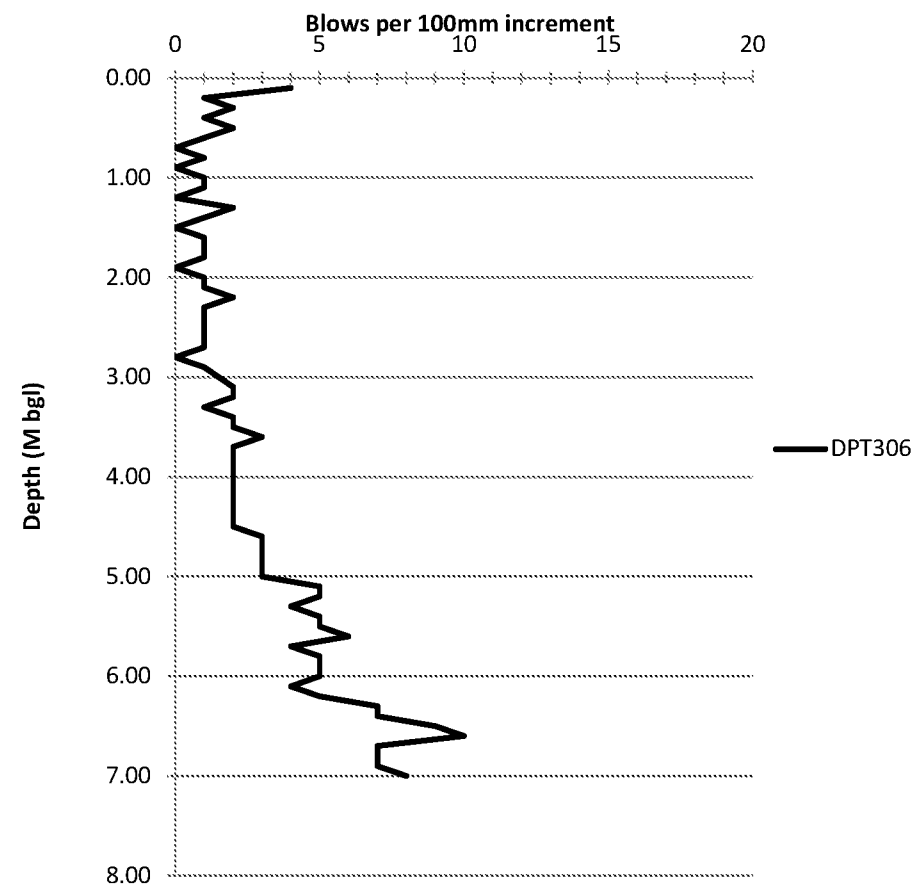
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT306

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	4	1	2	1	2	1	0	1	0	1	
1 - 2m	1	0	2	1	0	1	1	1	0	1	
2 - 3m	1	2	1	1	1	1	1	0	1	1	
3 - 4m	2	2	1	2	2	3	2	2	2	2	
4 - 5m	2	2	2	2	2	3	3	3	3	3	
5 - 6m	5	5	4	5	5	6	4	5	5	5	
6 - 7m	4	5	7	7	9	10	7	7	7	8	
7 - 8m											
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT306



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

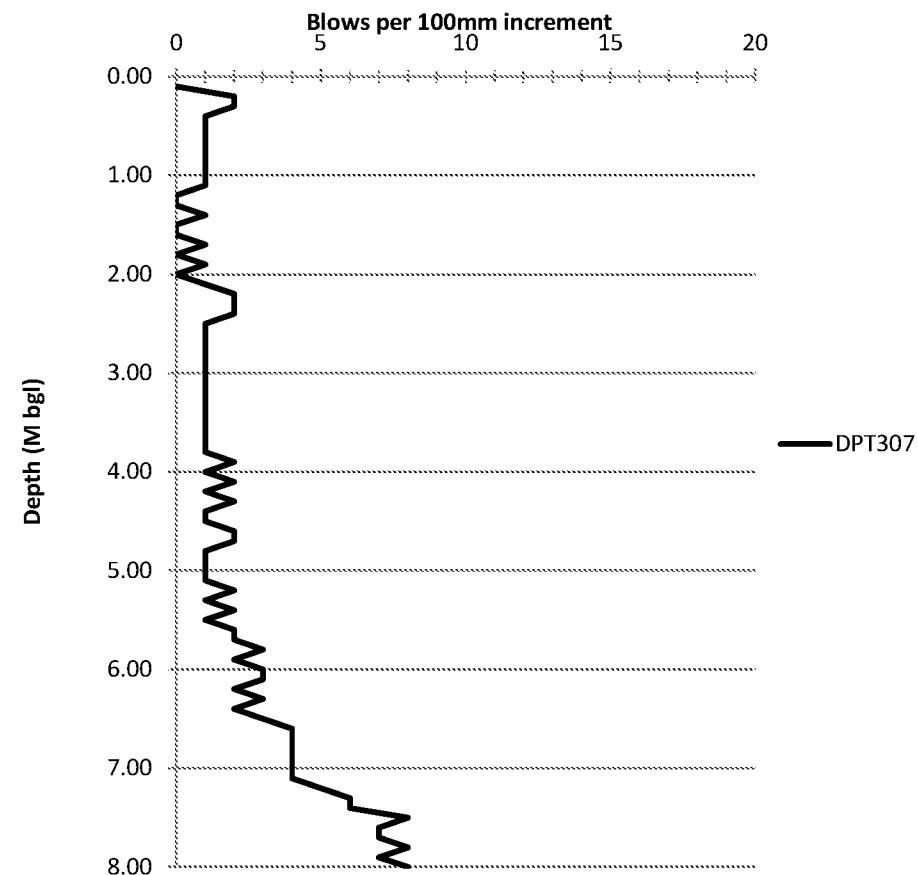
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT307

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	0	2	2	1	1	1	1	1	1	1	
1 - 2m	1	0	0	1	0	0	1	0	1	0	
2 - 3m	1	2	2	2	1	1	1	1	1	1	
3 - 4m	1	1	1	1	1	1	1	1	2	1	
4 - 5m	2	1	2	1	1	2	2	1	1	1	
5 - 6m	1	2	1	2	1	2	2	3	2	3	
6 - 7m	3	2	3	2	3	4	4	4	4	4	
7 - 8m	4	5	6	6	8	7	7	8	7	8	
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT307



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
 Registered Office Address: Unit 13, Firsland Park Estate, Henfield Road, Albourne, BN6 9JJ

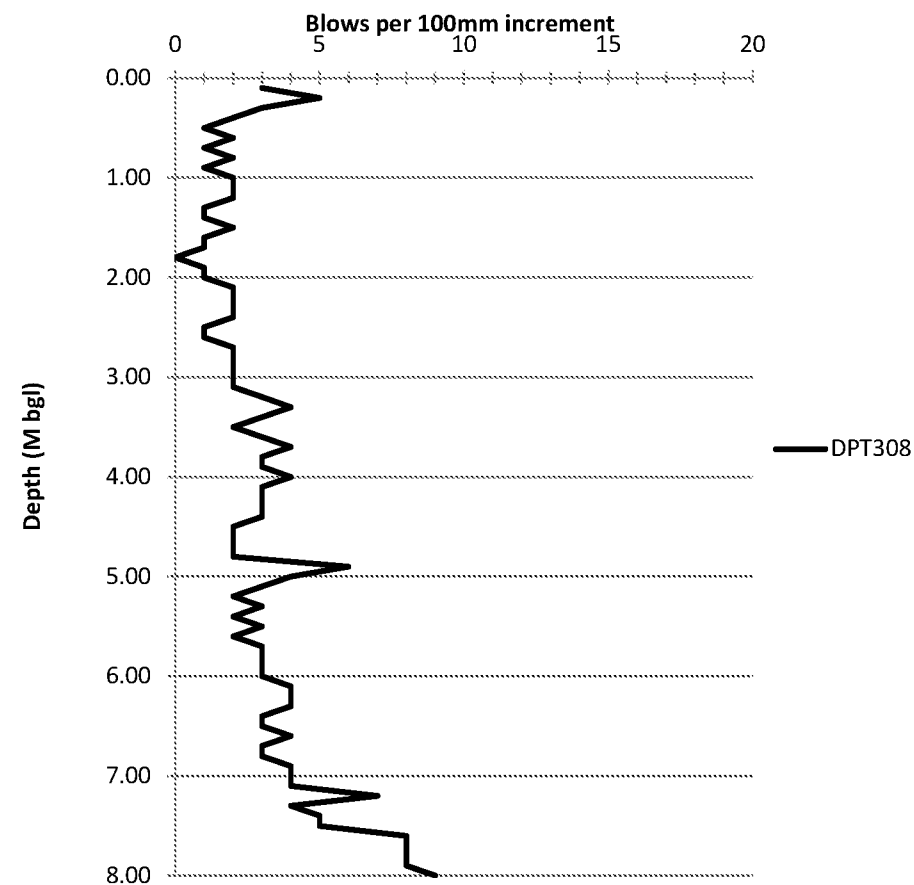
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT308

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	3	5	3	2	1	2	1	2	1	2	
1 - 2m	2	2	1	1	2	1	1	0	1	1	
2 - 3m	2	2	2	2	1	1	2	2	2	1	
3 - 4m	2	3	4	3	2	3	4	3	3	4	
4 - 5m	3	3	3	3	2	2	2	2	6	4	
5 - 6m	3	2	3	2	3	2	3	3	3	3	
6 - 7m	4	4	4	3	3	4	3	3	4	4	
7 - 8m	4	7	4	5	5	8	8	8	8	9	
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT308



