Basement Impact Assessment

in connection with proposed basement development at

10 Elsworthy Road
Camden
NW3 3DJ

for

Lorna & Peter Klimt

LBH4482 Ver. 2.0

September 2017

LBH WEMBLEY

ENGINEERING

Project No: LBH4482

Report Ref: LBH4482 Ver. 2.0

Date: 22nd September 2017

Report prepared by:

Digitally signed by Tom Jones
DN: cn=Tom Jones, o=LBH Wembley Engineering, ou, email=Tom@lbhgeo.co.uk, c=GB
Date: 2017.09.22 17:02:56 +01'00'

Tom Jones

MSci (Hons) FGS

Report approved by:

Darcy Kitson-Boyce

MEng (Hons) GMICE FGS FRGS

Report approved by: Seamus Lefroy-Brooks

Digitally signed by Seamus Lefroy-Brooks
Date: 2017.09.22 17:24:35 +01'00'

Seamus R Lefroy-Brooks

BSc (Hons) MSc CEng MICE CGeol FGS CEnv MIEnvSc FRGS SiLC
RoGEP UK Registered Ground Engineering Adviser

LBH WEMBLEY ENGINEERING

12 Little Balmer

Buckingham Industrial Park

Buckingham

MK18 1TF

Tel: 01280 812310

email: enquiry@lbhgeo.co.uk

website: www.lbhgeo.co.uk

Contents

Foreword-Guidance Notes

GENERAL

This report has been prepared for a specific client and to meet a specific brief. The preparation of this report may have been affected by limitations of scope, resources or time scale required by the client. Should any part of this report be relied on by a third party, that party does so wholly at its own risk and LBH Wembley Engineering disclaims any liability to such parties.

The observations and conclusions described in this report are based solely upon the agreed scope of work. LBH Wembley Engineering has not performed any observations, investigations, studies or testing not specifically set out in the agreed scope of work and cannot accept any liability for the existence of any condition, the discovery of which would require performance of services beyond the agreed scope of work.

VALIDITY

Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances shall be at the client's sole and own risk. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should therefore not be relied upon in the future and any such reliance on the report in the future shall again be at the client's own and sole risk. LBH Wembley Engineering should in all such altered circumstances be commissioned to review and update this report accordingly.

THIRD PARTY INFORMATION

The report may present an opinion on the disposition, configuration and composition of soils, strata and any contamination within or near the site based upon information received from third parties. However, no liability can be accepted for any inaccuracies or omissions in that information.

DRAWINGS

Any plans or drawings provided in this report are not meant to be an accurate base plan, but are used to present the general relative locations of features on, and surrounding, the site.

1. Introduction

1.1 Background

It is proposed to deepen the existing cellar space and create a full height basement at the property, extending into the rear garden. A lightwell will be constructed at the front of the property.

A ground floor extension to the rear and side of the property is also proposed, as well as a single storey lateral extension to the detached garage at the rear of the property.

1.2 Brief

LBH WEMBLEY have been appointed by Lorna & Peter Klimt to undertake a BIA for submission to the London Borough of Camden in order to satisfy the specific requirements of the 2017 Camden Local Plan, Camden Planning Policy and Supplementary Planning Guidance CPG4 on Basements and Lightwells. and associated Camden geological, hydrogeological and hydrological study 2010 (referred to as the 'Arup report').

1.3 Planning Policy

The 2017 Camden Local Plan Policy A5 Basements reads as follows:

> *"The Council will only permit basement development where it is demonstrated to its satisfaction that the proposal would not cause harm to:*
>
> *a) neighbouring properties;*
> *b) the structural, ground, or water conditions of the area;*
> *c) the character and amenity of the area;*
> *d) the architectural character of the building; and*
> *e) the significance of heritage assets.*
> *In determining proposals for basements and other underground development, the Council will require an assessment of the scheme's impact on drainage, flooding, groundwater conditions and structural stability in the form of a Basement Impact Assessment and where appropriate, a Basement Construction Plan.*
>
> *The siting, location, scale and design of basements must have minimal impact on, and be subordinate to, the host building and property. Basement development should:*
>
> *f) not comprise of more than one storey;*
> *g) not be built under an existing basement;*
> *h) not exceed 50% of each garden within the property;*
> *i) be less than 1.5 times the footprint of the host building in area;*
> *j) extend into the garden no further than 50% of the depth of the host building measured from the principal rear elevation;*
> *k) not extend into or underneath the garden further than 50% of the depth of the garden;*
> *l) be set back from neighbouring property boundaries where it extends beyond the footprint of the host building; and*
> *m) avoid the loss of garden space or trees of townscape or amenity value.*
>
> *Exceptions to f. to k. above may be made on large comprehensively planned sites.*

The Council will require applicants to demonstrate that proposals for basements:

n. do not harm neighbouring properties, including requiring the provision of a Basement Impact Assessment which shows that the scheme poses a risk of damage to neighbouring properties no higher than Burland Scale 1 'very slight';
o. avoid adversely affecting drainage and run-off or causing other damage to the water environment;
p. avoid cumulative impacts;
q. do not harm the amenity of neighbours;
r. provide satisfactory landscaping, including adequate soil depth;
s. do not harm the appearance or setting of the property or the established character of the surrounding area;
t. protect important archaeological remains; and
u. do not prejudice the ability of the garden to support trees where they are part of the character of the area.

The Council will not permit basement schemes which include habitable rooms and other sensitive uses in areas prone to flooding.

We will generally require a Construction Management Plan for basement developments.

Given the complex nature of basement development, the Council encourages developers to offer security for expenses for basement development to adjoining neighbours."

The following policies in the Local Plan are also relevant to basement development and will be taken into account when assessing basement schemes:

- "Policy A2 Open space";
- "Policy A3 Biodiversity";
- "Policy D1 Design";
- "Policy D2 Heritage"; and
- "Policy CC3 Water and flooding".

In addition to the Local Plan Policy Camden publishes Camden Planning Guidance on Basements and Lightwells. These CPG documents do not carry the same weight as the main Camden Development Plan documents (including the above Policy A5) but they are important supporting documents.

It is noted that the current CPG4 Planning Guidance on Basements and Lightwells (2015) has not yet been updated to reflect the Local Plan and refers primarily to the now withdrawn Planning Policy DP27 on Basements and Lightwells.

1.4 Report Structure

The report commences with a desk study and characterisation of the site, before progressing to BIA screening and scoping assessments, whereby the potential hydrogeological, hydrological and stability impacts associated with the proposed development are identified.

The findings of an intrusive ground investigation are then reported followed by a discussion of the geotechnical issues associated with the proposed development.

Finally, an assessment of the identified potential impacts of the proposed basement development is presented.

1.5 Documents Consulted

The following documents have been consulted during the preparation of this document:

1. Camden Local Plan – Adoption Version, 2017
2. Camden Planning Guidance 4, Basements and Lightwells, 2015
3. London Borough of Camden Geological, Hydrogeological and Hydrological Study (CGHHS), by Ove Arup & Partners Limited, dated 18th November 2010, Issue 01

2. The Site

2.1 Site Location

The property is located approximately 100m northeast of the junction of Elsworthy Rise and 200m southwest of the junction of Primrose Hill Road and may be located by postcode NW3 3DJ or by National Grid Reference 527440, 184160.

2.2 Topographical Setting

The site lies within a shallow saddle between Primrose Hill in the south and Hampstead Heath in the north.

2.3 Site Description

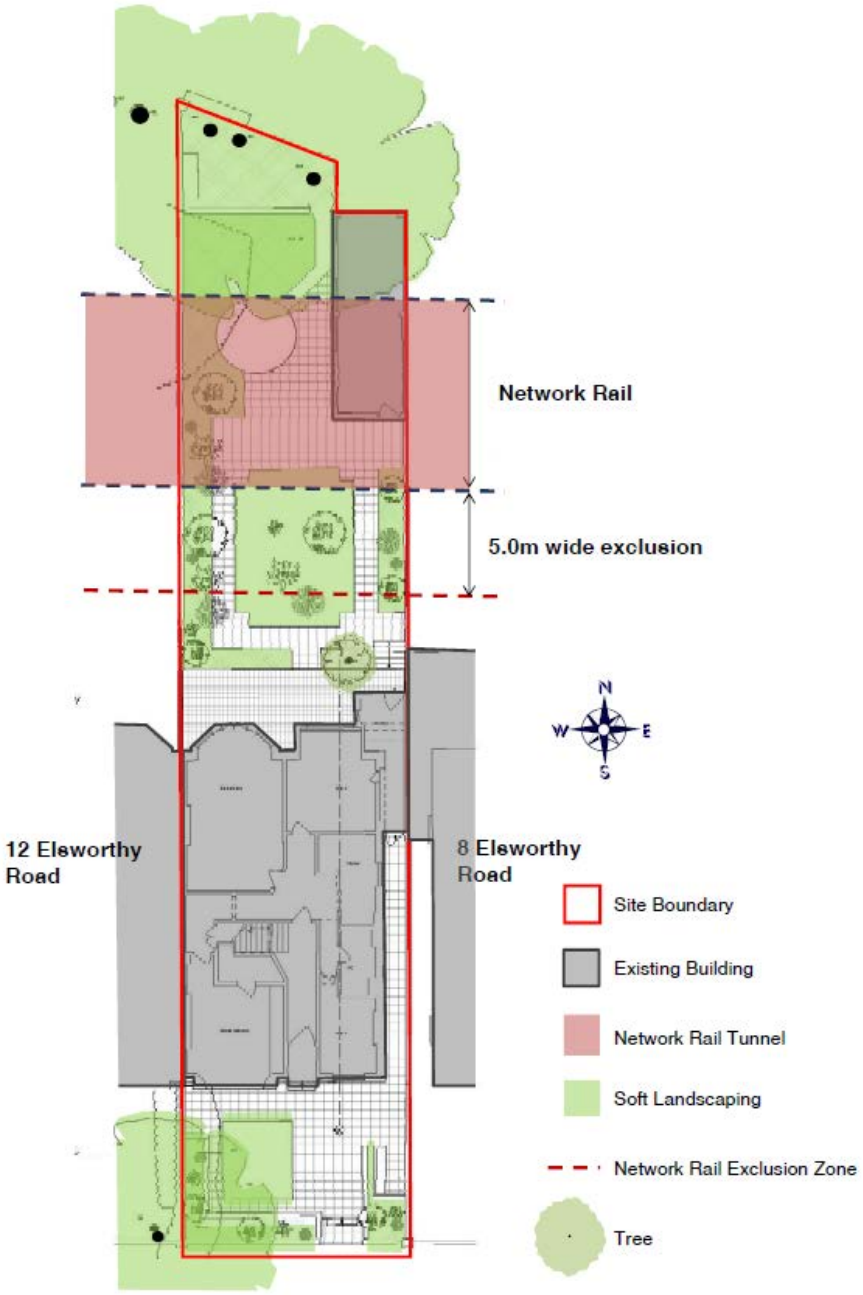
The site is approximately rectangular in shape and the southern end is occupied by a Victorian three-storey semi-detached house fronting onto the northern side of Elsworthy Road, which lies at approximately +49m OD.

To the rear of the house, the garden lies approximately 1m lower, and there is a verandah set at the ground floor level, with stepped access from the garden. Below the verandah there is access to a cellar that stretches beneath the entire property.

The rear garden has access to the rear from King Henry's Road, and includes a detached brick garage.

One branch of the Hampstead railway tunnels passes beneath the rear garden. The central axis of the tunnel is aligned roughly parallel to the main rear wall of the property and is situated approximately 15m from the existing house.

Front elevation of 10 Elsworthy Road



Plan of existing layout

2.4 Neighbouring Properties

The pair to No. 10, No. 12 to the west, is understood to contain a similar cellar to No. 10. Planning permission has been granted (Application Ref: 2016/2269/P) to construct a basement beneath No. 12.

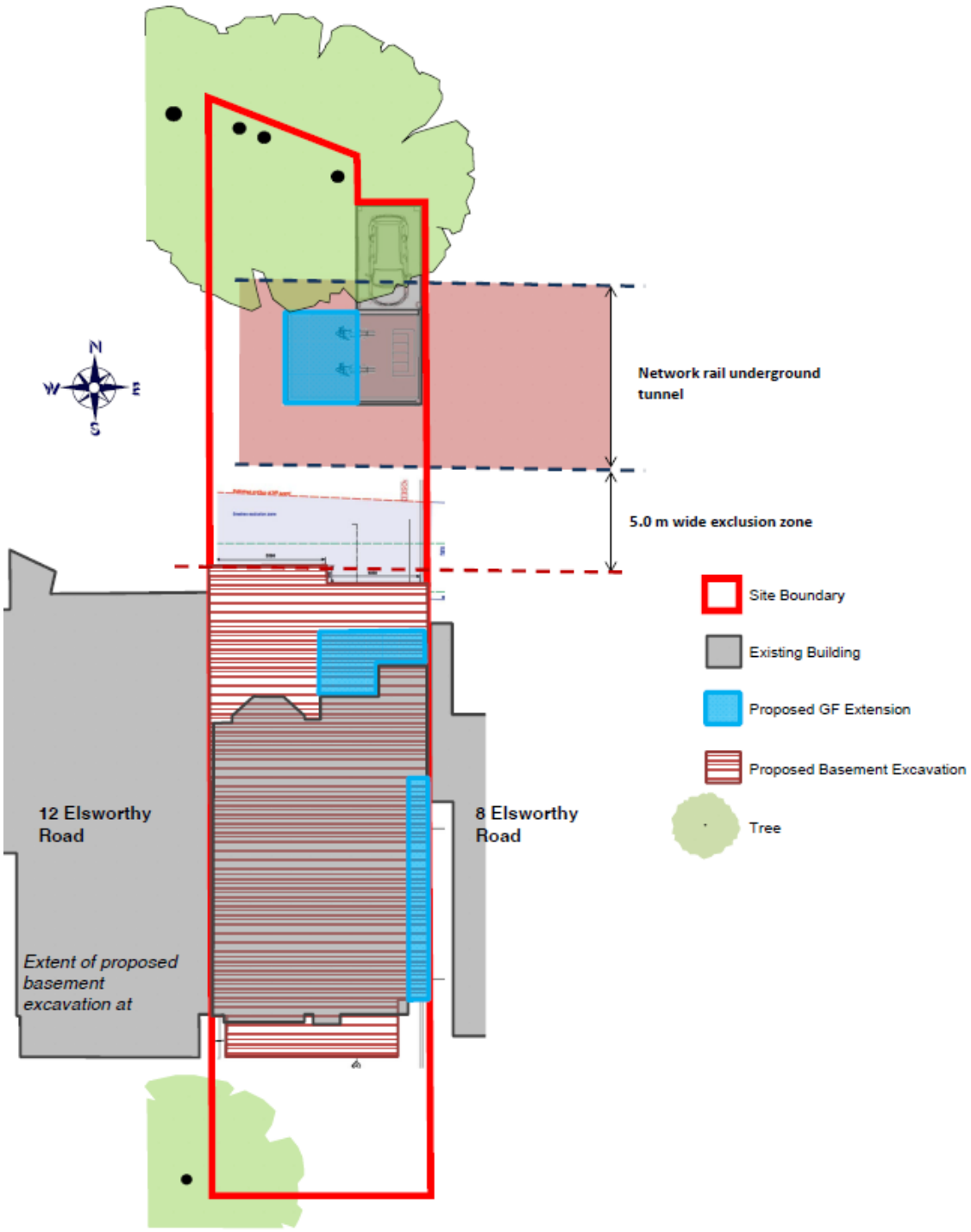
No. 8 to the east appears to have recently been extended with a basement extending to a similar level as proposed for this property.