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

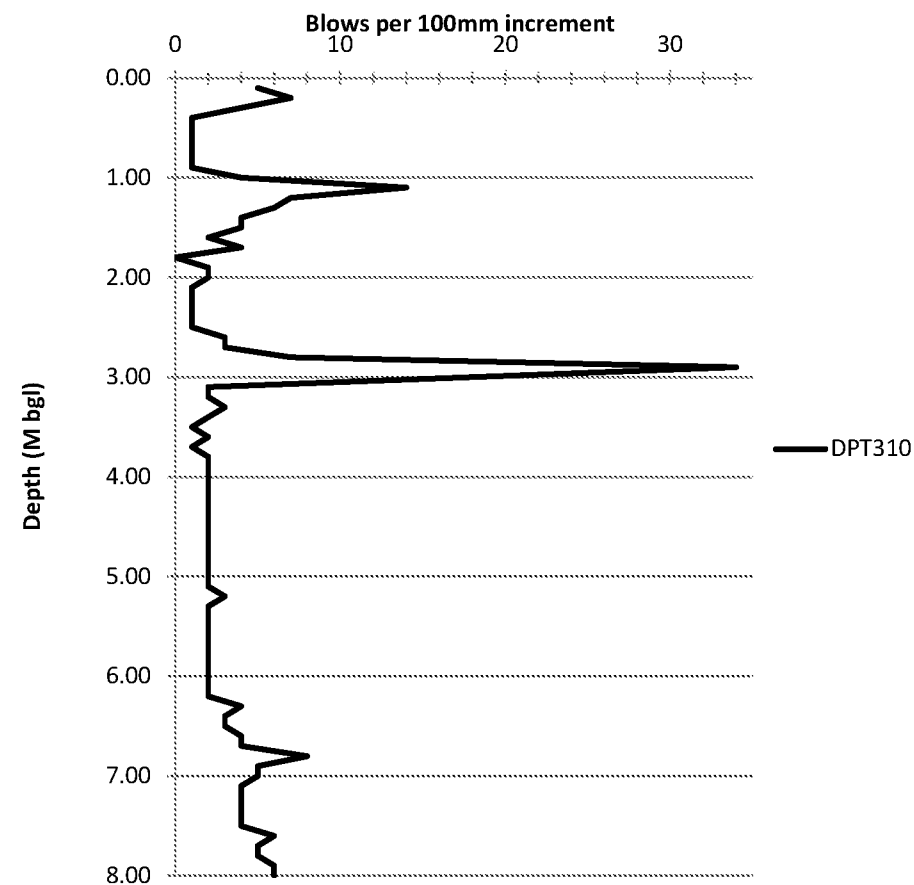
Job Reference:	LP2694
Site Address:	Phase 4, North Littlehampton
Client:	Leap Environmental

Probe No:
DPT310

Probe Type	DPSH	Rig	Spare Premier
Operator		Date	06/09/2021

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	5	7	4	1	1	1	1	1	1	4	
1 - 2m	14	7	6	4	4	2	4	0	2	2	
2 - 3m	1	1	1	1	1	3	3	7	34	2	
3 - 4m	2	2	3	2	1	2	1	2	2	2	
4 - 5m	2	2	2	2	2	2	2	2	2	2	
5 - 6m	2	3	2	2	2	2	2	2	2	2	
6 - 7m	2	2	4	3	3	4	4	8	5	5	
7 - 8m	4	4	4	4	4	6	5	5	6	6	
8 - 9m											
9 - 10m											
10 - 11m											
11 - 12m											
12 - 13m											
13 - 14m											
14 - 15m											
15 - 16m											
16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											

DPT310



Oakland Site Investigation www.oaklandsi.co.uk T:01444 871 464
Registered Office Address: Unit 13, Firstrand Park Estate, Henfield Road, Albourne, BN6 9JJ

APPENDIX F – Geotechnical Laboratory Results

Geotechnical Laboratory Results

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Location	Depth (m)	Sample Ref	Type	Description	WC	LL	PL	PI	<425 µm	Bulk	Dry	Condition	Cell Pressure	Deviator Stress	Shear Stress	pH	2:1 W/S SO4	W/S Mg	
					%	%	%	%	%	Mg/m³	Mg/m³		kPa	kPa	kPa		g/L	mg/L	
WS304	1.00		D	Orangish brown slightly gravelly sandy silty CLAY. Gravel is fine to medium and sand is fine.	23.8	51	23	28	99										
WS305	2.00		D	White CHALK															SMC
WS306	1.00		D													8.1	0.054		
WS306	2.00		D	Greyish brown and greenish grey sandy silty CLAY.	28.9	48	15	33	100										
WS306	3.00		D	White CHALK															SMC

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke - Senior Technician
05/10/2021

Project Number:

GEO / 33902

Project Name:

PHASE 4 NORTH LITTLEHAMPTON
LP2694

GEOLABS®

Notes

GEO LABS

(Ref 1633436932)

SUMMARY OF LIQUID AND PLASTIC LIMIT TESTS

Location	Depth m	Sample Ref	Sample Type	Description	Water Content BS EN ISO 17892-1 : 2014 %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Percentage Passing 425µm %	Atterberg Classification	Test Type	Sample Condition
BH103	1.00	B1	B	Brown and grey gravelly sandy silty CLAY. Gravel is flint and concrete.	20.0	34	20	14	63	CL	2	3
BH103	2.00	B2	B	Greyish brown and grey gravelly sandy silty CLAY. Gravel is fine to medium gravel sized chalk and concrete.	23.0	31	19	12	74	CL	2	3
BH103	3.00	B3	B	Brownish grey gravelly sandy silty CLAY. Gravel is flint and chalk.	29.5	30	20	10	76	CL	2	3
BH106	1.00	B1	B	Yellowish brown silty clayey structureless CHALK with some gravel sized chalk.	20.1	29	14	15	72	CL	2	3
BH111	1.00	B1	B	Yellowish brown and greyish brown sandy silty CLAY with rare gravel sized chalk.	20.2	36	17	19	92	CI	2	3
BH111	2.00	B3	B	Brown and grey sandy silty CLAY with rare gravel.	23.8	33	16	17	91	CL	2	3
BH111	3.00	B5	B	Cream and white gravel sized CHALK in a structureless chalk matrix.	24.9	30	18	12	51	CL	2	3
BH112	4.00	B6	B	Brown and light grey very gravelly sandy silty CLAY. Gravel is flint and chalk.	29.5	55	24	31	45	CH	2	3
BH112	5.00	B7	B	Brownish grey and white gravelly silty CLAY. Gravel is chalk.	40.0	52	22	30	69	CH	2	3
BH113	2.00	B3	B	Orangish brown and brown gravelly sandy silty CLAY.	19.7	28	16	12	81	CL	2	3
BH113	4.00	B6	B	Orangish brown and brown gravelly sandy silty CLAY. Gravel is chalk.	14.9	26	13	13	78	CL	2	3

Test Type:

- 1 - 1 point 80g / 30° fall cone method.
 2 - 4 point 80g / 30° fall cone method.
 3 - Non plastic determination.

Sample condition:

- 1 - As Received
 2 - Air Dried
 3 - Washed & Air Dried

Checked and Approved by:

Project Number:

GEO / 30617

Project Name:

NORTH LITTLEHAMPTON
LP2128

J Sturges - Operations Manager
 27/02/2020

GEOLABS[®]

SATURATION MOISTURE CONTENT OF CHALK

Location	Depth m	Sample Ref	Sample Type	Description	Water Content BS EN ISO 17892-1 : 2014 %	Bulk Density Mg/m ³	Dry Density Mg/m ³	Saturation Moisture Content %	Porosity %
BH103	3.50	B5	B	White CHALK.	14.6	2.19	1.91	15	29
BH103	7.00	D10	D	White CHALK.	18.0	2.13	1.81	18	33
BH103	10.00	B14	B	Cream and white CHALK.	13.4	2.23	1.97	14	27
BH103	13.00	D18	D	White CHALK.	13.5	2.21	1.95	14	28
BH106	2.00	B4	B	Cream and white CHALK.	20.2	2.08	1.73	21	36
BH106	3.00	D6	D	White CHALK.	19.3	2.10	1.76	20	35
BH106	6.00	D11	D	White CHALK.	22.1	2.06	1.69	22	37
BH106	7.00	D13	D	White CHALK.	19.7	2.08	1.74	20	36
BH106	9.00	D16	D	White CHALK.	15.9	2.18	1.88	16	30
BH106	11.50	D20	D	White CHALK.	20.7	2.09	1.73	21	36
BH106	14.50	D24	D	White CHALK.	16.9	2.07	1.77	19	34
BH106	16.00	D26	D	White CHALK.	18.6	2.11	1.78	19	34
BH111	4.00	B7	B	White CHALK.	18.6	2.10	1.77	19	34
BH111	6.50	B11	B	White CHALK.	17.1	2.14	1.83	18	32
BH111	9.50	B15	B	White CHALK.	19.8	2.07	1.73	21	36

Notes

Checked and Approved by:

Project Number:

GEO / 30617

Project Name:

**NORTH LITTLEHAMPTON
LP2128****GEOLABS**®J Sturges - Operations Manager
27/02/2020

SATURATION MOISTURE CONTENT OF CHALK

Location	Depth m	Sample Ref	Sample Type	Description	Water Content BS EN ISO 17892-1 : 2014 %	Bulk Density Mg/m ³	Dry Density Mg/m ³	Saturation Moisture Content %	Porosity %
BH111	12.50	D19	D	White CHALK.	16.6	2.17	1.86	17	31
BH111	15.50	D23	D	White CHALK.	15.5	2.17	1.88	16	30
BH111	18.00	D27	D	White CHALK.	22.0	2.07	1.70	22	37
BH111	21.50	D31	D	White CHALK.	16.8	2.13	1.82	18	33
BH112	5.50	B9	B	Cream and white CHALK.	16.1	2.18	1.88	16	30
BH112	7.00	B10	B	White CHALK.	16.4	2.15	1.85	17	31
BH112	9.50	B14	B	White CHALK.	18.1	2.14	1.81	18	33
BH112	12.50	B18	B	White CHALK.	21.3	2.08	1.71	21	37
BH112	15.50	D22	D	White CHALK.	21.5	2.05	1.69	22	37
BH112	18.50	D26	D	White CHALK.	15.3	2.20	1.91	15	29
BH112	23.00	D32	D	White CHALK.	20.1	2.08	1.73	21	36
BH112	24.50	D34	D	White CHALK.	14.2	2.19	1.92	15	29
BH113	5.00	B8	B	White CHALK.	20.6	2.06	1.71	21	37
BH113	7.00	D11	D	White iron stained CHALK.	21.5	2.08	1.71	21	37
BH113	8.00	B13	B	White CHALK.	21.6	2.06	1.69	22	37