2.5 Proposed Development

It is proposed to excavate the existing cellar to create a habitable, single-storey basement beneath the property, down to approximately +46.5m OD extending beyond the footprint of the building into the rear garden. It is envisaged that approximately 1.5m of excavation below the existing cellar floor will be required.

A basement level patio is also proposed, with steps up to the rear garden. A small extension of the ground floor at the rear of the property on the northern side will lead onto a garden-level patio. Basement lightwells will be constructed at the front of the property.

A single storey extension to the south west corner of the garage at the rear of the site is also proposed; over the footprint of the existing Network Rail Tunnel.



Proposed site plan

3. Desk Study

3.1 Site History

The row of semi-detached houses on Elsworthy Road, including No. 10, was constructed by 1895 along with the extension to King's Henry Road to the north of the site. The rail tunnel running beneath the rear of site is understood to have been constructed at a similar time.

1895

The property has remained relatively unchanged until present day aside from a small extension filling the rear section of the alleyway to the northeast of the house and the construction of the garage in the rear garden.

3.2 Geological Information

The British Geological Survey (BGS) records indicate that the site is directly underlain by the London Clay Formation, with no superficial deposits present.

3.3 Hydrogeological / Hydrological Information

The London Clay Formation may be considered virtually impermeable.

The Environment Agency (EA) classifies the London Clay Formation as Unproductive Strata in terms of groundwater flow.

The site is wholly located within Flood Zone 1 and the EA indicate the area of the site to be at very low risk of surface flooding.

The nearest surface water course is a tributary of River Tyburn, believed to be flowing approximately 350m west of the site towards the River Thames.

3.4 Other Environmental Information

Information provided by the BGS and National Geoscience Information Service (NGIS), indicates that the property is located in a lower probability radon area with less than 1% of homes expected to be above the action level. It is further reported that no radon protective measures are necessary in the construction of new dwellings or extensions in this area.

No landfill sites are recorded in close proximity to the site.

4. Screening & Scoping Assessments

The Screening & Scoping Assessments have been undertaken with reference to Appendices E and F of the CGHSS, which is a process for determining whether or not a BIA is usually required.

4.1 Screening Assessment

Screening uses checklists to identify whether there are matters of concern (with regard to hydrogeology, hydrology or ground stability) which should be investigated using a BIA (Section 6.2 and Appendix E of the CGHSS) and is the process for determining whether or not a BIA is required. There are three checklists as follows:

- Subterranean (groundwater) flow
- Ground stability
- Surface flow and flooding

4.1.1 Screening Checklist for Groundwater Flow

Question	Response	Justification
Is the site located directly above an aquifer?	**No**	The Environment Agency (EA) maps indicate that the site is not directly underlain by an aquifer.
Will the proposed basement extend beneath the water table surface?	**No**	No groundwater is present within the London Clay Formation.
Is the site within 100m of a watercourse, well (used/disused) or potential spring line?	**No**	The nearest watercourse is a tributary of the River Tyburn, roughly 350m to the west of the site.
Is the site within the catchment of the pond chains on Hampstead Heath?	**No**	The site is not within catchment of the Hampstead Heath Ponds specified by Figure 14 of the CGHHS.
Will the proposed development result in a change in the area of hard-surfaced/paved areas?	**Yes**	A minimal increase in hard-surfaced area is proposed due to the rear basement extension.
Will more surface water (e.g. rainfall and run-off) than at present will be discharged to the ground (e.g. via soakaways and/or SUDS)?	**No**	Discharge will be to the public sewer.
Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than the mean water level in any local pond?	**No**	No ponds are located in close proximity to the site.

4.1.2 Screening Checklist for Surface Flow and Flooding

Question	Response	Justification
Is the site within the catchment area of the pond chains on Hampstead Heath?	**No**	The site is not within catchment of the Hampstead Heath Ponds specified by Figure 14 of the CGHHS.
As part of the site drainage, will surface water flows (e.g. rainfall and run-off) be materially changed from the existing route?	**No**	Surface water will be disposed of by the existing means.
Will the proposed basement development result in a change in the proportion of hard-surfaced/paved areas?	**Yes**	An increase in hard-surfaced areas is proposed due to the rear basement extension.
Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface-water being received by adjacent properties or downstream watercourses?	**No**	Surface Water Drainage is to the sewer as per existing.
Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	**No**	Surface Water Drainage is to the sewer as per existing.
Is the site in an area known to be at risk from surface water flooding, or is it at risk from flooding for example because the proposed basement is below the static water level of a nearby surface water feature?	**No**	Neither Elsworthy Road nor King Henry's Road are reported to have flooded in 1975 or 2002, as shown by figure 15 of CGHHS. The EA identifies the site as being in the area of very low risk of surface flooding.

4.1.3 Screening Checklist for Stability

Question	Response	Justification
Does the existing site include slopes, natural or manmade, greater than 7 degrees?	**No**	There are no slopes greater than 7 degrees, as indicated by Fig. 16 of CGHHS.
Does the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees?	**No**	No re-profiling is planned at the site.
Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees?	**No**	No railway cuttings or neighbouring developments with steep slopes are present.
Is the site within a wider hillside setting in which the general slope is greater than 7 degrees?	**No**	No. Figure 16 of the CGHHS shows the site to be in an area of zero to 7 degrees.

Is London Clay the shallowest strata at the site?	**Yes**	Carried forward to scoping.
Will trees be felled as part of the proposed development and/or are works proposed within tree protection zones where trees are to be retained?	**Yes**	Carried forward to scoping. A tree in the rear garden will have to be removed to facilitate the excavation of the basement extension.
Is there a history of seasonal shrink-swell subsidence in the local area, and/or evidence of such effects at the site?	**No**	No.
Is the site within 100m of a watercourse of a potential spring line?	**No**	The nearest watercourse is a tributary of the River Tyburn, roughly 350m west of the site.
Is the site within an area of previously worked ground?	**No**	Figure 16 of the CGHHS indicates that no worked ground is present at the site.
Is the site within an aquifer?	**No**	The Environment Agency (EA) maps indicate that the site is not directly underlain by an aquifer.
Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	**No**	A shallow water table is not present.
Is the site within 50m of the Hampstead Heath ponds?	**No**	The site is approximately 1.8km away from the Hampstead Heath ponds.
Is the site within 5m of a highway or pedestrian right of way?	**No**	The proposed basement is situated approximately 5.05m away from the pavement of Elsworthy Road.
Will the proposed basement significantly increase the differential depth of foundations relative to the neighbouring properties?	**Yes**	The neighbouring property at No 8 Elsworthy Road has a basement beneath the house footprint extending to approximately 3.2m depth. The adjoining property at No 12 Elsworthy Road has an existing cellar extending to around 1.5m depth (although planning permission has been granted to extend the basement to the depth of the proposed basement to No. 10 Elsworthy Road).
Is the site over (or within the exclusion zone of) tunnels, e.g. railway lines?	**Yes**	The site is underlain by a Network Rail tunnel.

4.2 Scoping Assessment

Where the screening checklist is answered with a “yes” or “unknown” to any of the questions posed in the flowcharts, these matters are carried forward to the scoping stage of the BIA process.

The issues identified from the checklists as being of concern have been assigned bold text in the previous sections and are as follows:

4.2.1 Groundwater Flow

- **The development will result in a change in the area of hard-surfaced/paved areas**

The guidance advises that the sealing off of the ground surface by pavements and buildings to rainfall will increase in decreased recharge to the underlying ground. In areas underlain by an aquifer, this may impact upon the groundwater flow or levels. In areas of non-aquifer (i.e. on the London Clay), this may mean changes in the degree of wetness which in turn may affect stability.

4.2.2 Surface Flow and Flooding

- **The proposed basement development will result in a change in the proportion of hard-surfaced/paved areas**

The guidance advises that any changes will affect the way in which rainfall and surface water are transmitted away from the property. This includes changes to the surface water received by the underlying aquifers, adjacent properties and nearby watercourses. Changes may result in decreased flow, which may affect ecosystems or reduce amenity, or increase flow which may additionally increase the risk of flooding.

4.2.3 Ground Stability

- **London Clay is the shallowest strata at the site?**

The guidance advises that of the at-surface soil strata present in the London Borough of Camden, the London Clay is the most prone to seasonal shrink-swell.

- **Trees will be felled as part of the proposed development and/or are works proposed within tree protection zones where trees are to be retained**

The guidance advises that in high plasticity soils (such as the London Clay) it will lead to gradual swelling of the ground. This may reduce the soil strength which could affect the slope stability. Additionally the binding effect of tree roots can have a beneficial effect on stability and the loss of a tree may cause loss of stability.

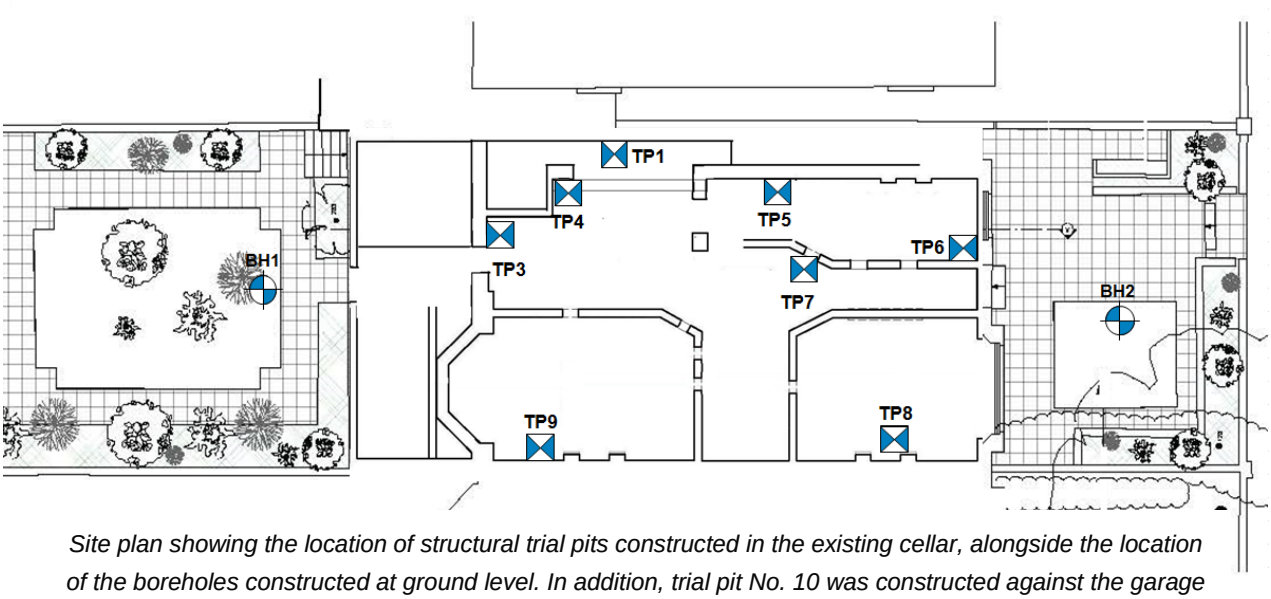
- **The site is over (or within the exclusion zone of) tunnels, e.g. railway lines**

The guidance advises that the excavation of a basement may result in damage to the tunnel.

5. Site Investigation

An investigation comprising an exercise of window sampler boreholes in the front and rear gardens, supplemented with structural trial pits in the existing cellar was carried out on 8th August 2017, in order to assess the ground conditions and existing foundations, and to recover samples for geotechnical laboratory testing.

The plan below indicates the positions of the exploratory boreholes and pits undertaken; the associated borehole and trial pit records as well as the laboratory results are appended.



Site plan showing the location of structural trial pits constructed in the existing cellar, alongside the location of the boreholes constructed at ground level. In addition, trial pit No. 10 was constructed against the garage wall to assess the garage foundations

5.1 Ground Conditions

The ground investigation indicated that, beneath the made ground, the site is directly underlain by the London Clay Formation.

Made Ground

5.2 Made Ground

Made ground in the rear garden is present to approximately 1m depth and generally consists of dirty brown sandy loam with roots, stones and extraneous material including fragments of brick, slate, iron and ceramic.

The front garden and road have evidently been raised to a higher level, and an increased thickness of 1.7m of made ground is present.

This material consists mainly of brown sandy silty clay with roots, brick fragments and occasional sand pockets.

5.3 London Clay Formation

Typical London Clay

The London Clay Formation consists of firm becoming stiff orange-brown and grey mottled fissured silty clay with occasional silt laminations and scattered selenite crystals.

The results of the plasticity index testing confirm that these soils are of high plasticity.

5.4 Groundwater

No groundwater was encountered during the investigation and a shallow groundwater table is not present beneath the site.

5.5 Existing Foundations

A total of nine structural trial pits were constructed in the existing cellar. These confirm that, generally, the outer walls are founded on strip foundations with three brick corbels while the internal wall foundations are set on two brick corbels. The brick corbels are bearing upon a variable thickness of lean mix brick and concrete around 500mm thick, slightly less for the internal walls.

6. Discussion of Geotechnical Issues

6.1 Basement Proposals

It is proposed to excavate the existing cellar in order to create a habitable basement beneath the entire footprint of the property. Additionally, the basement is proposed to extend beyond the footprint of the building to the rear. A small basement level patio will allow light into the rear of the basement with steps up to the garden level. Lightwells will also be constructed at the front of the property.

It is proposed to construct the perimeter wall to the new basement by a combination of conventional foundation construction and underpinning.

6.2 Stability of Neighbouring Structures

The adjoining building at No. 8 Elsworthy Road has an existing basement floor at a similar level to the proposed development, with the party wall foundations being extended downwards.

It is reported that significant damage occurred to the party wall, rear garden wall and flank wall of No.10 during the construction of the basement at No. 8.