Notes

Checked and Approved by:

Project Number:

GEO / 30617

Project Name:

**NORTH LITTLEHAMPTON
LP2128**J Sturges - Operations Manager
27/02/2020

Test Report By GEOLABS Limited Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX

Client : Leap Environmental Limited, Southern Coast Regional Office, Victoria Road, Burgess Hill, West Sussex, RH15 9LR

Page 2 of 3

(Ref 1582815681)

Notes

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J Sturges - Operations Manager
27/02/2020

PARTICLE SIZE DISTRIBUTION

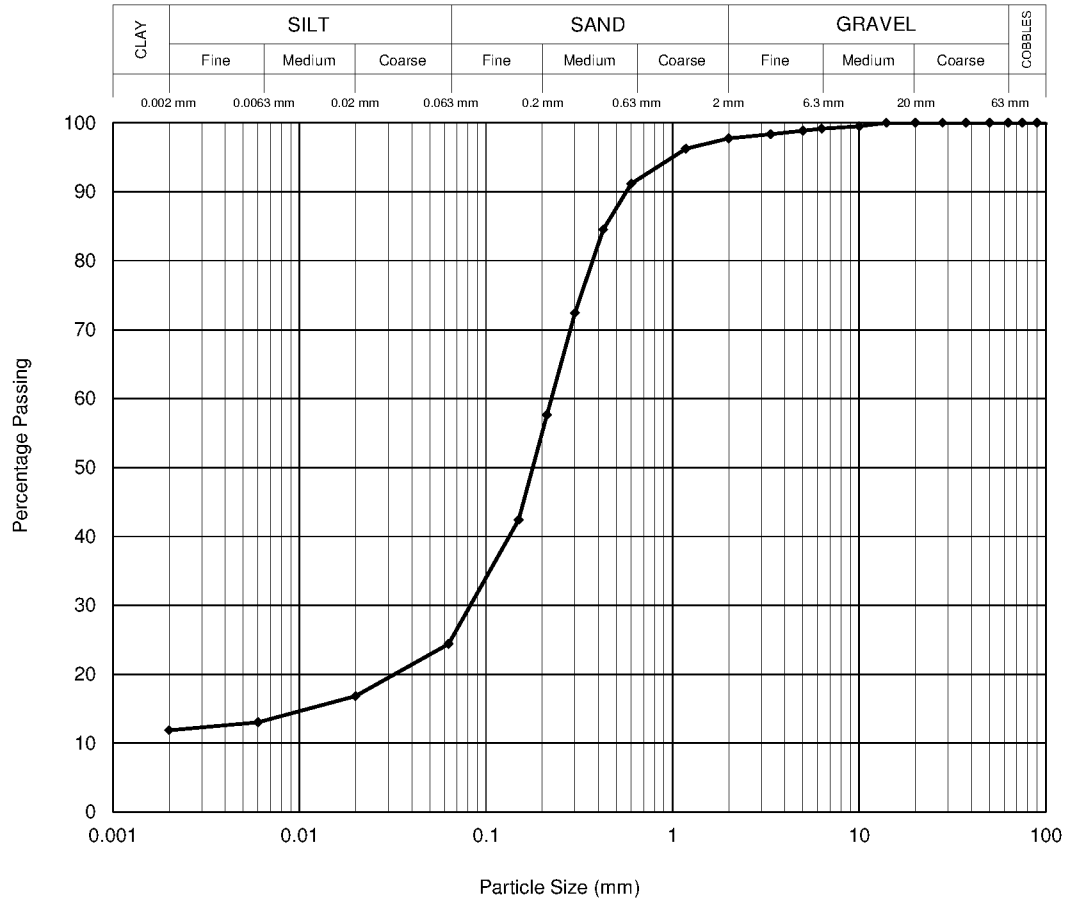
BH / TP No. BH113
 Sample Ref B1
 Depth (m) 1.00
 Sample Type B

Description

Brown clayey silty SAND with rare fine to medium gravel.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
 BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	99
6.30 mm	99
5.00 mm	99
3.35 mm	98
2.00 mm	98
1.18 mm	96
600 µm	91
425 µm	85
300 µm	72
212 µm	58
150 µm	42
63 µm	24



Sedimentation	
Pre-treatment used	
Temp (°C)	25
Size	% Pass
20 µm	17
6 µm	13
2 µm	12

Particle Density 2.70(A) Mg/m³

Particle Proportions	
Cobbles	0
Gravel	2
Sand	73
Silt	13
Clay	12

Processed by JS
 Checked and Approved by

J Sturges - Operations Manager
 28/02/2020

Project Number:

GEO / 30617

Project Name:

NORTH LITTLEHAMPTON
LP2128

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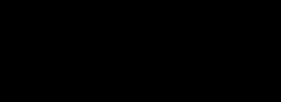
Test Report By: GEOLABS Limited, Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX

Client : Leap Environmental Limited, Southern Coast Regional Office, Victoria Road, Burgess Hill, West Sussex, RH15 9LR

SUMMARY OF CHEMICAL TESTS ON SOIL

Location	Depth m	Sample Ref	Sample Type	pH Value	Total Acid Soluble Sulphate as SO ₄ %	Water Soluble Sulphate as SO ₄ 2:1 Water:Soil Extract g/l	Total Sulphur %	Water Soluble Chloride g/l	Water Soluble Nitrate g/l	Magnesium g/l	Organic Content %	Mass Loss on Ignition %	Carbonate Content %
BH103	1.00	B1	B	10.2	0.15	0.31	0.054	-	-	-	-	-	-
BH103	3.00	B3	B	8.8	0.091	0.18	0.052	-	-	-	-	-	-
BH106	1.00	B1	B	8.5	0.043	0.023	0.019	-	-	-	-	-	-
BH111	1.00	B1	B	8.5	0.016	0.031	0.012	-	-	-	-	-	-
BH111	2.00	B3	B	7.8	0.048	0.13	0.025	-	-	-	-	-	-
BH111	3.00	B5	B	8.7	0.030	< 0.010	0.011	-	-	-	-	-	-
BH112	5.00	B7	B	10.7	0.13	0.21	0.056	-	-	-	-	-	-
BH113	2.00	B3	B	8.3	0.010	0.047	< 0.010	-	-	-	-	-	-
BH113	4.00	B6	B	9.1	0.024	0.012	0.011	-	-	-	-	-	-
TP115	1.00		B	8.1	0.061	0.11	0.044	-	-	-	-	-	-
TP116	1.00		D	7.6	0.031	0.019	0.019	-	-	-	-	-	-
TP120	1.00		D	8.4	0.010	0.018	0.011	-	-	-	-	-	-
TP127	0.60		D	7.3	0.037	0.055	0.019	-	-	-	-	-	-
TP211	0.50		D	8.2	0.024	0.057	0.014	-	-	-	-	-	-
TP212	0.90		D	8.1	0.016	0.014	0.011	-	-	-	-	-	-
TP224	0.80		D	8.2	0.039	0.048	0.028	-	-	-	-	-	-

Tested by Chemtest Ltd : MCERTS / UKAS No 2183

Checked and Approved by:  J Sturges - Operations Manager 28/02/2020	Project Number: GEO / 30617 Project Name: NORTH LITTLEHAMPTON LP2128	
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Tested by Chemtest Ltd : MCERTS / UKAS No 2183

GEOLABS

Page 2 of 2
(Ref 1582908382)