The approved basement construction at No. 12 has not yet started, but this basement floor will extend to a level similar to the proposed depth at No. 10 Elsworthy Road, with planned underpinning of party walls.

Therefore the differential depths of the foundations in relation to the adjoining structures are not expected to be significantly increased by the development at No. 10 Elsworthy Road.

There will nevertheless be some small amount of heave expected as a result of the excavation of the new basement.

6.3 Network Rail Tunnel

The proposed single storey garage extension is over the footprint of the Network Rail Tunnel but the combination of light structural loading and shallow foundation excavations are very unlikely to result in any effect upon the tunnel.

The proposed basement may extend slightly within the normal tunnel exclusion zone and, following a meeting with Network Rail, it has been agreed that a check will be undertaken to assess any ground movement resulting from the basement excavation, and this has been presented in **Section 7.4.5.**

6.4 New Foundations

The basement excavation will bypass the made ground and extend down into the London Clay Formation.

The structural loads applied by the basement extension will be accommodated by the perimeter walls, possibly together with internal spread foundations or thickened sections of the basement slab.

Outside the zone of influence of any trees, the new underpinning should be placed in suitably firm London Clay and may be designed to apply a net allowable bearing pressure 120kN/m^2. Within the potential zone of influence of any vegetation, the guidance provided by the NHBC in respect of building near trees should be followed.

6.5 Basement Flooring

Following excavation of the basement, loading will be reapplied to the soil as a result of the new structure.

It is evident that there is a mismatch between the weight of the soil that is to be removed during the basement excavation and the weight of the new structure that is to replace this. In this situation there will inevitably be a component of long-term heave that could proceed for several decades.

For the purpose of this assessment, the structural loading has not been modelled, in order to represent a worst-case scenario. The analysis suggests that owing to the net unloading in the permanent situation following construction, an additional 10mm of heave could occur beneath the basement. However, in practice, this figure will be reduced by the effect of the loading from the proposed foundations.

It is considered that the areas of flooring between the main foundations may be sufficiently reinforced and tied into the latter to provide a semi-rigid structure that will act to redistribute any residual imbalance heave movement.

6.6 Effect of Trees

A tree is to be removed in the rear garden, within the proposed basement footprint.

In addition, there are several mature trees adjacent to the rear boundary of the garden that may have caused desiccation to the clay soil underlying the proposed garage extension, as well as mature trees in neighbouring property No. 12 Elsworthy Road whose zone of influence may intersect with the proposed basement excavation.

Where foundations are constructed within the zone of influence of existing or proposed trees, or trees that are to be removed, there will be a potential for heave / shrinkage of the clay soils to occur and this will need to be taken account of in the design of the structure and foundations. The NHBC guidance for building near trees in high shrinkable soils should be followed.

The excavations should be carefully inspected in order to identify any areas of existing desiccation that could potentially result in additional forces being exerted on the structure as a result of possible future swelling of the clay.

6.7 Basement Waterproofing

Groundwater was not encountered within the envisaged depth of the basement excavation. Nevertheless, there is potential for water to collect around the basement structure in the long term unless perimeter and under floor drainage is assured. Hence, it is recommended that the basement should be fully waterproofed and designed to withstand hydrostatic pressures in accordance with Guidance provided in BS8102:2009, Code of Practice for the Protection of Below-Ground Structures against Water from the Ground.

An assumed groundwater level at +48m OD would be prudent for the purposes of assessing hydrostatic pressures in order to allow for the possibility of surface water flooding due to a water main burst or similar.

6.7.1 Retaining Walls

The following parameters may be considered in the design of new retaining walls:-

Stratum	Bulk Density	Effective Cohesion	Effective Friction Angle
	(kg/m^3)	(c' - kN/m^2)	(ϕ'- degrees)
Made Ground	1900	Zero	20
London Clay Formation	2000	Zero	23

6.8 Foundation Concrete

The results of chemical analyses carried out on selected samples of the soils encountered indicate soluble sulphate concentrations falling within Class DS-3 as defined by BRE Special Digest 1 (2005). The recommendations of that guidance for Class DS-3 sulphate conditions should therefore be followed, assuming an Aggressive Chemical Environment for Concrete (ACEC) site classification of AC-2s for static groundwater.

6.9 Waste Disposal

All material to be disposed of off-site should be properly recorded, including the retention of any waste tickets, details of excavated soil export destinations and the waste classification.

The results have suggested that the made ground should be classed as Hazardous for waste disposal purposes, due to the presence of elevated concentrations of Copper and Zinc.

The underlying natural soils may be expected to be Non-Hazardous and, provided that they can be adequately separated from any made ground, it may be possible to dispose of these natural soils to a tip licensed to accept Inert material.

7. Impact Assessment

The screening and scoping stages have identified potential effects of the development on those attributes or features of the geological, hydrogeological and hydrological environment. This stage is concerned with evaluating the direct and indirect implications of each of these potential impacts.

7.1 Potential Hydrogeological Impacts

No groundwater is present at the site and, given the clay nature of the soils, no significant groundwater flow is envisaged.

Therefore, the development is not expected to have any impact upon groundwater flow and there is no scope for any cumulative effect.

7.2 Potential Hydrological Impacts

The new development is expected to result in a small change in the amount of hard landscaping.

A SUDS assessment will be undertaken and the new drainage scheme is to include attenuation in accordance with LBC and TW guidance and CPG4 Section 3.51.

7.3 Potential Stability Impacts

7.3.1 Tree Removal

The new basement will be designed in accordance with the NHBC guidance in order to protect the building from any potential shrink /swell movements of the clay.

In addition, no threat to slope stability is perceived as a result of the removal of the tree.

7.3.2 London Clay / Shrink-Swell

The depth of the proposed construction is expected to obviate concerns regarding season movements within the London Clay Formation.

7.4 Ground Movement to Neighbouring Structures

The key factor to consider when undertaking a ground movement assessment for the development is that the design of the new basement will need to preserve the stability of the adjacent buildings and structures, both during excavation and construction and in the permanent situation.

A ground movement assessment has been undertaken to assess the potential damage that will be caused to the neighbouring structures as a result of the proposed development.

7.4.1 Structures assessed for Ground Movement

There are three structures neighbouring the proposed basement development which have been assessed for the purpose of ground movement.

Site plan showing neighbouring structures assessed for the purpose of ground movement

7.4.1.1 Network Rail Tunnel

A Network Rail Tunnel with a cross section diameter of 10m runs beneath the rear garden, orientated approximately on the northeast-southwest axis, with its crown present at approximately 8m below rear garden level (approx. +40.5m OD). A 5m horizontal exclusion zone is established from the edge of the tunnel.

7.4.1.2 No. 8 Elsworthy Road

No. 8 Elsworthy Road is a three storey terraced building with a single storey basement. It is adjoined to No. 10 Elsworthy Road to the northeast of and is believed to have been constructed at a similar time.

The basement level at No. 8 Elsworthy Road is set at approximately +46.5m OD, a similar level to the proposed basement at 10 Elsworthy Road. As the party wall between Nos. 8 and 10 Elsworthy Road is already at the depth of the proposed basement, it is envisaged that the footing to this party wall does not require underpinning.

As a result, the ground movements that may occur at this depth due to the proposed basement construction are expected to be negligible and cannot be meaningfully modelled.

7.4.1.3 No. 12 Elsworthy Road

No. 12 Elsworthy Road is a three storey terraced building with an underlying cellar. It is adjoined to No. 10 Elsworthy Road to the southwest and is also believed to have been constructed at a similar time.

The foundations to the building are understood to be set at approximately +47.5m OD, some 1m above the proposed basement at No. 10 Elsworthy Road.

A planning application (2012/4744/P) was granted in August 2013 subject to a Section 106 Legal Agreement, in order to extend the existing cellar to a single storey basement. The proposed basement will be extended to a similar depth to the proposed basement at No. 12 Elsworthy Road.

If this neighbouring basement is constructed prior to the construction of the basement at No. 10 Elsworthy Road, then it is envisaged that the footing to the party wall does not require underpinning.

However, in order to represent a worst case scenario, the existing configuration of the neighbouring house has been assessed for the purpose of ground movement.

7.4.2 Modelled Ground Conditions

Excavation of the basement will result in unloading of the clay leading to theoretical heave movement of the underlying soil in both the short and long term, depending upon the reapplication of loading.

Therefore, an analysis of the vertical movements has been carried out for a modelled situation, based on a soil model devised from the results of the ground investigation together with published information on the London Clay Formation.

The relation between the undrained shear strength (C_u) and depth (z) from the top of the London Clay Formation is therefore assumed to be $C_u = 50 + 8z$.

The soil layers of this model are detailed in the table below.

Analysis Layer:	Upper Boundary (+m OD)	Thickness (m)	Average C_u (kN/m^2)	Soil Stiffness (kN/m^2)	
				E_u	E’
London Clay Formation (basement)	46.50	2	58	26100	14500
London Clay Formation	44.50	2	74	33300	18500
London Clay Formation	42.50	2	90	40500	22500
London Clay Formation (tunnel crown)	40.50	4	122	54900	30500
London Clay Formation	36.50	5	162	72900	40500
London Clay Formation	31.50	5	202	90900	50500
London Clay Formation	26.50	5	242	108900	60500
London Clay Formation	21.50	5	282	126900	70500
Assumed Rigid Boundary	16.50				

The Undrained Modulus of Elasticity (Eu) has been based upon an empirical relationship of Eu = 450 x Cu, and the Drained Modulus of Elasticity (E') has been based upon an empirical relationship of 250 x Cu.

Poisson's Ratios of 0.5 and 0.2 have been used for short term (undrained) and long term (drained) conditions respectively.

Based on the above parameters and loading / unloading and ignoring any benefit gained from the loading of previous buildings on site, the potential vertical displacements and the post construction movements have been analysed.

The analysis uses classic modified Boussinesq elastic theory, assuming a fully flexible foundation applying a uniform loading/unloading to a semi-infinite elastic half-space, using the above parameters for stratified homogeneity and with the introduction of an assumed rigid boundary at approximately 30m depth (+16.50m OD).

The programme calculates the theoretical Boussinesq elastic stress increase/decrease due to the applied net loadings / unloadings (over the given loaded/unloaded areas) at the mid-level of each stratum.

Short-term and long-term displacements are then calculated at each calculation point for each stratum, using the given values of Stiffness Moduli and Poisson's Ratio of the whole area of the site on a 1m calculation grid.

7.4.3 Short Term Movements to No. 12 Elsworthy Road

There are two main components of short term movements that might potentially interact to affect No. 12 Elsworthy Road. These are settlements associated with the underpinning process and theoretical elastic heave movements from excavation of the basement.

7.4.3.1 Underpinning

It is not possible to model the party wall settlements arising from conventional underpinning. However, experience indicates that the potential movements are very much dependent on workmanship.

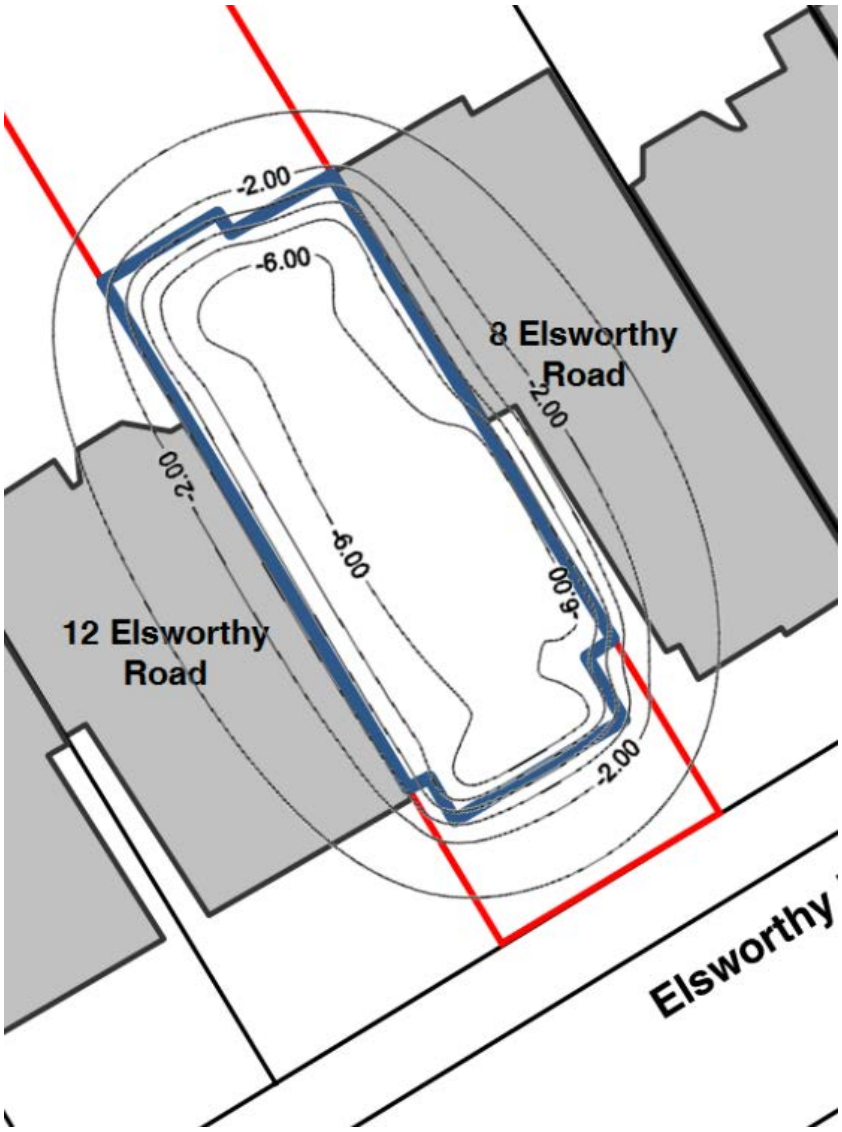
It is suggested that given dry conditions and good workmanship, the amount of vertical movement of the party walls can be expected to be approximately 5mm per stage of underpinning. In view of the envisaged depth of underpinning excavation (approx. 1m), one stage of underpinning is expected.

The subsequent horizontal movements that may occur due to yielding of the underpinning wall during the basement excavation may also be estimated. As a first approximation, the magnitude of the horizontal movement is assumed to be equal to the vertical movement at the underpinned wall; hence the horizontal movement expected at the party wall is also predicted to be 5mm.

7.4.3.2 Excavation

It is envisaged that the excavation will extend to approximately 1.5m below the existing cellar beneath the building footprint, increasing to roughly 2m below the rear garden, and 3m below the front garden, where the lightwells are proposed.

The potential ground movement due to basement excavation has been considered by applying a net unloading of -30 kN/m^2 due to soil unloading below the building footprint. This unloading is increased to -40 kN/m^2 beneath the rear garden and to -60 kN/m^2 beneath the front garden.