APPENDIX G – Analytical Summary

Analytical Summary

LP2694 Phase 4, North Littlehampton																		
Soil Analytical Results and Human Health QRA - Residential with Homegrown Produce																		
				NOTES														
				Sample Location:	TP101	TP101	TP102	TP103	TP301	TP303	TP304	TP305	WS301	WS302	WS303	WS304	WS305	WS306
				Depth (m):	0.1	2.9	0.4	0.3	0.05	2.00	0.50	1.50	1.6	0.7	0.35	0.2	0.5	0.15
				Matrix:	MG	MG	CLAY	MG	MG	MG	MG	MG	MG	MG	MG	TS	MG	MG
				Date Sampled:	04/12/2019	04/12/2019	10/12/2019	10/12/2019	31/08/2021	31/08/2021	31/08/2021	31/08/2021	03/09/2021	03/09/2021	03/09/2021	03/09/2021	03/09/2021	03/09/2021
Determinand	Units	LOD	Screening Value*	Source														
Miscellaneous																		
pH	pH units	0.1	n.v.	n.a.	8.8	8.1	7.3	8.5	8.4	8.8	10.5	9.5	8.3	8.3	8.5	8	8.6	8.6
Total Organic Carbon	%	0.1	n.v.	n.a.	0.93	1.6	0.41	3.2	1.2	0.74	0.99	0.45	0.69	0.65	1	0.48	0.08	0.91
Soil Organic Matter (calculated)**	%	-	n.v.	n.a.	1.60	2.75	0.71	5.50	2.06	1.27	1.70	0.77	1.19	1.12	1.72	0.83	0.14	1.57
Metals																		
Arsenic	mg/kg	2	37	C4SL	11.5	28.3	8.5	31.3	17	11.8	11.3	12.3	13.1	11.6	21	8.6	4.8	14.5
Cadmium	mg/kg	0.1	22	C4SL	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.6
Chromium	mg/kg	0.5	910	S4UL	23.7	34.8	20.8	30.1	34	31.1	27.2	29.7	22.2	26.5	28.8	18.7	10.3	32.1
Chromium VI	mg/kg	1	21	C4SL	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Copper	mg/kg	2	2,400	S4UL	24.3	28.9	10.7	65.6	19.3	14.4	19.7	14.6	16.6	22.2	34.8	13.5	10.2	26.7
Lead	mg/kg	2	200	C4SL	27.9	33	12	47	29	23.7	41.8	22.1	16.3	32.3	31.1	14.5	14	32.1
Mercury	mg/kg	1	40	S4UL	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Nickel	mg/kg	0.5	130	S4UL	18.6	23.9	14.6	49.6	22.4	20.3	20.7	20.3	21.9	20.2	33.6	14.4	11.6	25.1
Selenium	mg/kg	3	250	S4UL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	mg/kg	2	3,700	S4UL	84.8	192	50.7	128	100	75.6	96.4	73.1	63.8	77	82.9	45.2	34.3	117
Asbestos																		
Asbestos Identification	-	-	Presence	n.a.	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
Asbestos Quantification	%	0.001	Presence	n.a.														
Polycyclic Aromatic Hydrocarbons (USEPA 16)																		
Benzo(a)pyrene	mg/kg	0.1	5.0	C4SL	0.5	0.3	<0.1	0.5	0.7	0.6	4.4	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3
Naphthalene	mg/kg	0.1	2.3	S4UL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	4.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	n.v.	n.a.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	n.v.	n.a.	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	2.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	n.v.	n.a.	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	n.v.	n.a.	0.2	<0.1	<0.1	0.3	0.6	0.6	8.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	n.v.	n.a.	<0.1	<0.1	<0.1	0.1	0.2	0.2	2.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	n.v.	n.a.	1.1	0.4	<0.1	0.9	1.3	0.9	12.4	0.2	<0.1	0.3	<0.1	0.1	0.2	0.3
Pyrene	mg/kg	0.1	n.v.	n.a.	1	0.4	<0.1	0.8	1	0.7	9.6	0.2	<0.1	0.2	<0.1	<0.1	0.1	0.2
Benzo(a)anthracene	mg/kg	0.1	n.v.	n.a.	0.6	0.2	<0.1	0.5	0.6	0.5	4.5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Chrysene	mg/kg	0.1	n.v.	n.a.	0.6	0.2	<0.1	0.6	0.7	0.6	5.4	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.3
Benzo(b)fluoranthene	mg/kg	0.1	n.v.	n.a.	0.4	0.2	<0.1	0.5	0.8	0.7	4.8	0.2	<0.1	0.2	<0.1	<0.1	<0.1	0.4
Benzo(k)fluoranthene	mg/kg	0.1	n.v.	n.a.	0.6	0.3	<0.1	0.6	0.7	0.6	4.1	0.2	<0.1	0.2	<0.1	<0.1	<0.1	0.4
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	n.v.	n.a.	0.4	0.2	<0.1	0.5	0.6	0.6	3.2	0.2	<0.1	0.1	<0.1	<0.1	<0.1	0.3
Dibenzo(ah)anthracene	mg/kg	0.1	n.v.	n.a.	<0.1	<0.1	<0.1	<0.1	0.2	0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(ghi)perylene	mg/kg	0.1	n.v.	n.a.	0.5	0.3	<0.1	0.4	0.5	0.5	2.8	0.2	<0.1	0.1	<0.1	<0.1	<0.1	0.3
Total PAH (16)	mg/kg	0.1	n.v.	n.a.	6.1	3	<0.4	5.9	8	6.9	73.6	1.7	<0.4	1.7	<0.4	<0.4	1.1	3
Petroleum Hydrocarbons																		
Benzene	µg/kg	0.01	260	C4SL	n/t	<10	n/t	<10	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
Toluene	µg/kg	0.01	130,000	S4UL	n/t	<10	n/t	<10	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
Ethylbenzene	µg/kg	0.01	47,000	S4UL	n/t	<10	n/t	<10	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
Xylenes	µg/kg	0.01	56,000	S4UL	n/t	<10	n/t	<10	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
Methyl tert-Butyl Ether	µg/kg	0.01	62,000	n.a.	n/t	<10	n/t	<10	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C5-C6 Aliphatic																		
>C5-C6 Aliphatic	mg/kg	0.01	42	S4UL	n/t	<0.1	n/t	<0.1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C6-C8 Aliphatic																		
>C6-C8 Aliphatic	mg/kg	0.01	100	S4UL	n/t	<0.1	n/t	<0.1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C8-C10 Aliphatic																		
>C8-C10 Aliphatic	mg/kg	1	27	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C10-C12 Aliphatic																		
>C10-C12 Aliphatic	mg/kg	1	130	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C12-C16 Aliphatic																		
>C12-C16 Aliphatic	mg/kg	1	1,100	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C16-C21 Aliphatic																		
>C16-C21 Aliphatic	mg/kg	1	65,000	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C21-C35 Aliphatic																		
>C21-C35 Aliphatic	mg/kg	1		S4UL	n/t	3.9	n/t	2.9	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C35-C40 Aliphatic																		
>C35-C40 Aliphatic	mg/kg	1	65,000	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C5-C7 Aromatic																		
>C5-C7 Aromatic	mg/kg	0.01	70	S4UL	n/t	<0.1	n/t	<0.1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C7-C8 Aromatic																		
>C7-C8 Aromatic	mg/kg	0.01	130	S4UL	n/t	<0.1	n/t	<0.1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C8-C10 Aromatic																		
>C8-C10 Aromatic	mg/kg	1	34	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C10-C12 Aromatic																		
>C10-C12 Aromatic	mg/kg	1	74	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C12-C16 Aromatic																		
>C12-C16 Aromatic	mg/kg	1	140	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C16-C21 Aromatic																		
>C16-C21 Aromatic	mg/kg	1	260	S4UL	n/t	<1	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C21-C35 Aromatic																		
>C21-C35 Aromatic	mg/kg	1	1,100	S4UL	n/t	7.5	n/t	7.4	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
>C35-C40 Aromatic																		
>C35-C40 Aromatic	mg/kg	1	1,100	S4UL	n/t	4.3	n/t	<1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
Total (>C5-C40) Ali/Aro																		
Total (>C5-C40) Ali/Aro	mg/kg	1	n.v.	-	n/t	15.7	n/t	10.3	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t

* Assuming 1% SOM for organic compounds
** - Soil Organic Matter = Total Organic Carbon x 1.72

NAD = No asbestos detected
MG = Made Ground
n.v = no published value available

APPENDIX H – Geoenvironmental Analytical Test Results

**Geoenvironmental
Analytical Test Results**



Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 21-35728

Issue: 1

Date of Issue: 08/09/2021

Contact: Kleri Tantele

Customer Details: Leap Environmental Ltd
Book House
Glebelands Centre
Dorking
Surrey RH4 3HW

Quotation No: Q14-00063

Order No: LPO-4332

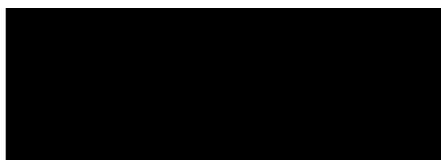
Customer Reference: LP2694

Date Received: 01/09/2021

Date Approved: 08/09/2021

Details: Phase 4 North Littlehampton

Approved by:



Mike Varley, Technical Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

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Sample Summary

Report No.: 21-35728, issue number 1

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
249490	TP301 0.05	31/08/2021	01/09/2021	Silty loam	
249491	TP302 0.10	31/08/2021	01/09/2021		
249492	TP302 1.95	31/08/2021	01/09/2021		
249493	TP303 1.00	31/08/2021	01/09/2021		
249494	TP303 2.00	31/08/2021	01/09/2021	Silty clayey loam	
249495	TP304 0.50	31/08/2021	01/09/2021	Sandy silty loam	
249496	TP305 1.50	31/08/2021	01/09/2021	Silty clayey loam	



Results Summary

2683

Report No.: 21-35728, issue number 1

Report No.: 249490, Issue Number: 1

ELAB Reference	249490	249494	249495	249496
Customer Reference				
Sample ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sample Location	TP301	TP303	TP304	TP305
Sample Depth (m)	0.05	2.00	0.50	1.50
Sampling Date	31/08/2021	31/08/2021	31/08/2021	31/08/2021
Determinand	Codes	Units	LOD	
Soil sample preparation parameters				
Material removed	N	%	0.1	14.9
Description of Inert material removed	N		0	Stones
Metals				
Arsenic	M	mg/kg	1	17.0
Cadmium	M	mg/kg	0.5	< 0.5
Chromium	M	mg/kg	5	34.0
Copper	M	mg/kg	5	19.3
Lead	M	mg/kg	5	29.0
Mercury	M	mg/kg	0.5	< 0.5
Nickel	M	mg/kg	5	22.4
Selenium	M	mg/kg	1	< 1.0
Zinc	M	mg/kg	5	100
Inorganics				
Hexavalent Chromium	N	mg/kg	0.8	< 0.8
Miscellaneous				
pH	M	pH units	0.1	8.4
Total Organic Carbon	N	%	0.01	1.2
Polyaromatic hydrocarbons				
Naphthalene	M	mg/kg	0.1	< 0.1
Acenaphthylene	M	mg/kg	0.1	< 0.1
Acenaphthene	M	mg/kg	0.1	< 0.1
Fluorene	M	mg/kg	0.1	< 0.1
Phenanthrene	M	mg/kg	0.1	0.6
Anthracene	M	mg/kg	0.1	0.2
Fluoranthene	M	mg/kg	0.1	1.3
Pyrene	M	mg/kg	0.1	1.0
Benzo(a)anthracene	M	mg/kg	0.1	0.6
Chrysene	M	mg/kg	0.1	0.7
Benzo(b)fluoranthene	M	mg/kg	0.1	0.8
Benzo(k)fluoranthene	M	mg/kg	0.1	0.7
Benzo(a)pyrene	M	mg/kg	0.1	0.7
Indeno(1,2,3-cd)pyrene	M	mg/kg	0.1	0.6
Dibenzo(a,h)anthracene	M	mg/kg	0.1	0.2
Benzo(g,h,i)perylene	M	mg/kg	0.1	0.5
Total PAH(16)	M	mg/kg	0.4	8.0

Tests marked N are not UKAS accredited.