Plan showing theoretical approximate short term heave (mm) due to basement excavation

The potential effect of this soil excavation may lead up to approximately 7mm beneath the proposed basement, reducing to roughly 5mm beneath both of the party wall between Nos. 8 & 12 Elsworthy Road.

7.4.4 Impact on No. 12 Elsworthy Road

In the view of the potential party wall movements described in the previous section, regardless of actual movements of the surrounding ground, the expectation of vertical movements affecting the party wall to No. 12 Elsworthy Road could potentially be 5mm. However, the upwards movement that occurs due to soil heave may serve to counteract some of this underpinning settlement.

The degree of overall vertical movement due to underpinning suggests that Burland scale Category 1 (very slight) damage may be expected to No 12 Elsworthy Road.

7.4.4.1 Mitigation of Ground Movements

In line with DP27, Camden will ensure that harm is not caused to neighbouring properties by basement development. Camden Local Plan (June 2017) states that the BIA must demonstrate that the basement scheme has a risk of damage to the neighbouring properties no higher than Burland Scale 1 (very slight).

As shown in the above section, Burland scale Category 1 (very slight) damage may be expected to No 12 Elsworthy Road.

It should also be noted that as previously discussed, a planning application (2012/4744/P) has been submitted to extend the basement to No. 12 Elsworthy Road, which will essentially match the configuration of the proposed basement to No. 10 Elsworthy Road. On the basis of both basements being constructed simultaneously, it is envisaged that the stability of No. 12 Elsworthy Road could be further preserved.

Monitoring of the neighbouring property will be an essential tool in the prevention of unacceptable movements. A structural monitoring plan is presented in **Section 8** and **Section 9.**

7.4.5 Short Term Movements to Network Rail Tunnel

Vertical displacements at the crown of the Network Rail Tunnel have been modelled for the following conditions.

1. Unloading due to excavation of basement (short-term)
2. Loading due to construction of basement (short-term)
3. Loading due to construction of basement (long-term)

Although, the proposed single storey garage extension lies over the footprint of the Network Rail Tunnel, the combination of light structural loading and shallow foundation excavations are very unlikely to result in any effect upon the tunnel.

7.4.5.1 Excavation (short-term)

The unloading conditions due to the basement excavation are described in **Section 7.4.3.2**.

The potential effect of soil excavation on the tunnel crown is predicted to be negligible.

7.4.5.2 Construction of Basement (short-term and long-term)

Loading information has been provided. By convention, when considering the average loading condition, the loading is assumed to be 100% dead load plus 25% live load. The applied loading condition on the party walls is up to around 150kN/m^2 , while up to around 170kN/m^2 is envisaged for the internal walls and up to 10kN/m^2 is placed on the basement slab.

The potential effect of construction the basement on the tunnel crown is predicted to be negligible, both in the short-term and long-term.

7.4.6 Impact on Network Rail Tunnel

The proposed basement development is predicted to cause negligible ground movement at the crown of the tunnel. Therefore, it is envisaged that there will be no significant impact to the Network Rail Tunnel.

8. Structural Monitoring Plan

In light of the reported damage that occurred to the party wall to Nos. 8 & 10 Elsworthy Road, and the rear garden wall and flank wall to No. 10 Elsworthy Road during the construction of the basement to No. 8 Elsworthy Road (No. 8 Elsworthy Road BIA Addendum – Revised Methodology since Commencement, Rev B, Ref 20261), there is heightened sensitivity regarding the proposed basement extension to No. 10 Elsworthy Road.

The above ground movement assessment suggests Burland scale Category 1 (very slight).damage may be expected to No. 12 Elsworthy Road due to the basement development.

To ensure the movements remain within acceptable limits, a structural monitoring plan has been devised to enable mitigation to be effectively implemented in the event of agreed trigger values for movement being exceeded.

8.1 Responsibilities for Implementation of the Monitoring Plan

The responsibility for implementation of the monitoring plan shall rest with the appointed contractor, working in conjunction with the appointed structural engineer, the party wall surveyor for No. 12 Elsworthy Road and any further named interested parties.

8.2 Location of Monitoring Positions

Monitoring positions are to be located along the front and rear elevations to both Nos. 10 & 12 Elsworthy Road and along the party wall between Nos.10 & 12 Elsworthy Road.

8.3 Movement Monitoring Equipment

Precise survey equipment is to be used for monitoring movement. This equipment is to record all vertical and horizontal components of movement (in two perpendicular plan directions) to a minimum accuracy of 1mm.

8.4 Condition Survey

Condition Surveys will be prepared for both Nos. 10 & 12 Elsworthy Road before any monitoring commences, in order to fully understand the present physical condition of each property.

8.5 Baseline Situation

Before any excavation or construction works commence, monitoring is to be undertaken in order to establish a baseline situation.

8.6 Frequency of Monitoring

During all underpinning works and basement excavation works, monitoring is to be undertaken daily at the start and end of every work shift.

At other times monitoring is to be undertaken weekly to cover a period prior to commencement of any works and ceasing after completion of the works, by agreement of all interested parties.

8.7 Criteria for assessment of Monitoring data and Comparison with Predicted Movements

The cumulative movements in any direction of any monitoring point are to be compared with the predicted movements at any stage and using the following decision table:

MONITORING CRITERIA		
Total movement less than 2mm in any direction		Green
Total movement in excess of 2mm in any direction or additional movement of 2mm in any direction	Notify Structural Engineer	Amber
Total movement in excess of 5mm in any direction or additional movement of 5mm in any direction	Notify Structural Engineer and Party Wall Surveyor	Red

8.8 Communication of the Monitoring Data to Interested Parties

The monitoring data are to be distributed to all interested parties of a weekly basis during Green and Amber conditions, and daily during any Red condition.

9. Proposed Contingency Plan

9.1 Responsibilities for Implementation of the Contingency Plan

The responsibility for implementation of the Contingency Plan shall rest with the appointed contractor, working in conjunction with the appointed structural engineer, the party wall surveyor for No. 12 Elsworthy Road and any further named interested parties.

9.2 Contingent Actions

Contingency actions are to be undertaken as provided using the following decision table:

CONTINGENT ACTIONS	
Green	None
Amber	Notify Structural Engineer.
Red	Cease work and backfill excavations immediately (subject to safety assessment). Notify Structural Engineer. Temporary additional propping installed within 24 hours. Works to commence only once a revised construction methodology has been agreed.

9.3 Resources required to enable Implementation of the Contingent Actions

The site manager is to identify sources of emergency plant hire and labour to provide and deploy any additional propping and shoring.

The appointed contractor is to have additional propping equipment stored on site so that it can be readily installed in the event of the red trigger value being exceeded.

Appendix

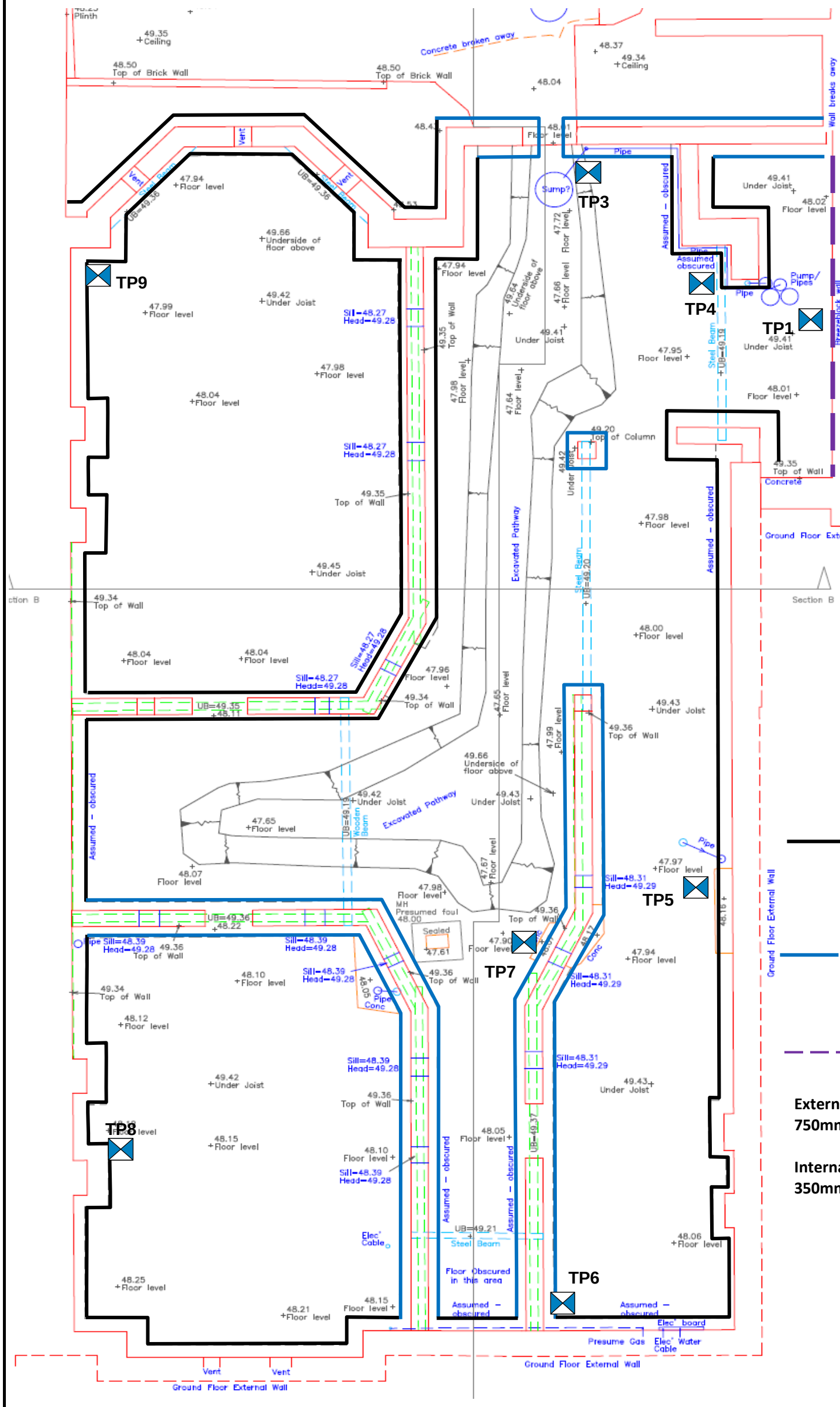
EXPLORATORY LOGS

GEOTECHNICAL TEST RESULTS

ENVIROCHECK REPORT (SEPARATE FILE)

PROJECT:	10 Elsworthy Road	LBH4482
CLIENT:	Lorna & Peter Klimt	

BASEMENT FOUNDATION LAYOUT



NOTES

3 corbel foundation (approx. 260mm from edge of wall) upon 450 to 750mm bound brick aggregate

2 corbel foundation (approx. 190mm from edge of wall) upon 300 to 350mm brick bound aggregate

Breezeblock wall (Unknown foundation type)

External walls sitting upon 450 to 750mm bound brick aggregate

Internal walls sitting upon 300 to 350mm brick bound aggregate

DO NOT SCALE

LBH WEMBLEY ENGINEERING

PROJECT: 10 Elsworthy Road
CLIENT: Lorna & Peter Klimt

LBH4482

BOREHOLE BH1

BORING METHOD: Small Diameter Percussive Rig

Date: 08/08/2017

GROUND WATER: No Groundwater Observed

REMARKS:

G.L Approx. +48.5m OD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
					0.35	MADE GROUND (Brown topsoil with roots, gravel, brick fragments, pieces of brick and slate and occasional sand pockets)
					0.50	MADE GROUND (dirty brown sand with ash and metal and ceramic fragments)
					0.90	MADE GROUND (dirty brown clayey sand with abundant brick fragments)
					1.10	Firm brown grey silty CLAY with scattered sand
1	D	1.20				Firm orange-brown and grey mottled silty CLAY
	SPT	1.30	4			
2	D	2.20				
	SPT	2.30	8		2.50	
						Firm to stiff brown and grey mottled silty CLAY with occasional pale orange-brown silt laminations and scattered selenite
						Claystone encountered at 3m
	SPT	3.30	12			
3	D	3.50				… becoming stiff at 3.5m
	SPT	4.30	13			
4	D	4.50				

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

LBH WEMBLEY ENGINEERING

PROJECT: 10 Elsworthy Road | LBH4481

CLIENT: Lorna & Peter Klimt

BOREHOLE BH1

BORING METHOD: Small Diameter Percussive Rig | Date: 03/08/2017

GROUND WATER: No Groundwater Observed

REMARKS:

G.L Approx. +48.5m OD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
	SPT	5.30	15			Stiff brown and grey mottled silty CLAY with occasional pale orange-brown silt laminations and scattered selenite
						Claystone encountered at 5.85m depth
	SPT	6.30	20			
	SPT	7.30	22		7.45	

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

LBH WEMBLEY ENGINEERING

PROJECT: 10 Elsworthy Road | LBH4481 | **BOREHOLE BH2**

CLIENT: Lorna & Peter Klimt

BORING METHOD: Small Diameter Percussive Rig | Date: 03/08/2017

GROUND WATER: No Groundwater Observed

REMARKS:

G.L Approx. +49.5m OD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
					0.60	MADE GROUND (decorative gravel over very gravelly topsoil with occasional roots)
					1.70	MADE GROUND (Brown sandy silty clay with brick fragments, roots and occasional sand pockets)
	SPT	1.30	8			
	SPT	2.30	9			Firm, becoming firm to stiff, orange-brown and grey mottled silty CLAY with occasional silt laminations and scattered selenite
1	D	2.50				
	SPT	3.30	15			
2	D	3.50				
	SPT	4.30	13			… becoming stiff at 4.0m

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

PROJECT: 10 Elsworthy Road | LBH4481

CLIENT: Lorna & Peter Klimt

BOREHOLE BH2

BORING METHOD: Small Diameter Percussive Rig | Date: 03/08/2017

GROUND WATER: No Groundwater Observed

REMARKS:

G.L Approx. +49.5m OD

Samples No	Samples Type	Depth m	Tests	Legend	Depth m	Description
	SPT	5.30	17			Stiff brown and grey mottled silty CLAY with occasional silt laminations and scattered selenite
	SPT	6.30	21			
	SPT	7.30	23		7.45	

U=Undisturbed
B= Bulk
D=Disturbed
W=Water

LBH WEMBLEY ENGINEERING

PROJECT: 10 Elsworthy Road

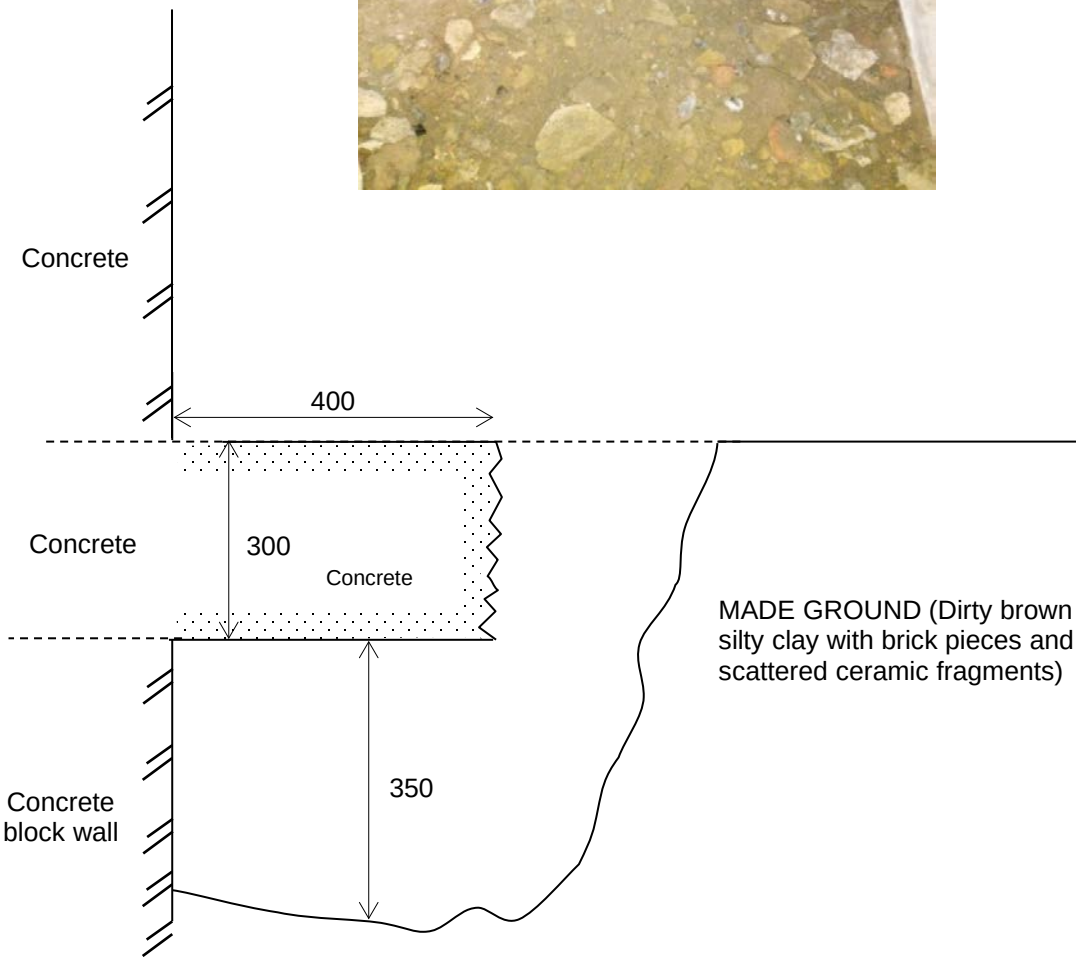
CLIENT: Lorna & Peter Klimt

Project No LBH4482

SPT RESULTS

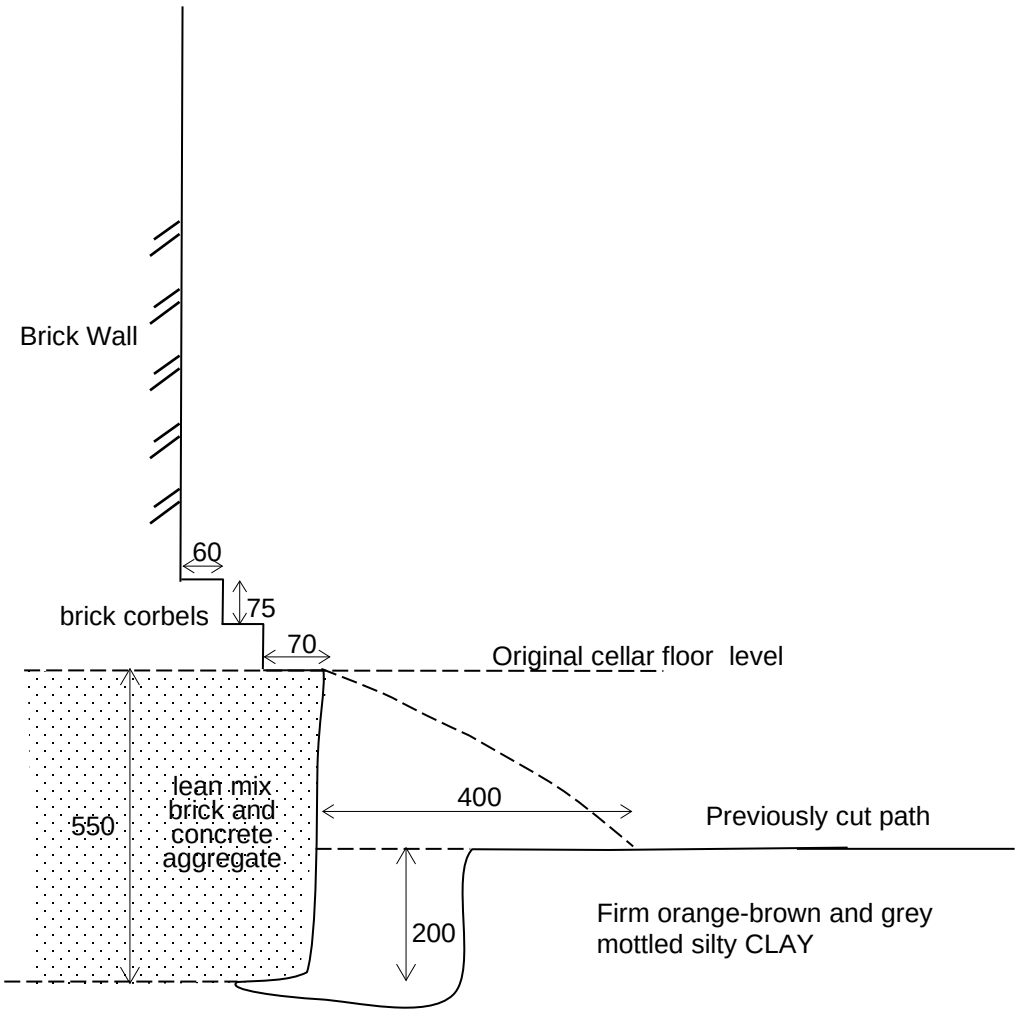
Borehole No	Depth at Start of Test (m)	Spoon or Cone	Blow for each successive 75mm penetration						Water Level (m)	Is Hole Blowing?	N Value
1	1.00	S	1	1	1	1	1	1	DRY	-	4
	2.00	S	1	2	1	2	2	3	DRY	-	8
	3.00	S	2	2	3	3	3	3	DRY	-	12
	4.00	S	3	3	3	3	3	4	DRY	-	13
	5.00	S	3	3	3	4	4	4	DRY	-	15
	6.00	S	3	4	4	5	5	6	DRY	-	20
	7.00	S	3	4	5	5	6	6	DRY	-	22
2	1.00	S	2	2	2	2	2	2	DRY	-	8
	2.00	S	2	1	2	2	3	2	DRY	-	9
	3.00	S	2	2	3	3	4	5	DRY	-	15
	4.00	S	3	2	3	3	3	4	DRY	-	13
	5.00	S	3	3	3	5	4	5	DRY	-	17
	6.00	S	3	5	5	6	5	5	DRY	-	21
	7.00	S	3	8	6	6	5	6	DRY	-	23

PROJECT: 10 Elsworthy Road	LBH4482	**TRIAL PIT 1**
CLIENT: Lorna & Peter Klimt		



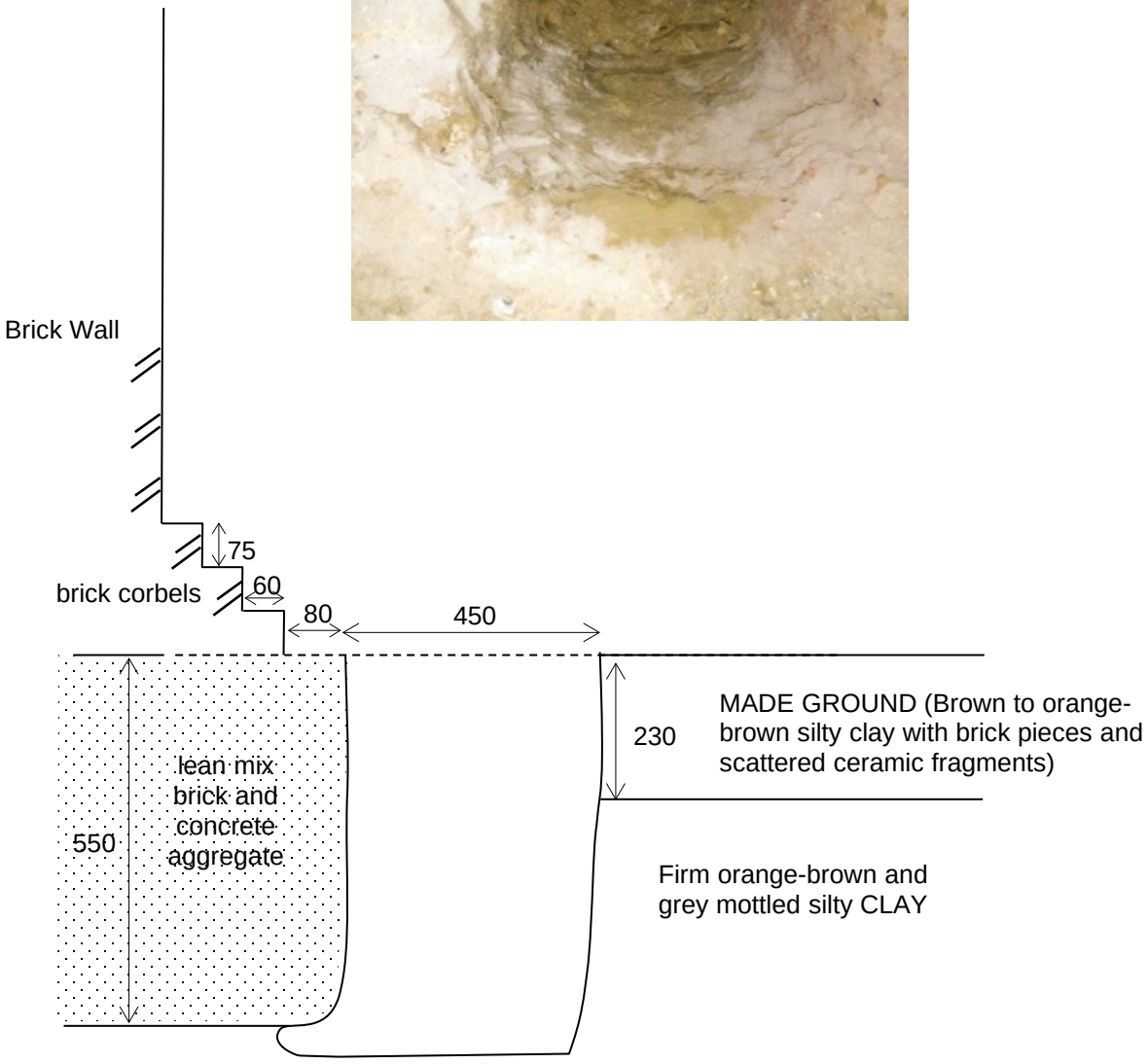
Pit inspected 08.08.17
Approx. OD +48.0 m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road	LBH4482	**TRIAL PIT 3**
CLIENT: Lorna & Peter Klimt		



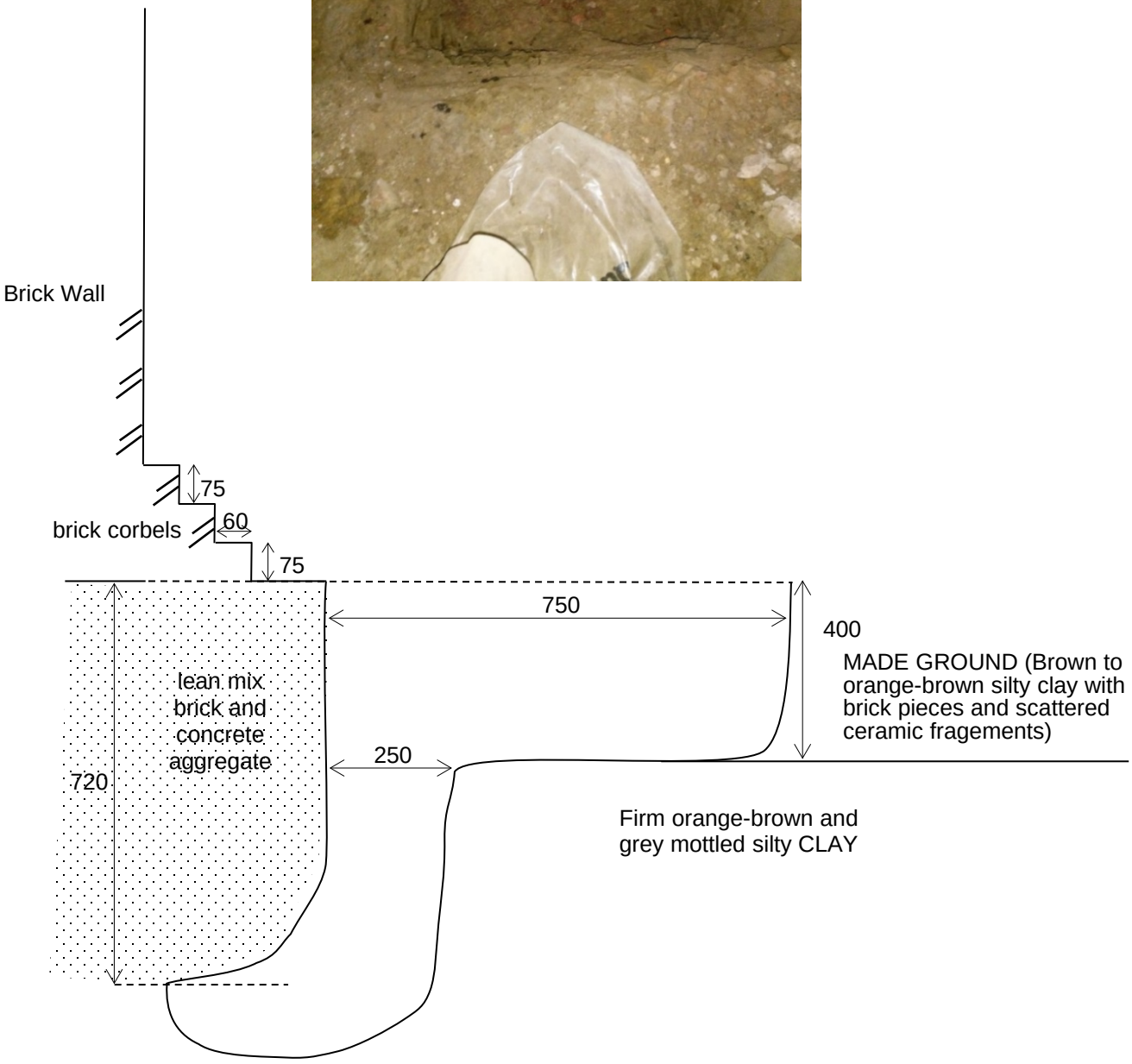
Pit inspected 08.08.17
Approx. OD +48.0m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road CLIENT: Lorna & Peter Klimt	LBH4482	**TRIAL PIT 4**