The Environmental Laboratory Ltd. Reg. No. 3882193



Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards on Sea, East Sussex, TN38 9BY

Results Summary

Report No.: 21-35728, issue number 1

Asbestos Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #) in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client.

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Asbestos Identification	Gravimetric Analysis Total (%)	Gravimetric Analysis by ACM Type (%)	Free Fibre Analysis (%)	Total Asbestos (%)
249490	0.05	TP301	Brown Soil,Stones	No asbestos detected	n/t	n/t	n/t	n/t
249494	2.00	TP303	Brown	No asbestos detected	n/t	n/t	n/t	n/t
249495	0.50	TP304	Brown	No asbestos detected	n/t	n/t	n/t	n/t
249496	1.50	TP305	Brown Soil,Stones	No asbestos detected	n/t	n/t	n/t	n/t



Method Summary

Report No.: 21-35728, issue number 1

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Hexavalent chromium	N	As submitted sample	03/09/2021	110	Colorimetry
pH	M	Air dried sample	08/09/2021	113	Electromeric
PAH (GC-FID)	M	As submitted sample	03/09/2021	133	GC-FID
Total organic carbon/Total sulphur	N	Air dried sample	06/09/2021	210	IR
Asbestos identification	U	Air dried sample	07/09/2021	280	Microscopy
Aqua regia extractable metals	M	Air dried sample	03/09/2021	300	ICPMS

Tests marked N are not UKAS accredited



Report Information

Report No.: 21-35728, issue number 1

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

LOD	LOD refers to limit of detection, except in the case of pH soils and pH waters where it means limit of discrimination. Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed. ELAB are unable to provide an interpretation or opinion on the content of this report. The results relate only to the sample received. PCB congener results may include any coeluting PCBs Uncertainty of measurement for the determinands tested are available upon request Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.
-----	--

Deviation Codes

-
- | | |
|---|--|
| a | No date of sampling supplied |
| b | No time of sampling supplied (Waters Only) |
| c | Sample not received in appropriate containers |
| d | Sample not received in cooled condition |
| e | The container has been incorrectly filled |
| f | Sample age exceeds stability time (sampling to receipt) |
| g | Sample age exceeds stability time (sampling to analysis) |

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

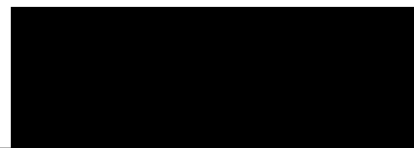
All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage



Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY



THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 21-36000

Issue: 1

Date of Issue: 21/09/2021

Contact: Martin Weil

Customer Details: Leap Environmental Ltd
Book House
Glebelands Centre
Dorking
Surrey RH4 3HW

Quotation No: Q14-00063

Order No: LPO-4344

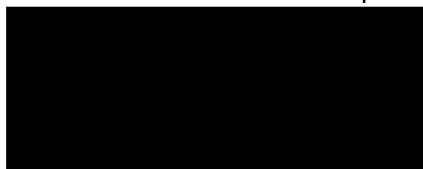
Customer Reference: LP2694

Date Received: 06/09/2021

Date Approved: 21/09/2021

Details: Phase 4 North Littlehampton

Approved by:



Mike Varley, Technical Manager

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Sample Summary

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Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
251077	WS303 0.35	03/09/2021	16/09/2021	Silty loam	
251078	WS301 1.60	03/09/2021	16/09/2021	Silty clayey loam	
251079	WS302 0.70	03/09/2021	16/09/2021	Silty clayey loam	
251080	WS306 0.15	03/09/2021	16/09/2021	Silty loam	
251081	WS305 0.50	03/09/2021	16/09/2021	Chalk & Silty loam	
251082	WS304 0.20	03/09/2021	16/09/2021	Silty loam	
251083	WS301 0.15	03/09/2021	16/09/2021		
251084	WS301 0.40	03/09/2021	16/09/2021		
251085	WS302 0.20	03/09/2021	16/09/2021		
251086	WS302 1.50	03/09/2021	16/09/2021		
251087	WS303 0.10	03/09/2021	16/09/2021		
251088	WS305 0.10	03/09/2021	16/09/2021		
251089	WS306 0.40	03/09/2021	16/09/2021		
251090	WS306 0.80	03/09/2021	16/09/2021		



Results Summary

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ELAB Reference	251077	251078	251079	251080	251081	251082
Customer Reference						
Sample ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sample Location	WS303	WS301	WS302	WS306	WS305	WS304
Sample Depth (m)	0.35	1.60	0.70	0.15	0.50	0.20
Sampling Date	03/09/2021	03/09/2021	03/09/2021	03/09/2021	03/09/2021	03/09/2021
Determinand	Codes	Units	LOD			
Soil sample preparation parameters						
Material removed	N	%	0.1	22.6	< 0.1	< 0.1
Description of Inert material removed	N		0	Stones	None	None
Metals						
Arsenic	M	mg/kg	1	21.0	13.1	11.6
Cadmium	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Chromium	M	mg/kg	5	28.8	22.2	26.5
Copper	M	mg/kg	5	34.8	16.6	22.2
Lead	M	mg/kg	5	31.1	16.3	32.3
Mercury	M	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Nickel	M	mg/kg	5	33.6	21.9	20.2
Selenium	M	mg/kg	1	< 1.0	< 1.0	< 1.0
Zinc	M	mg/kg	5	82.9	63.8	77.0
Inorganics						
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	< 0.8	< 0.8
Miscellaneous						
pH	M	pH units	0.1	8.5	8.3	8.3
Total Organic Carbon	N	%	0.01	1.0	0.69	0.65
Polyaromatic hydrocarbons						
Naphthalene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Fluorene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Anthracene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	M	mg/kg	0.1	< 0.1	< 0.1	0.3
Pyrene	M	mg/kg	0.1	< 0.1	< 0.1	0.2
Benzo(a)anthracene	M	mg/kg	0.1	< 0.1	< 0.1	0.1
Chrysene	M	mg/kg	0.1	< 0.1	< 0.1	0.1
Benzo(b)fluoranthene	M	mg/kg	0.1	< 0.1	< 0.1	0.2
Benzo(k)fluoranthene	M	mg/kg	0.1	< 0.1	< 0.1	0.2
Benzo(a)pyrene	M	mg/kg	0.1	< 0.1	< 0.1	0.1
Indeno(1,2,3-cd)pyrene	M	mg/kg	0.1	< 0.1	< 0.1	0.1
Dibenzo(a,h)anthracene	M	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Benzo(g,h,i)perylene	M	mg/kg	0.1	< 0.1	< 0.1	0.1
Total PAH(16)	M	mg/kg	0.4	< 0.4	< 0.4	1.7

Tests marked N are not UKAS accredited.

The Environmental Laboratory Ltd. Reg. No. 3882193

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Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards on Sea, East Sussex, TN38 9BY

Results Summary

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Asbestos Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #) in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client.

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Asbestos Identification	Gravimetric Analysis Total (%)	Gravimetric Analysis by ACM Type (%)	Free Fibre Analysis (%)	Total Asbestos (%)
251077	0.35	WS303	Brown sandy soil, stones	No asbestos detected	n/t	n/t	n/t	n/t
251078	1.60	WS301	Brown soil, stones	No asbestos detected	n/t	n/t	n/t	n/t
251079	0.70	WS302	Brown soil, stones	No asbestos detected	n/t	n/t	n/t	n/t
251080	0.15	WS306	Brown soil, stones	No asbestos detected	n/t	n/t	n/t	n/t
251081	0.50	WS305	Chalky soil, chalk	No asbestos detected	n/t	n/t	n/t	n/t
251082	0.20	WS304	Brown soil, stones	No asbestos detected	n/t	n/t	n/t	n/t



Method Summary

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Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Hexavalent chromium	N	As submitted sample	17/09/2021	110	Colorimetry
pH	M	Air dried sample	17/09/2021	113	Electromeric
Aqua regia extractable metals	M	Air dried sample	17/09/2021	118	ICPMS
PAH (GC-FID)	M	As submitted sample	17/09/2021	133	GC-FID
Total organic carbon/Total sulphur	N	Air dried sample	20/09/2021	210	IR
Asbestos identification	U	Air dried sample	21/09/2021	280	Microscopy

Tests marked N are not UKAS accredited



Report Information

Report No.: 21-36000, issue number 1

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

LOD	LOD refers to limit of detection, except in the case of pH soils and pH waters where it means limit of discrimination. Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed. ELAB are unable to provide an interpretation or opinion on the content of this report. The results relate only to the sample received. PCB congener results may include any coeluting PCBs Uncertainty of measurement for the determinands tested are available upon request Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.
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Deviation Codes

-
- | | |
|---|--|
| a | No date of sampling supplied |
| b | No time of sampling supplied (Waters Only) |
| c | Sample not received in appropriate containers |
| d | Sample not received in cooled condition |
| e | The container has been incorrectly filled |
| f | Sample age exceeds stability time (sampling to receipt) |
| g | Sample age exceeds stability time (sampling to analysis) |

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

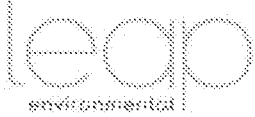
All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage

APPENDIX I – Monitoring Results

Monitoring Results

Continuous Gas Monitoring Record								
Date	20/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	21					
Site	N.Littlehampton	Ambient Pressure	1023					
BH301		Time	Flow (l/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.0	0.3	0.1	20.6	1	0
Hole ID		00:15	0.0	0.4	3.3	14.2	2	0
VOC peak (ppm)	Not Measured	00:30	0.0	0.3	3.3	14.0	2	0
VOC steady (ppm)	Not Measured	01:00	0.0	0.3	3.4	13.7	2	0
		01:30	0.0	0.3	3.5	13.5	2	0
Borehole Depth (mbgl)	4.92	02:00	0.0	0.3	3.6	13.2	2	0
		02:30	0.0	0.3	3.7	13.0	1	0
Water level (mbgl)	2.28	03:00	0.0	0.3	3.9	12.6	1	0
		03:30	0.0	0.3	4.0	12.3	1	0
Borehole Pressure (mb)	1023	04:00	0.0	0.3	4.3	11.8	1	0
		04:30	0.0	0.3	4.5	11.2	1	0
		05:00	0.0	0.3	4.7	10.8	1	0
		05:30	0.0	0.3	5.0	10.3	1	0
		06:00	0.0	0.3	5.2	9.8	1	0
		06:30	0.0	0.3	5.4	9.4	1	0
		07:00	0.0	0.3	5.7	9.0	1	0
		07:30	0.0	0.3	5.9	8.4	1	0
		08:00	0.0	0.3	6.2	8.0	1	0
		08:30	0.0	0.3	6.3	7.6	1	0
		09:00	0.0	0.3	6.5	7.3	1	0
		09:30	0.0	0.2	6.6	7.1	1	0
		10:00	0.0	0.2	6.8	6.8	1	0

Continuous Gas Monitoring Record								
Date	21/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	17					
Site	N.Littlehampton	Ambient Pressure	1032					
BH303		Time	Flow (l/h)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)
		00:00	0.0	0.1	0.2	21.0	4	0
Hole ID		00:15	0.0	0.1	0.8	20.5	1	0
VOC peak (ppm)		00:30	0.0	0.1	0.4	20.7	0	0
Not Measured		01:00	0.0	0.1	0.3	20.9	0	0
VOC steady (ppm)		01:30	0.0	0.1	0.2	20.9	0	0
Not Measured		02:00	0.0	0.1	0.2	20.9	0	0
Borehole Depth (mbgl)		02:30	0.0	0.1	0.2	21.0	0	0
9.74		03:00	0.0	0.1	0.2	21.0	0	0
Water level (mbgl)		03:30	0.0	0.1	0.1	21.0	0	0
0.72		04:00	0.0	0.1	0.1	21.0	0	0
Borehole Pressure (mb)		04:30	0.0	0.1	0.1	21.0	0	0
1032		05:00	0.0	0.1	0.1	21.0	0	0

Continuous Gas Monitoring Record								
Date	20/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	21					
Site	N.Littlehampton	Ambient Pressure	1024					
WS301		Time	Flow (l/h)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)
		00:00	0.0	0.2	0.0	20.9	4	0
Hole ID		00:15	0.0	0.2	5.4	17.6	9	0
VOC peak (ppm)	Not Measured	00:30	0.0	0.2	7.9	15.8	4	0
		01:00	0.0	0.2	8.0	15.6	2	0
VOC steady (ppm)	Not Measured	01:30	0.0	0.2	8.0	15.6	2	0
		02:00	0.0	0.2	8.0	15.6	2	0
Borehole Depth (mbgl)	3.16	02:30	0.0	0.2	8.0	15.6	2	0
		03:00	0.0	0.2	8.0	15.6	2	0
Water level (mbgl)	2.70	03:30	0.0	0.2	7.8	15.7	2	0
		04:00	0.0	0.2	7.6	15.8	2	0
Borehole Pressure (mb)	1024	04:30	0.0	0.2	7.4	16.0	2	0
		05:00	0.0	0.2	7.2	16.1	2	0
		05:30	0.0	0.2	7.0	16.2	2	0
		06:00	0.0	0.2	6.8	16.4	2	0
		06:30	0.0	0.2	6.6	16.5	2	0
		07:00	0.0	0.2	6.6	16.7	2	0
		07:30	0.0	0.2	6.4	16.9	2	0
		08:00	0.0	0.2	6.0	17.2	2	0
		08:30	0.0	0.2	5.5	17.3	1	0
		09:00	0.0	0.2	5.2	17.5	1	0
		09:30	0.0	0.2	5.0	17.7	2	0
		10:00	0.0	0.2	4.7	17.9	1	0
		11:00	0.0	0.2	4.3	18.3	2	0
		12:00	0.0	0.2	3.9	18.6	1	0

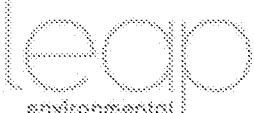
Continuous Gas Monitoring Record								
Date	20/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	21					
Site	N.Littlehampton	Ambient Pressure	1023					
WS302		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.0	0.2	0.3	20.6	2	0
Hole ID		00:15	0.0	rapidly rising numbers				
VOC peak (ppm)	Not Measured	00:30	0.0	61.7	20.6	3.0	6	0
		01:00	0.0	61.9	21.2	1.1	7	0
VOC steady (ppm)	Not Measured	01:30	0.0	61.9	21.2	0.9	7	0
		02:00	0.0	62.0	21.3	0.9	6	0
Borehole Depth (mbgl)	1.65	02:30	0.0	61.9	21.2	0.9	6	0
		03:00	0.0	61.9	21.2	0.9	6	0
Water level (mbgl)	DRY	03:30	0.0	61.3	21.1	0.9	6	0
		04:00	0.0	60.9	21.1	0.9	6	0
Borehole Pressure (mb)	1023	04:30	0.0	60.5	21.0	0.9	6	0
		05:00	0.0	60.0	20.9	1.0	5	0
		05:30	0.0	59.3	20.7	1.2	5	0
		06:00	0.0	58.2	20.4	1.4	5	0
		06:30	0.0	56.5	20.0	1.8	5	0
		07:00	0.0	53.4	19.3	2.6	5	0
		07:30	0.0	50.3	18.6	3.4	4	0
		08:00	0.0	48.8	17.8	4.2	4	0
		08:30	0.0	45.2	17.2	4.9	3	0
		09:00	0.0	42.8	16.4	5.6	3	0
		09:30	0.0	40.0	15.8	6.4	3	0
		10:00	0.0	37.4	15.0	7.2	2	0

Continuous Gas Monitoring Record								
Date	21/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	17					
Site	N.Littlehampton	Ambient Pressure	1032					
WS302		Time	Flow (l/h)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)
		00:00	0.0	0.1	0.0	20.1	0	0
Hole ID		00:15	0.0	0.1	5.7	17.6	0	0
VOC peak (ppm)	Not Measured	00:30	0.0	0.1	5.8	17.3	0	0
		01:00	0.0	0.1	5.8	17.4	0	0
VOC steady (ppm)	Not Measured	01:30	0.0	0.1	5.5	17.5	0	0
		02:00	0.0	0.1	5.8	17.3	0	0
Borehole Depth (mbgl)	1.65	02:30	0.0	0.1	5.0	17.8	0	0
		03:00	0.0	0.1	5.0	17.8	0	0
Water level (mbgl)	DRY	03:30	0.0	0.1	5.2	17.7	0	0
		04:00	0.0	0.1	5.2	17.7	0	0
Borehole Pressure (mb)	1032	04:30	0.0	0.1	6.0	17.4	0	0
		05:00	0.0	0.1	5.1	17.8	0	0

Continuous Gas Monitoring Record								
Date	21/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	17					
Site	N.Littlehampton	Ambient Pressure	1032					
WS303 Hole ID		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.0	0.1	0.0	21.1	0	0
		00:15	0.0	0.6	5.2	20.3	0	0
VOC peak (ppm)	Not Measured	00:30	0.0	0.1	9.0	15.4	0	0
		01:00	0.0	0.1	9.0	15.0	0	0
VOC steady (ppm)	Not Measured	01:30	0.0	0.1	9.1	14.9	0	0
		02:00	0.0	0.0	9.0	14.9	0	0
Borehole Depth (mbgl)	1.69	02:30	0.0	0.1	9.2	14.8	0	0
		03:00	0.0	0.1	9.2	14.6	0	0
Water level (mbgl)	1.55	03:30	0.0	0.1	9.4	14.5	0	0
		04:00	0.0	0.1	9.5	14.3	0	0
Borehole Pressure (mb)	1032	04:30	0.0	0.1	9.7	14.0	0	0
		05:00	0.0	0.1	10.0	13.7	0	0
		05:30	0.0	0.1	10.1	13.5	0	0
		06:00	0.0	0.2	10.2	13.5	0	0
		06:30	0.0	0.1	10.1	13.5	0	0
		07:00	0.0	0.1	10.2	13.5	3	0
		07:30	0.0	0.1	10.1	13.6	0	0
		08:00	0.0	0.9	10.6	13.6	7	0
		08:30	0.0	5.7	9.4	13.7	0	0
		09:00	0.0	0.1	9.9	13.8	0	0
		09:30	0.0	0.0	9.5	13.9	0	0
		10:00	0.0	0.1	9.6	14.0	0	0
		11:00	0.0	0.3	9.5	14.1	0	0
		12:00	0.0	0.1	9.5	14.2	0	0
		13:00	0.0	0.1	9.3	14.3	0	0
		14:00	0.0	0.1	9.1	14.4	0	0
		15:00	0.0	0.1	8.9	14.8	0	0

Continuous Gas Monitoring Record								
Date	27/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	16					
Site	N.Littlehampton	Ambient Pressure	1011					
BH301		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
Hole ID		00:00	0.0	0.2	0.5	20.3	0	0
		00:15	0.0	0.2	2.6	20.2	0	0
VOC peak (ppm)	0.4	00:30	0.0	0.3	3.5	19.2	0	0
		01:00	0.0	0.3	3.5	17.2	0	0
VOC steady (ppm)	0.4	01:30	0.0	0.5	3.8	14.9	0	0
		02:00	0.0	0.5	4.3	14.2	0	0
Borehole Depth (mbgl)	4.93	02:30	0.0	0.5	4.6	13.3	0	0
		03:00	0.0	0.5	5.2	12.8	0	0
Water level (mbgl)	2.29	03:30	0.0	0.6	5.7	12.1	0	0
		04:00	0.0	0.6	6.0	11.7	0	0
Borehole Pressure (mb)	1011	04:30	0.0	0.6	6.1	11.6	0	0
		05:00	0.0	0.6	6.3	11.2	0	0
		05:30	0.0	0.6	6.4	11.1	0	0
		06:00	0.0	0.7	6.5	11.0	0	0
		06:30	0.0	0.7	6.6	10.9	0	0
		07:00	0.0	0.7	6.6	10.9	0	0
		07:30	0.0	0.7	6.7	11.0	0	0
		08:00	0.0	0.7	6.6	11.2	0	0
		08:30	0.0	0.7	6.7	11.3	0	0
		09:00	0.0	0.7	6.6	11.5	0	0
		09:30	0.0	0.7	6.6	11.6	0	0
		10:00	0.0	0.7	6.5	11.8	0	0

Continuous Gas Monitoring Record								
Date	27/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	16					
Site	N.Littlehampton	Ambient Pressure	1011					
BH303		Time	Flow (l/h)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)
		00:00	0.0	0.1	0.0	20.8	0	0
Hole ID		00:15	0.0	0.1	1.8	20.1	1	0
VOC peak (ppm)		00:30	0.0	0.1	1.9	19.0	0	0
1.5		01:00	0.0	0.1	1.9	18.9	0	0
VOC steady (ppm)		01:30	0.0	0.1	1.9	18.8	0	0
0.2		02:00	0.0	0.1	1.8	18.9	0	0
Borehole Depth (mbgl)		02:30	0.0	0.1	1.7	19.1	0	0
9.74		03:00	0.0	0.1	1.6	19.2	0	0
Water level (mbgl)		03:30	0.0	0.1	1.5	19.3	0	0
0.72		04:00	0.0	0.1	1.4	19.3	0	0
Borehole Pressure (mb)		04:30	0.0	0.1	1.4	19.3	0	0
1011		05:00	0.0	0.1	1.3	19.4	0	0
		05:30	0.0	0.1	1.3	19.4	0	0
		06:00	0.0	0.1	1.3	19.4	0	0
		06:30	0.0	0.1	1.3	19.5	0	0
		07:00	0.0	0.1	1.2	19.5	0	0
		07:30	0.0	0.1	1.2	19.6	0	0
		08:00	0.0	0.1	1.2	19.5	0	0
		08:30		0.1	1.2	19.6	0	0
		09:00		0.1	1.2	19.6	0	0
		09:30		0.1	1.1	19.6	0	0
		10:00		0.1	1.1	19.6	0	0

Continuous Gas Monitoring Record								
Date	27/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	16					
Site	N.Littlehampton	Ambient Pressure	1011					
WS301 Hole ID		Time	Flow (l/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.0	0.0	0.2	20.4	0	0
		00:15	0.0	0.2	7.1	16.2	0	0
		00:30	0.0	0.2	7.3	15.8	0	0
VOC peak (ppm)	0.8	01:00	0.0	0.2	7.3	15.8	0	0
VOC steady (ppm)	0.8	01:30	0.0	0.2	7.3	15.7	0	0
		02:00	0.0	0.2	7.3	15.7	0	0
Borehole Depth (mbgl)	3.18	02:30	0.0	0.2	7.3	15.6	0	0
		03:00	0.0	0.2	7.3	15.6	0	0
Water level (mbgl)	2.71	03:30	0.0	0.2	7.3	15.6	0	0
		04:00	0.0	0.2	7.3	15.7	0	0
Borehole Pressure (mb)	1011	04:30	0.0	0.2	6.9	15.9	0	0
		05:00	0.0	0.2	6.7	16.1	0	0
		05:30	0.0	0.2	6.4	16.2	0	0
		06:00	0.0	0.2	6.3	16.3	0	0
		06:30	0.0	0.2	6.1	16.4	0	0
		07:00	0.0	0.2	5.9	16.6	0	0
		07:30	0.0	0.2	5.6	16.8	0	0
		08:00	0.0	0.2	5.5	16.9	0	0

Continuous Gas Monitoring Record									
Date	27/09/2021	Engineer	SH						
Project No	LP2694	Temp °C	16						
Site	N.Littlehampton	Ambient Pressure	1011						
WS302		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)	
		00:00	0.0	0.2	0.6	19.8	0	0	
Hole ID		00:15	0.0	64.0	21.3	4.5	1	0	
VOC peak (ppm)		0.7	00:30	0.0	66.1	21.8	1.2	1	0
VOC steady (ppm)		0.3	01:00	0.0	66.2	21.9	0.9	1	0
Borehole Depth (mbgl)		1.66	01:30	0.0	66.1	21.8	0.9	2	0
Water level (mbgl)		DRY	02:00	0.0	65.5	21.8	1.0	1	0
Borehole Pressure (mb)		1011	02:30	0.0	65.1	21.3	1.0	1	0
			03:00	0.0	64.6	21.5	1.0	1	0
			03:30	0.0	64.7	21.6	0.9	1	0
			04:00	0.0	63.2	21.5	0.9	1	0
			04:30	0.0	62.9	21.2	1.1	1	0
			05:00	0.0	61.8	21.0	1.2	1	0
			05:30	0.0	60.4	20.7	1.3	1	0
			06:00	0.0	59.3	20.5	1.4	1	0
			06:30	0.0	57.4	20.1	1.7	1	0
			07:00	0.0	56.7	19.8	1.9	1	0
			07:30	0.0	55.5	19.6	2.2	1	0
			08:00	0.0	53.3	19.1	2.7	1	0
			08:30	0.0	51.0	18.3	3.4	1	0
			09:00	0.0	48.3	17.7	4.1	1	0
			09:30	0.0	45.6	17.1	4.8	1	0
			10:00	0.0	43.3	16.6	5.4	1	0

Continuous Gas Monitoring Record								
Date	27/09/2021	Engineer	SH					
Project No	LP2694	Temp °C	16					
Site	N.Littlehampton	Ambient Pressure	1011					
WS303		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.0	0.1	8.3	20.5	0	0
Hole ID		00:15	0.0	0.1	10.0	17.4	0	0
VOC peak (ppm)	0.3	00:30	0.0	0.1	10.0	14.3	0	0
VOC steady (ppm)	0.1	01:00	0.0	0.1	9.7	14.1	0	0
		01:30	0.0	0.1	9.7	14.3	0	0
		02:00	0.0	0.1	9.7	14.3	0	0
Borehole Depth (mbgl)	1.69	02:30	0.0	0.1	9.7	14.3	0	0
		03:00	0.0	0.1	9.7	14.3	0	0
Water level (mbgl)	1.54	03:30	0.0	0.1	9.7	14.3	0	0
		04:00	0.0	0.1	9.7	14.3	0	0
Borehole Pressure (mb)	1011	04:30	0.0	0.1	9.7	14.3	0	0
		05:00	0.0	0.1	9.7	14.3	0	0
		05:30	0.0	0.2	9.7	14.3	0	0
		06:00	0.0	0.2	9.7	14.4	0	0
		06:30	0.0	0.2	9.7	14.4	0	0
		07:00	0.0	0.2	9.6	14.4	0	0

Continuous Gas Monitoring Record								
Date	04/10/2021	Engineer	SH					
Project No	LP2694	Temp °C	15					
Site	N.Littlehampton	Ambient Pressure	1011					
BH301		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00 Unable to monitor- well flooded						
Hole ID		00:15						
VOC peak (ppm)		00:30						
VOC steady (ppm)		01:00						
Borehole Depth (mbgl)		01:30						
Water level (mbgl)		02:00						
Borehole Pressure (mb)		02:30						
		03:00						
		03:30						
		04:00						
		04:30						
		05:00						
		05:30						
		06:00						
		06:30						
		07:00						
		07:30						
		08:00						
		08:30						
		09:00						
		09:30						
		10:00						

Continuous Gas Monitoring Record								
Date	01/04/2021	Engineer	SH					
Project No	LP2694	Temp °C	15					
Site	N.Littlehampton	Ambient Pressure	1011					
BH303		Time	Flow (l/h)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)
		00:00	-0.1	0.2	0.0	20.9	0	0
Hole ID		00:15	-0.2	0.2	1.0	18.8	1	0
VOC peak (ppm)	Not Measured	00:30	0.0	0.2	0.5	17.7	1	0
VOC steady (ppm)	Not Measured	01:00	0.0	0.2	0.5	17.8	1	0
		01:30	0.0	0.2	0.4	18.2	1	0
		02:00	0.0	0.2	0.4	18.4	1	0
Borehole Depth (mbgl)	9.75	02:30	0.0	0.2	0.3	18.9	0	0
		03:00	0.0	0.2	0.3	19.4	1	0
Water level (mbgl)	0.48	03:30	0.0	0.2	0.2	19.8	0	0
		04:00	0.0	0.2	0.2	20.1	0	0
Borehole Pressure (mb)	1011	04:30	0.0	0.2	0.1	20.3	0	0
		05:00	0.0	0.2	0.1	20.5	0	0

Continuous Gas Monitoring Record								
Date	04/10/2021	Engineer	SH					
Project No	LP2694	Temp °C	15					
Site	N.Littlehampton	Ambient Pressure	1011					
WS301		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	-17.0	0.1	0.0	20.9	0	0
Hole ID		00:15	-16.9	0.1	0.3	20.8	0	0
		00:30	-13.5	0.1	0.3	20.5	0	0
VOC peak (ppm)	Not Measured	01:00	-11.0	0.1	0.4	20.4	0	0
VOC steady (ppm)	Not Measured	01:30	-6.7	0.1	0.6	20.1	0	0
		02:00	-5.9	0.1	0.7	19.9	0	0
Borehole Depth (mbgl)	3.18	02:30		0.1	1.0	19.5	0	0
		03:00		0.1	1.2	19.3	0	0
Water level (mbgl)	1.76	03:30		0.1	1.4	19.1	0	0
		04:00		0.1	1.5	19.0	0	0
Borehole Pressure (mb)		04:30		0.1	1.6	18.9	0	0
		05:00		0.1	1.7	18.7	0	0
		05:30		0.1	1.8	18.7	0	0
		06:00		0.1	1.9	18.5	0	0
		06:30		0.1	2.1	18.4	0	0
		07:00		0.1	2.1	18.6	0	0