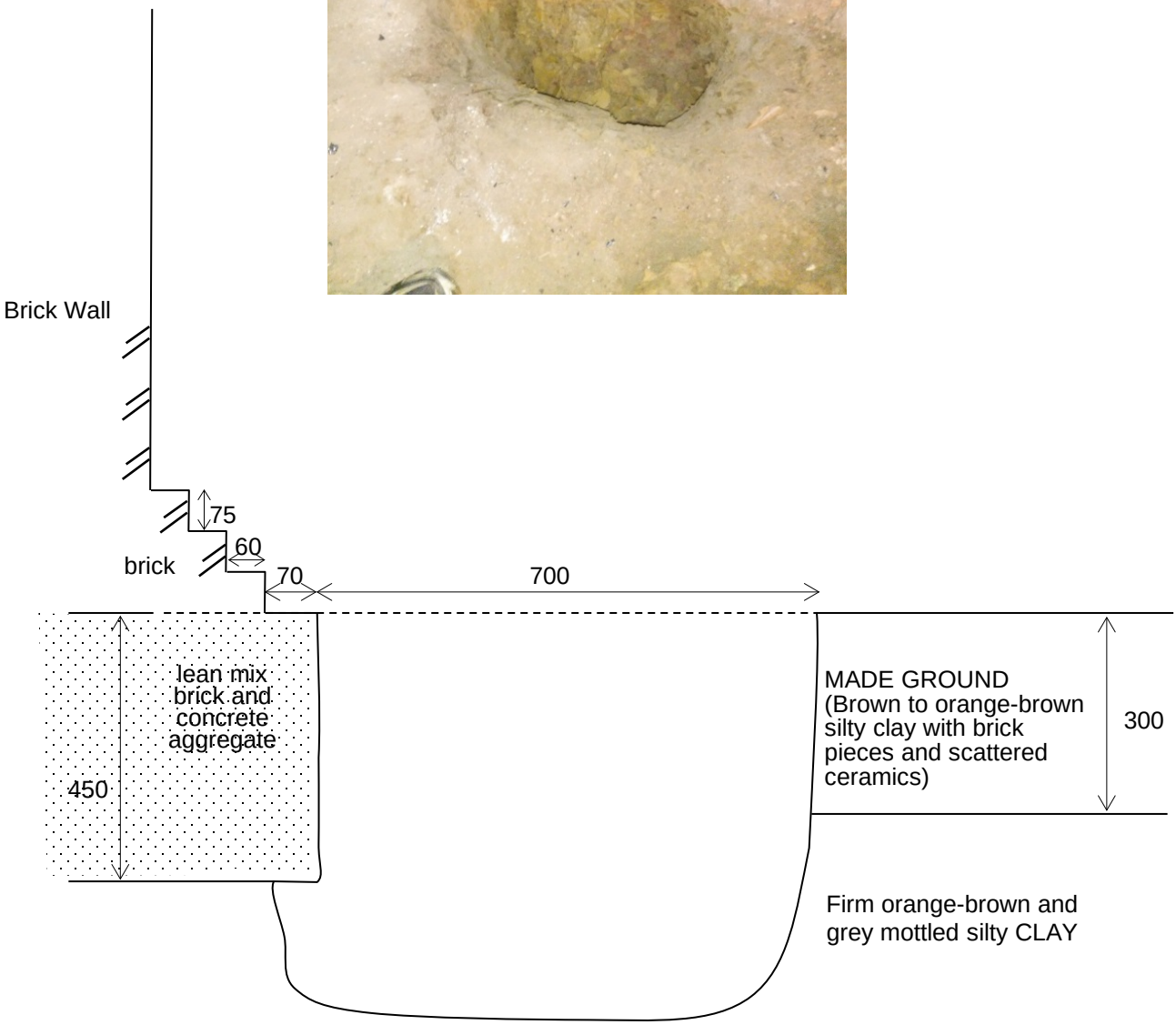
Pit inspected 08.08.17
Approx. OD +47.9m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road CLIENT: Lorna & Peter Klimt	LBH4482	**TRIAL PIT 5**



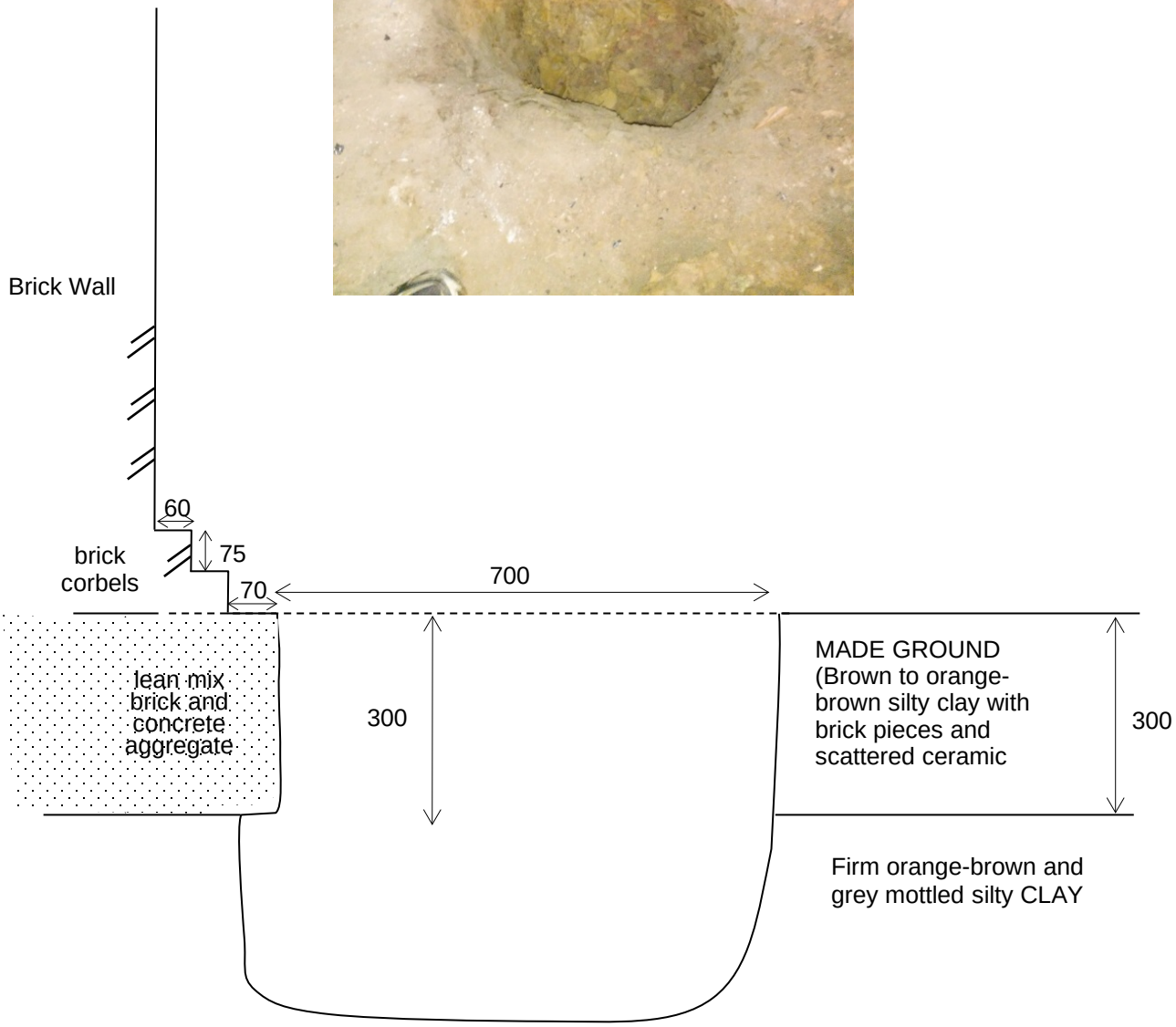
Pit inspected 08.08.17
Approx. OD +48.0m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road CLIENT: Lorna & Peter Klimt	LBH4482	**TRIAL PIT 6a**



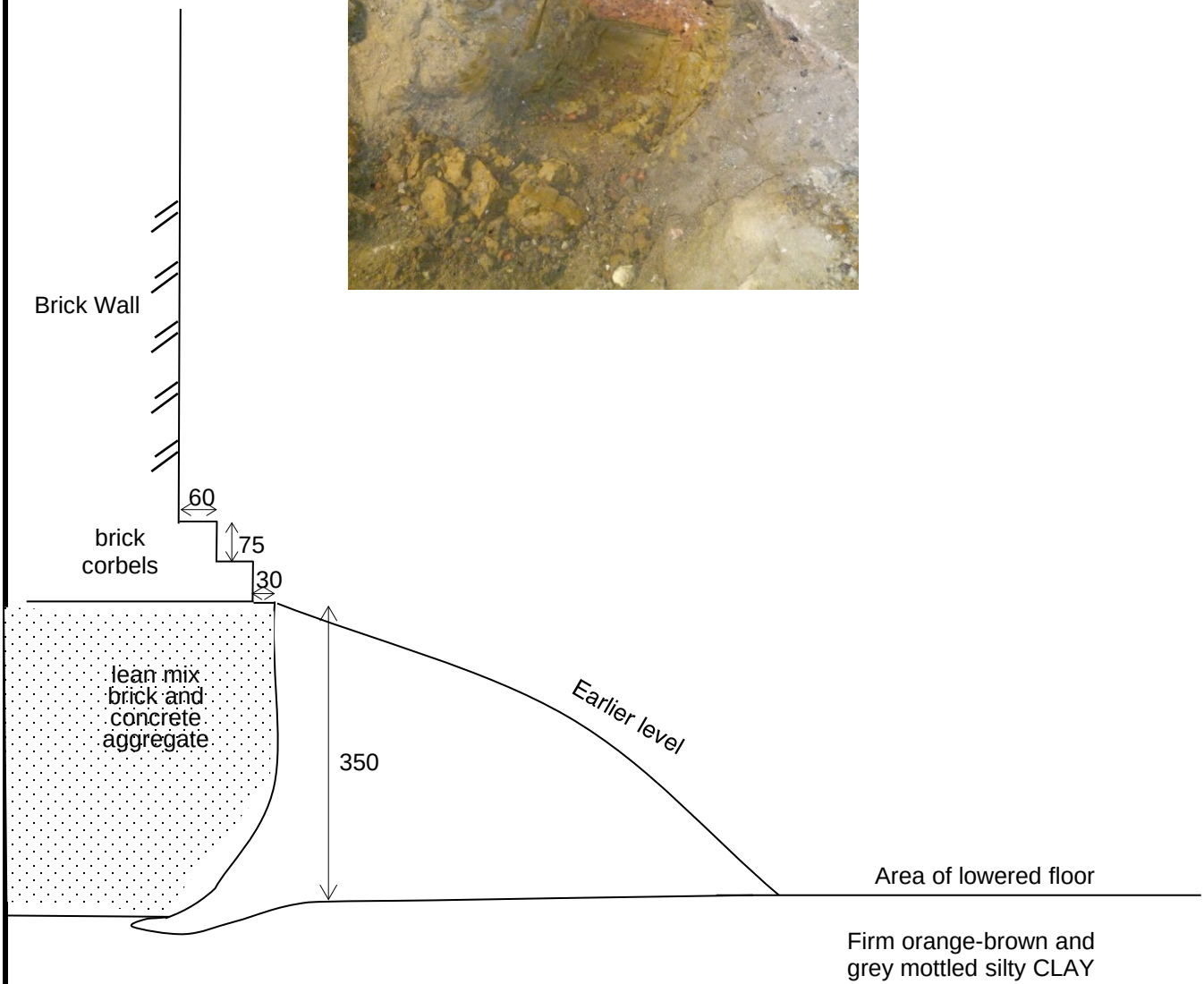
Pit inspected 08.08.17
Approx. OD +48.1m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road CLIENT: Lorna & Peter Klimt	LBH4482	**TRIAL PIT 6b**