Continuous Gas Monitoring Record								
Date	04/10/2021	Engineer	SH					
Project No	LP2694	Temp °C	15					
Site	N.Littlehampton	Ambient Pressure	1011					
WS302		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.0	0.1	0.1	20.3	0	0
Hole ID		00:15	0.0	22.0	16.5	10.2	1	0
		00:30	0.0	22.1	17.7	2.6	1	0
VOC peak (ppm)	Not Measured	01:00	0.0	22.2	17.7	2.0	1	0
VOC steady (ppm)	Not Measured	01:30	0.0	22.0	17.7	1.7	1	0
		02:00	0.0	21.9	17.7	1.7	1	0
Borehole Depth (mbgl)	1.66	02:30	0.0	21.5	17.7	1.7	0	0
		03:00	0.0	21.1	17.7	1.7	1	0
Water level (mbgl)	DRY	03:30	0.0	20.6	17.7	1.6	1	0
		04:00	0.0	19.9	17.5	1.6	1	0
Borehole Pressure (mb)	1011	04:30	0.0	18.9	17.4	1.6	1	0
		05:00	0.0	18.0	17.0	1.9	1	0
		05:30	0.0	17.3	16.6	2.3	0	0
		06:00	0.0	16.3	15.8	3.1	0	0
		06:30	0.0	15.3	15.1	3.9	0	0
		07:00	0.0	14.5	14.4	4.8	0	0
		07:30	0.0	13.8	13.9	5.4	0	0
		08:00	0.0	13.2	13.4	6.1	0	0
		08:30	0.0	12.2	12.5	7.1	0	0
		09:00	0.0	11.4	11.9	7.9	0	0
		09:30	0.0	10.6	11.1	8.9	0	0
		10:00	0.0	9.6	10.3	9.8	0	0
		12:00	0	5.4	6.9	14.3	0	0
		14:00	0	2.5	4.7	17.3	0	0
		16:00	0	1.6	3.8	18.4	0	0
		18:00	0	1	3.2	19.2	0	0
		20:00	0	0.8	2.8	19.5	0	0
		22:00	0	0.6	2.4	19.9	0	0

Continuous Gas Monitoring Record								
Date	04/10/2021	Engineer	SH					
Project No	LP2694	Temp °C	15					
Site	N.Littlehampton	Ambient Pressure	1011					
WS303		Time	Flow (J/h)	CH ⁴ (%)	CO ² (%)	O ² (%)	CO (ppm)	H ² S (ppm)
		00:00	0.0	0.2	0.0	20.9	0	0
Hole ID		00:15	0.0	0.2	3.5	19.5	0	0
VOC peak (ppm)		00:30	0.0	0.2	3.6	18.5	0	0
Not Measured		01:00	0.0	0.2	3.6	18.4	0	0
VOC steady (ppm)		01:30	0.0	0.2	3.7	18.4	0	0
Not Measured		02:00	0.0	0.2	3.6	18.4	0	0
Borehole Depth (mbgl)		02:30	0.0	0.2	3.6	18.4	0	0
1.69		03:00	0.0	0.2	3.6	18.4	0	0
Water level (mbgl)		03:30	0.0	0.2	3.6	18.4	0	0
1.36		04:00	0.0	0.2	3.6	18.4	0	0
Borehole Pressure (mb)		04:30	0.0	0.2	3.6	18.4	0	0
1011		05:00	0.0	0.2	3.5	18.3	0	0
		05:30	0.0	0.2	3.5	18.3	0	0
		06:00	0.0	0.2	3.4	18.2	0	0
		06:30	0.0	0.2	3.4	18.2	0	0
		07:00	0.0	0.2	3.3	18.2	0	0

APPENDIX J – Approach to the Selection of Generic Assessment Criteria

Approach to the
Selection of Generic
Assessment Criteria

LEAP APPROACH TO THE SELECTION OF GENERIC ASSESSMENT CRITERIA

Chronic Risks to Human Health

Defra and the EA have published a limited number of Soil Guideline Values (SGVs)¹⁹ that represent minimal chronic risk to human health. CL:AIRE has published a limited number of Category Four Screening Levels (C4SLs)²⁰ which represent a low but still strongly precautionary level of chronic risk to human health. Both the SGVs and C4SLs have both been derived for a Soil Organic Matter (SOM) content of 6%, which is not always representative of the low SOM that are encountered within Made Ground on brownfield sites.

Land Quality Management Ltd. (LQM) responded to the demand for a more comprehensive set of screening values and for a wider range of SOM by producing Suitable for Use Levels (S4ULs)²¹ which are a hybrid of SGVs and C4SLs. The S4ULs have been endorsed by the Chartered Institute of Environmental Health (CIEH).

A smaller set of 35 GACs was published by CL:AIRE in association with AGS and EIC in 2010. These were based on the exposure scenarios that were used to derive the SGVs. These exposure scenarios have since been superseded, in part, by the publication of the C4SLs and the S4ULs. A second phase of C4SLs is currently under development.

LEAP uses C4SLs where they are available as generic assessment criteria to quantitatively assess the potential chronic risks to human health. Where C4SLs are not available, the S4ULs or CL:AIRE GACs are used. It is noted that S4ULs are not equivalent to C4SLs in all their exposure assumptions but are generally more conservative. To ensure the greatest possible consistency in LEAP's human health GQRAs, the physicochemical and toxicological input parameters that were used to derive the CL:AIRE GACs have been re-modelled using the exposure parameters selected by LQM to derive the S4ULs.

For the organic compounds benzene and benzo(a)pyrene) for which C4SLs are available for a SOM of 6% only, LEAP has calculated equivalent C4SLs for 1% and 2.5% SOM. SOM does not affect the inorganic contaminants.

¹⁹ Environment Agency Science Report SC050021 series.

²⁰ CL:AIRE Final Project Report. 'SPI010 – Development of Category 4 Screening Levels for assessment of land affected by contamination'. CL:AIRE, December 2013

²¹ 'The LQM/CIEH S4ULs for Human Health Risk Assessment', Nathaniel P et al, 2015. Copyright Land Quality Management Ltd, reproduced with permission: Publication Number S4UL3509.

In accordance with current Public Health England (PHE) guidance²², LEAP carries out the assessment of PAHs using a surrogate marker approach, whereby the assessment of risk from benzo(a)pyrene also captures potential risks from other carcinogenic PAHs that may be present. The alternative S4ULs for PAHs using the Toxic Equivalent Factor (TEF) approach are not used because this approach is likely to under predict the true carcinogenicity of PAHs and is not advocated by PHE. The threshold PAHs have been assessed similarly, by using naphthalene as a marker compound due to its high volatility relative to other PAHs.

Total phenols are assessed by LEAP against the S4UL for phenol and total chromium is assessed against the S4UL for trivalent chromium.

LEAP does not consider the theoretical soil saturations in the evaluation of organic compounds and as such, some of the S4ULs for the less sensitive exposure scenarios are lower than their more sensitive equivalents.

Risks to human health from inhalation of vapours derived from groundwater are evaluated by LEAP using the SoBRA groundwater GAC_{gwap} ²³.

Acute Risks to Human Health

Cyanide has not been modelled using CLEA because it has high acute toxicity and CLEA is designed to evaluate chronic risks. Assuming an acute risk and based on a single dose of 3 g of soil, an assessment criterion of 33 mgkg⁻¹ free inorganic cyanide and 544 mgkg⁻¹ complex cyanide has been calculated by LEAP. At this stage LEAP has chosen to adopt a conservative screening value of 20 mgkg⁻¹ for total cyanide (essentially the sum of free and complex cyanides) to highlight any potential risks to human health.

Risks to Controlled Waters

RTM (2006)²⁴ requires receptor-specific Water Quality Standards (WQS) to be used to determine potentially unacceptable risks to water bodies in England and Wales. It requires appropriate criteria to be taken from a hierarchy of sources, where they are available as follows:

²² HPA 'Contaminated Land Information Sheet. Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)'. Public Health England, 2017.

²³ Society of Brownfield Risk Assessment (SoBRA) 'Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater' Version 1.0. February 2017.

²⁴ EA 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination' 2006.

1. UK published values
2. EU published values
3. WHO published values

Drinking Water Resources

For groundwater and surface waters that are abstracted for potable supply LEAP uses:

- UK Drinking Water Quality Standards (DWS) from *The Water Supply (Water Quality) Regulations 2016* (England).
- *The Water Supply (Water Quality) Regulations 2010* (Wales) as amended in 2016.
- World Health Organisation *Guidelines for Drinking Water Quality*, Fourth Edition, Volume 1, (2011).

☒ Where the groundwater is not abstracted for potable supply, this is a precautionary approach which protects the potential future exploitation of the groundwater.

Surface Water (Ecological) Receptors

For surface waters as ecological receptors, LEAP uses the Environmental Quality Standards (EQS) from The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. There are no appropriate EU or WHO standards available.

Petroleum Hydrocarbons

☒ There are no current UK standards available for petroleum hydrocarbons, either for groundwater or surface water receptors, so an initial assessment criterion of 10µg/l, based on the former target concentration for dissolved or emulsified hydrocarbons, is used to represent a conservative preliminary screening value for total petroleum hydrocarbons.

☒ Where considered appropriate, LEAP then follows the guidance of CL:AIRE 2017²⁵ for the further assessment of the petroleum hydrocarbon fractions and derivatives. For a drinking water resource, the WHO guidelines are used. For surface waters as ecological receptors, proxy compounds are used to select appropriate EQS based on recommended indicator compounds, as follows:

- Aromatic EC5-EC7 – benzene
- Aromatic >EC7-EC8 – toluene

²⁵ CL:AIRE, 2017. 'Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies'. CL:AIRE, London. ISBN 978-1-905046-31-7.

- Aromatic >EC8-EC10 – ethylbenzene
- Aromatic >EC10-EC12 – naphthalene
- Aromatic >EC12-EC16 – no proxy
- Aromatic >EC16-EC21 – anthracene
- Aromatic >EC21-EC35 – benzo(a)pyrene