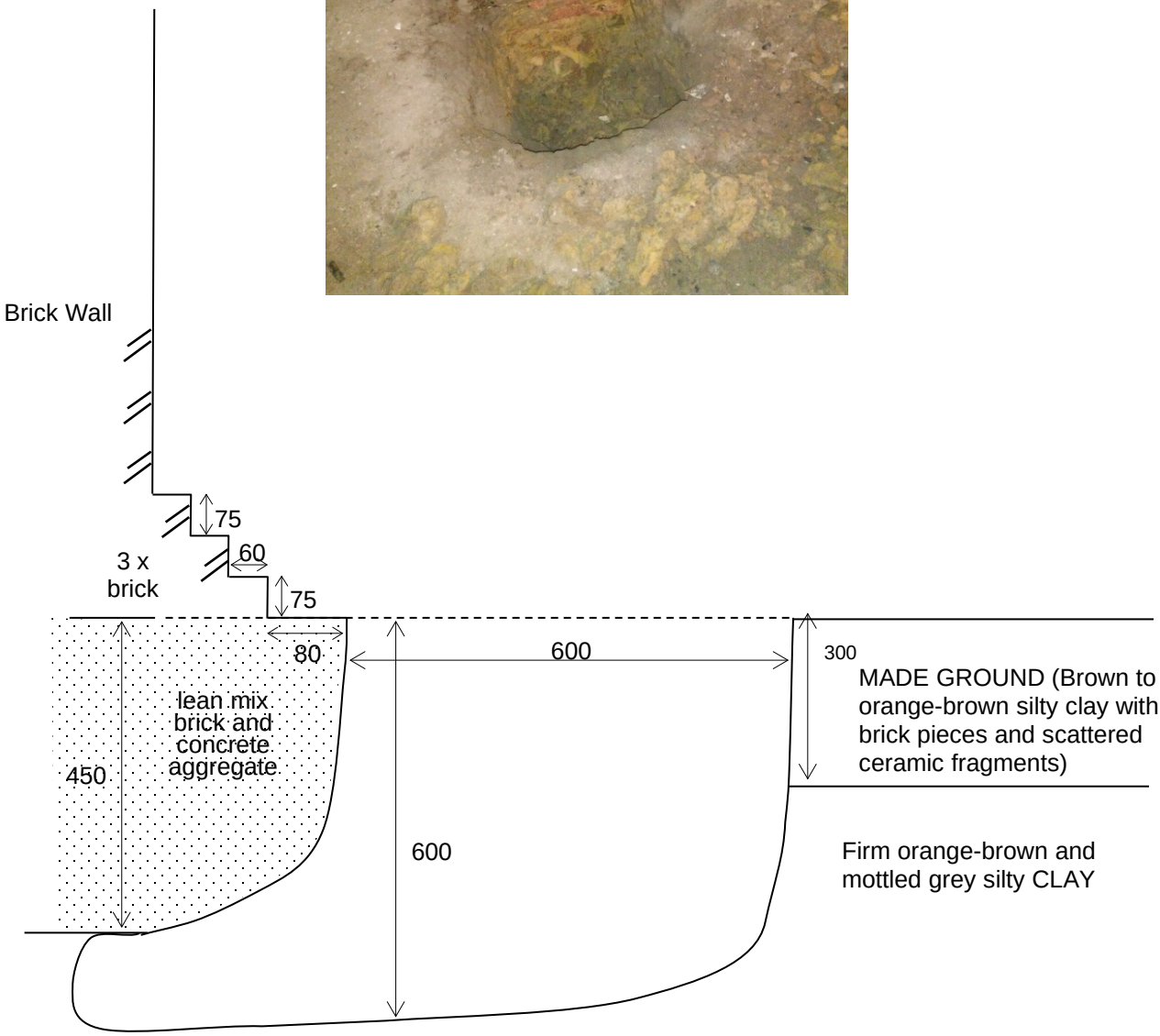
Pit inspected 08.08.17
Approx. OD +48.1m
All dimensions in millimetres
Do not scale
No ground water encountered

PROJECT: 10 Elsworthy Road CLIENT: Lorna & Peter Klimt	LBH4482	**TRIAL PIT 7**



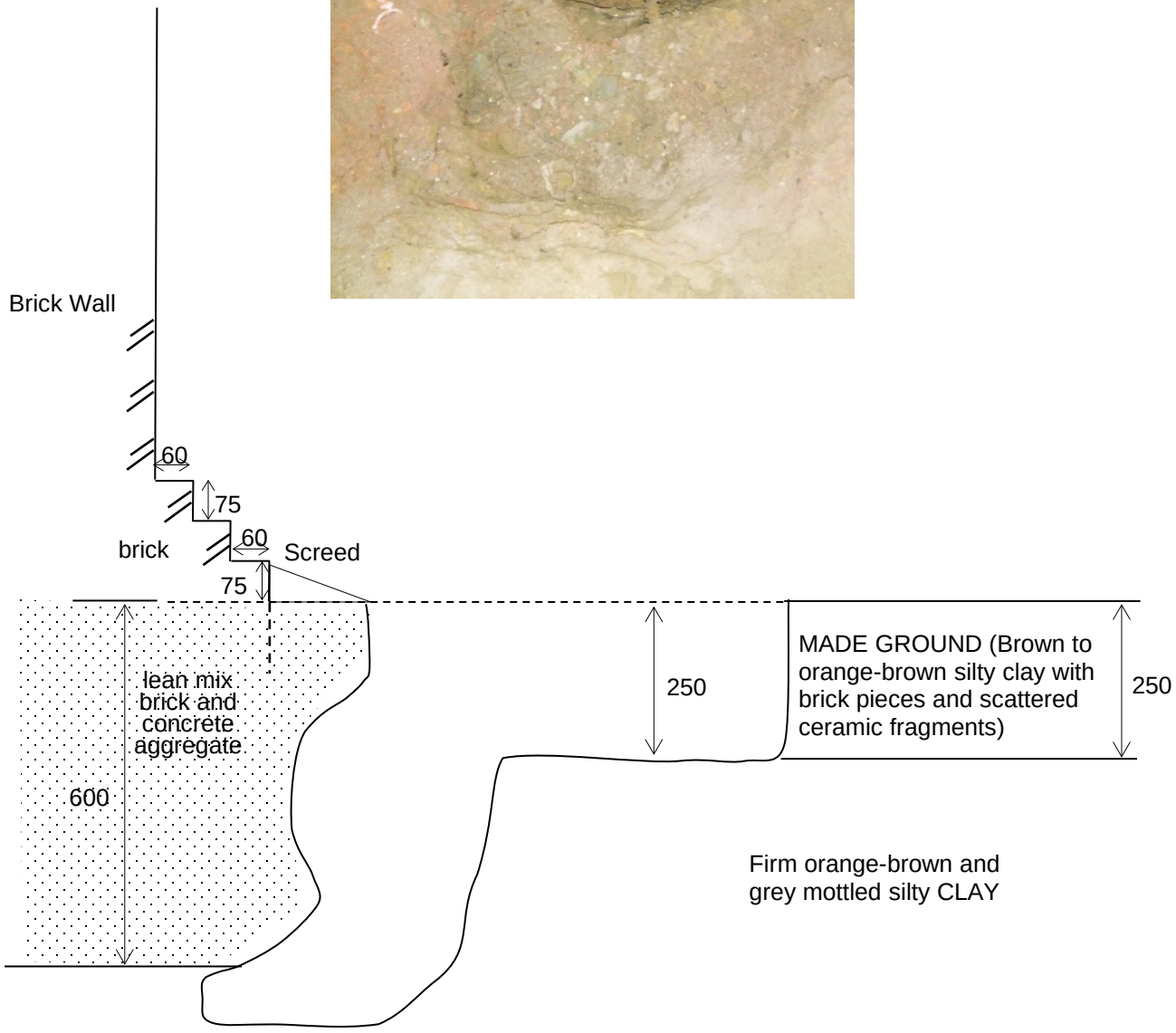
Pit inspected 08.08.17
Approx. OD +47.9m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road CLIENT: Lorna & Peter Klimt	LBH4482	**TRIAL PIT 8**



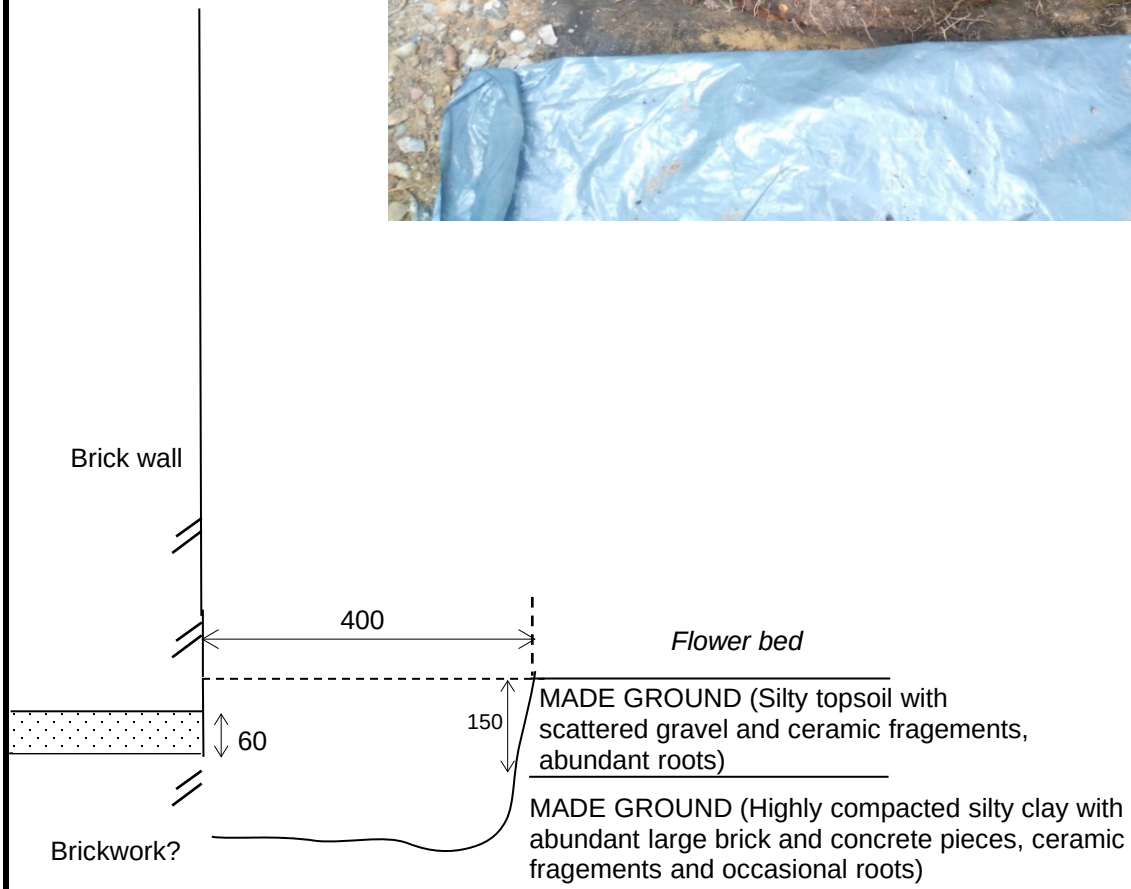
Pit inspected 08.08.17
Approx. OD +48.1m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road	LBH4482	**TRIAL PIT 9**
CLIENT: Lorna & Peter Klimt		



Pit inspected 08.08.17
Approx. OD +48.0m
All dimensions in millimetres
Do not scale
No groundwater encountered

PROJECT: 10 Elsworthy Road CLIENT: Lorna & Peter Klimt	LBH4482	**TRIAL PIT 9**



Pit inspected 08.08.17
Approx. OD +48.5m
All dimensions in millimetres
Do not scale
No groundwater encountered

Certificate of Analysis

Certificate Number 17-07736

21-Aug-17

Client LBH Wembley
Unit 12 Little Balmer
Buckingham Industrial Park
Buckingham
MK18 1TF

Our Reference 17-07736

Client Reference LBH4482

Order No LBH4482

Contract Title 10 Elsworthy Road, Camden, NW3 3DJ

Description 2 Soil samples, 4 Leachate samples.

Date Received 12-Aug-17

Date Started 12-Aug-17

Date Completed 21-Aug-17

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 17-07736
Client Ref LBH4482
Contract Title 10 Elsworthy Road, Camden, NW3 3DJ

			Lab No	1216907	1216908
			Sample ID	BH1	BH2
			Depth	0.45	0.80
			Other ID		
			Sample Type	SOIL	SOIL
			Sampling Date	11/08/17	11/08/17
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Preparation					
Moisture Content	DETSC 1004	0.1	%	24	20
Metals					
Arsenic	DETSC 2301#	0.2	mg/kg	22	52
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.7	1.0
Cadmium	DETSC 2301#	0.1	mg/kg	0.4	2.7
Chromium	DETSC 2301#	0.15	mg/kg	35	30
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	52	1900
Lead	DETSC 2301#	0.3	mg/kg	180	920
Mercury	DETSC 2325#	0.05	mg/kg	0.72	17
Nickel	DETSC 2301#	1	mg/kg	21	26
Selenium	DETSC 2301#	0.5	mg/kg	0.5	2.9
Zinc	DETSC 2301#	1	mg/kg	190	1200
Inorganics					
pH	DETSC 2008#			8.5	8.2
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.1	0.5
Cyanide, Free	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1
Thiocyanate	DETSC 2130#	0.6	mg/kg	< 0.6	0.8
Total Organic Carbon	DETSC 2002	0.1	%	1.1	3.6
Organic matter	DETSC 2002#	0.1	%	1.9	6.2
Sulphide	DETSC 2024*	10	mg/kg	36	44
Sulphur (free)	DETSC 3049#	0.75	mg/kg	11	< 0.75
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.09	0.16
Petroleum Hydrocarbons					
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	5.3	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	6.6	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	12	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	12	< 10

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 17-07736
Client Ref LBH4482
Contract Title 10 Elsworthy Road, Camden, NW3 3DJ

			Lab No	1216907	1216908
			Sample ID	BH1	BH2
			Depth	0.45	0.80
			Other ID		
			Sample Type	SOIL	SOIL
			Sampling Date	11/08/17	11/08/17
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01
MTBE	DETSC 3321	0.01	mg/kg	< 0.01	< 0.01
PAHs					
Naphthalene	DETSC 3303#	0.03	mg/kg	0.28	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	1.0	0.05
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.43	0.12
Pyrene	DETSC 3303#	0.03	mg/kg	0.34	0.11
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.12	0.05
Chrysene	DETSC 3303	0.03	mg/kg	0.14	0.05
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.13	0.04
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	2.5	0.42
Phenols					
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	0.4

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Asbestos Analysis
Soil Samples

Our Ref 17-07736
Client Ref LBH4482
Contract Title 10 Elsworthy Road, Camden, NW3 3DJ

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1216907	BH1 0.45	SOIL	NAD	none	Rebecca Burgess
1216908	BH2 0.80	SOIL	NAD	none	Rebecca Burgess

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 17-07736
Client Ref LBH4482
Contract Title 10 Elsworthy Road, Camden, NW3 3DJ
Sample Id BH1 0.45

Sample Numbers 1216907 1216909 1216910
Date Analysed 17/08/2017

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084* Total Organic Carbon	%	1.1	3	5	6
DETSC 2003# Loss On Ignition	%	6.4	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	370	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	7.6	100	n/a	n/a
DETSC 2008# pH	pH Units	8.5	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	7	7	0.014	0.07	0.5	2	25
DETSC 2306 Barium as Ba	3.4	1.7	< 0.02	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	1.2	0.65	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	12	8.7	0.024	0.091	2	50	100
DETSC 2306 Mercury as Hg	0.59	0.31	0.0012	0.0034	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	14	16	0.03	0.16	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.5	< 0.5	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	4.7	4.7	< 0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	3.3	1.2	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.61	0.38	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	5.3	4.8	0.011	0.049	4	50	200
DETSC 2055 Chloride as Cl	4400	3500	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	590	120	1.18	1.72	10	150	500
DETSC 2055 Sulphate as SO4	11000	3400	22	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	100000	56000	200	609	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	5800	4500	11.6	< 50	500	800	1000

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive Hazardous Waste

Additional Information

DETSC 2008 pH	7.7	7.7
DETSC 2009 Conductivity uS/cm	145	79.9
* Temperature*	21	21

Mass of Sample Kg	0.140
Mass of dry Sample Kg	0.106

Stage 1

Volume of Leachant L2	0.178
Volume of Eluate VE1	0.118

Stage 2

Volume of Leachant L8	0.847
Volume of Eluate VE2	0.8

Disclaimer: *The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.*

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 17-07736
Client Ref LBH4482
Contract Title 10 Elsworthy Road, Camden, NW3 3DJ
Sample Id BH2 0.80

Sample Numbers 1216908 1216911 1216912
Date Analysed 17/08/2017

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084* Total Organic Carbon	%	3.6	3	5	6
DETSC 2003# Loss On Ignition	%	10	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	17	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	< 1.6	100	n/a	n/a
DETSC 2008# pH	pH Units	8.2	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	11	7.2	0.022	0.077	0.5	2	25
DETSC 2306 Barium as Ba	2.4	2.9	< 0.02	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	0.13	0.06	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	2.9	3	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	8.3	5.3	0.017	0.057	2	50	100
DETSC 2306 Mercury as Hg	0.06	0.05	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	130	51	0.26	0.61	0.5	10	30
DETSC 2306 Nickel as Ni	2.2	1.4	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	13	12	0.03	0.121	0.5	10	50
DETSC 2306 Antimony as Sb	2.4	1.3	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.8	0.4	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	13	11	0.026	0.113	4	50	200
DETSC 2055 Chloride as Cl	5100	4600	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	1200	390	2.4	4.93	10	150	500
DETSC 2055 Sulphate as SO4	6300	3200	< 20	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	130000	61000	260	697.9	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	9100	7100	18.2	73.5	500	800	1000

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive Hazardous Waste

Additional Information

DETSC 2008 pH	7.6	7.6
DETSC 2009 Conductivity uS/cm	191	86.8
* Temperature*	21	21

Mass of Sample Kg	0.140
Mass of dry Sample Kg	0.111

Stage 1

Volume of Leachant L2	0.194
Volume of Eluate VE1	0.142

Stage 2

Volume of Leachant L8	0.891
Volume of Eluate VE2	0.83

Disclaimer: *The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.*

Information in Support of the Analytical Results

Our Ref 17-07736
Client Ref LBH4482
Contract 10 Elsworthy Road, Camden, NW3 3DJ

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1216907	BH1 0.45 SOIL	11/08/17	GJ 250ml, GJ 60ml, PT 1L		
1216908	BH2 0.80 SOIL	11/08/17	GJ 250ml, GJ 60ml, PT 1L		
1216909	BH1 0.45 LEACHATE	11/08/17	GJ 250ml, GJ 60ml, PT 1L		
1216910	BH1 0.45 LEACHATE	11/08/17	GJ 250ml, GJ 60ml, PT 1L		
1216911	BH2 0.80 LEACHATE	11/08/17	GJ 250ml, GJ 60ml, PT 1L		
1216912	BH2 0.80 LEACHATE	11/08/17	GJ 250ml, GJ 60ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

Telephone:- 01327 860947/860060 Fax:- 01327 860430 Email: groundtech@listersgeotechnics.co.uk

PROJECT INFORMATION		SAMPLE INFORMATION		
Site Location:-	10 Elsworthy Road Camden London NW3 3DJ	**Laboratory Tests Undertaken:-**		
		TEST TYPE	**TEST METHOD**	**TESTED**
		Natural Water Contents (WC%)	(BS 1377:Part 2:1990 Clause 3.2)	✓
		Liquid Limits (%)	(BS 1377:Part 2:1990 Clause 4.3)	✓
		Plastic Limits (%)	(BS 1377:Part 2:1990 Clause 5.3)	✓
		Plasticity Index (%)	(BS 1377:Part 2:1990 Clause 5.4)	✓
		Linear Shrinkage (%)	(BS 1377:Part 2:1990 Clause 6.5)	
		PSD - Wet Sieving	(BS 1377:Part 2:1990 Clause 9.2)	
Client Reference:-	-	Engineering Sample Descriptions	(BS 5930 : Section 6)	✓
		Passing 425/63 (μm)	-	✓
		Hydrometer	(BS 1377:Part 2:1990 Clause 9.5)	
Date Samples Received:-	18th August 2017	Loss on Ignition (%)	-	
Date Testing Completed:-	29th August 2017	Soil Suctions (kPa)	BRE Digest IP 4/93, 1993	
		Bulk Density (Mg/m^3)	(BS 1377:Part 2:1990 Clause 7.2)	
		Strength Tests	(BS 1377:Part 7:1990 Clause 8 & 9)	
		Soluble Sulphate Content (SO_4g/l)	(BS 1377:Part 3:1990 Clause 5.3)	✓
		pH value	(BS 1377:Part 3:1990 Clause 9.4)	✓
		California Bearing Ratios (CBR)	(BS 1377:Part 4:1990 Clause 7)	
		Compaction Tests	(BS 1377:Part 4:1990 Clauses 3.0-3.6)	
The results relate only to the samples tested				

Laboratory testing in accord with BS EN ISO/IEC 17025-2000 and Quality Management in accord with ISO 9001

Signed on behalf of GroundTech Laboratories:- _____ **Technical Signatory**

Quality Assured to ISO 9001

GEOTECHNICAL LABORATORY TEST RESULTS

Report No: 17.08.012

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD
Telephone: 01327 860947/860060 Fax: 01327 860430 Email: groundtech@listersgeotechnics.co.uk

Quality Assured to ISO 9001

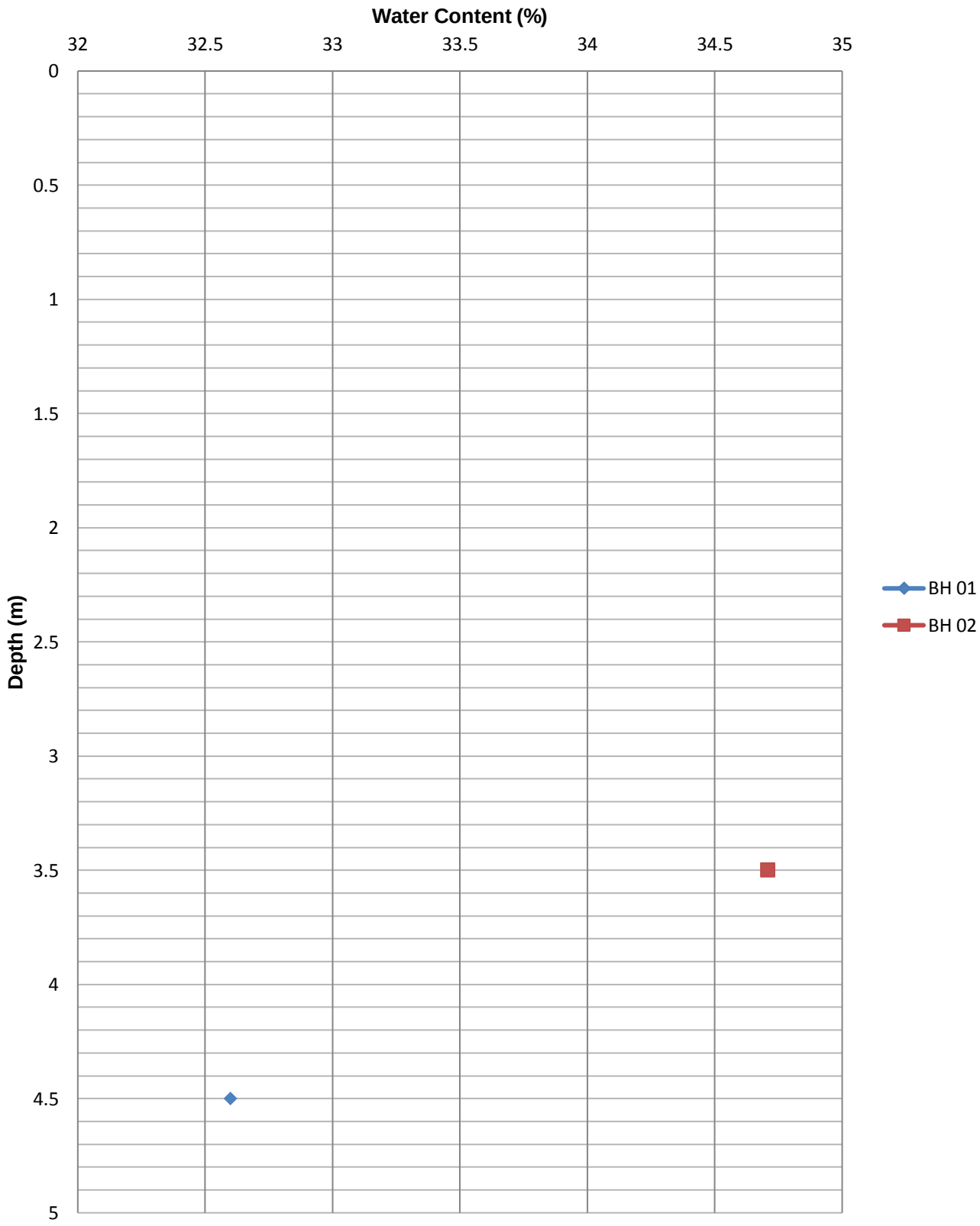
SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS	
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 µm %	Modified PI %	Class	Passing 63 µm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	ϕ	pH Value	Soluble Sulphate Content SO4 g/l
BH 01	D	2.20																					6.5	1.96
	D	4.50	PI/63	33	74	28	46	99	45	CV	92	0.45	30	0.11										
BH 02	D	2.50																					6.7	0.67
	D	3.50	PI/63	35	74	28	46	99	46	CV	96	0.47	30	0.15										

Symbols:

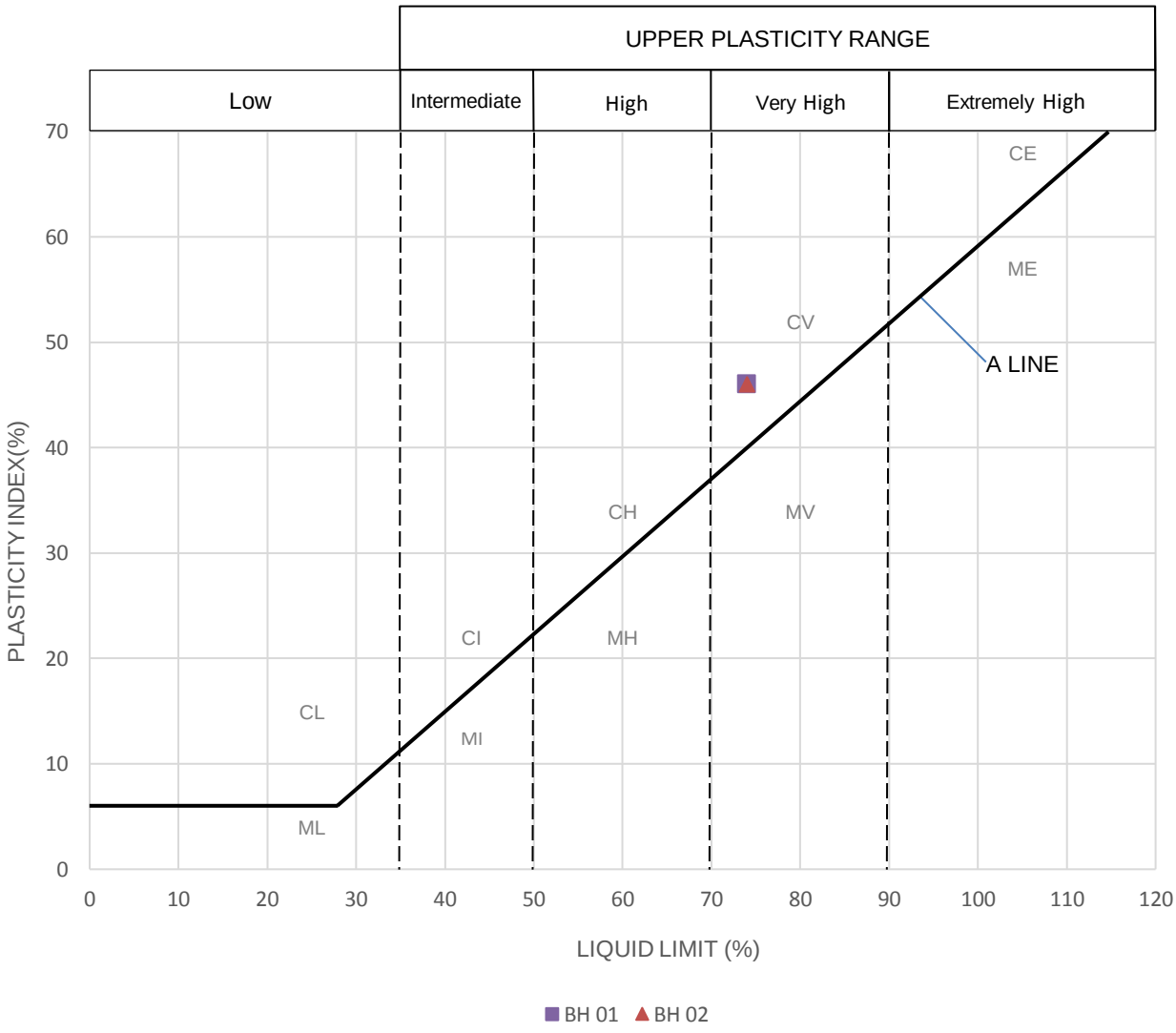
U	Undisturbed Sample	R	Remoulded	PI	Plasticity Index	T	Triaxial Undrained	L	100mm specimen
D	Disturbed Sample	63	Passing 63µm	F	Filter Paper Suction Tests	M	Multistage Triaxial	S	38mm specimen
B	Bulk Sample	H	Hydrometer	CC	Continuous Core	HP	Hand Penetrometer		
W	Water Sample	PSD	Wet Sieving			V	Vane Test		

LABORATORY TEST RESULTS

Project Reference
17.08.012



WATER CONTENT v DEPTH	Report: 17.08.012



PLASTICITY CHART

Report:
17.08.012

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northamptonshire. NN12 8QD
Telephone: (01327) 860947/860060 Fax: (01327) 860430

Test Location	Depth –m	Sample Description
BH 01	2.20	Firm brown slightly silty CLAY with rare orange sand and abundant fine selenite.
BH 01	4.50	Firm brown closely fissured slightly sity CLAY with rare red brown silt and occasional fine selenite.
BH 02	2.50	Firm brown locally mottled grey slightly silty CLAY.
BH 02	3.50	Firm brown locally mottled grey slightly silty CLAY with abundant selenite.

SAMPLE DESCRIPTIONS | Report No: 17.08.012