RIDGE

BASEMENT IMPACT ASSESSMENT
BRANCH HILL HOUSE
ALMAX GROUP
05 December 2019

RIDGE

Camden

BASEMENT IMPACT ASSESSMENT
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ALMAX GROUP

05 December 2019

Prepared for

Almax Group Ltd
4 Old Park Lane
London
W1K 1QW

Prepared by

Ridge and Partners LLP
Partnership House
Moorside Road
Winchester
Hampshire
SO23 7RX

Tel: 01962 834400

Contact

William Springthorpe
Structural Engineer
wspringthorpe@ridge.co.uk

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VERSION	DATE	DESCRIPTION	CREATED BY	REVIEWED BY
1.0	05.12.2019	First Draft	WS	JR
2.0	18.12.2019	Final Draft	JR	RL

CONTENTS

1. NON-TECHNICAL SUMMARY

Ridge and Partners LLP (Ridge) has been commissioned by Almax Group to carry out a desk study and ground investigation at the land adjacent to Branch Hill House, London, NW3 7LS. This report forms the main part of a Basement Impact Assessment (BIA) which has been carried out in accordance with the London Borough of Camden (LBC) Basement Impact Assessment Pro Forma 1v0 in support of a planning application.

1.1. Site Location

The site location is the land adjacent to Branch Hill House, Hampstead Heath, London, NW3 7LS.

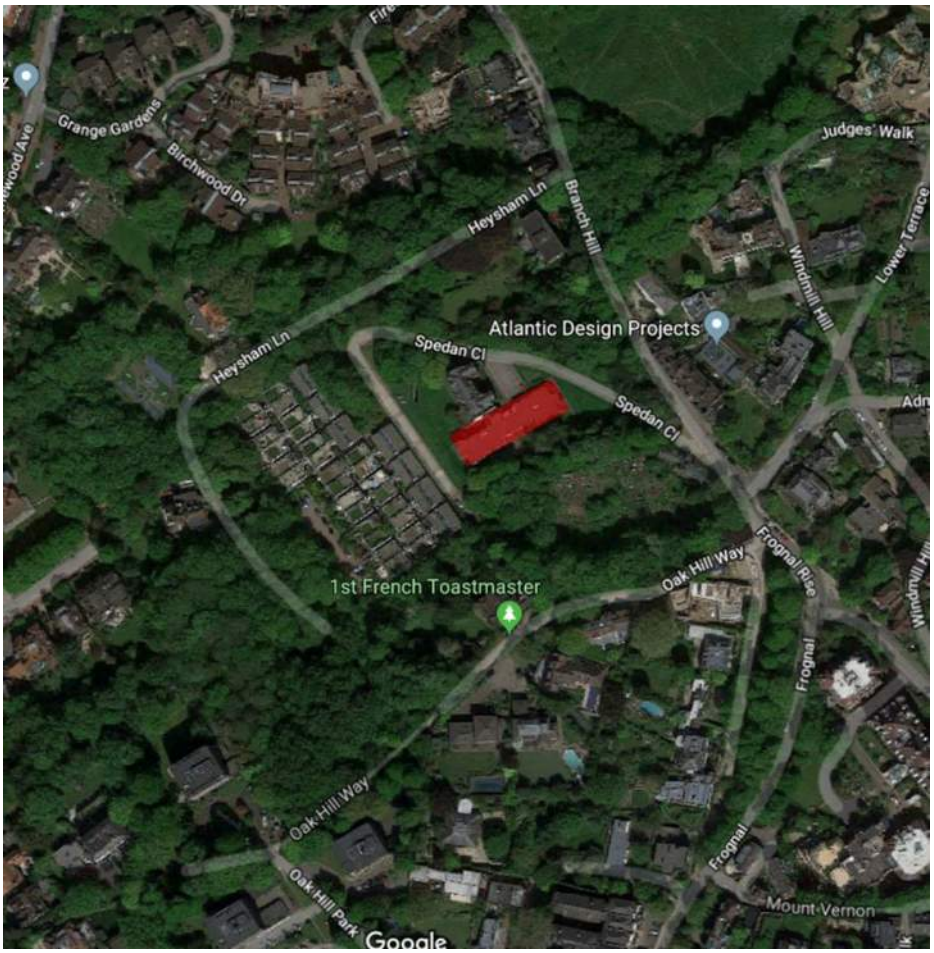


Figure 1 – Aerial view with approx. site area indicatively shown.

1.2. Existing Site

The current site arrangement comprises a 3-storey (+1 storey basement) residential manor house constructed circa 1860s, with an abutting 2-storey residential block constructed circa 1960s. The site has formerly been used as a residential facility for senior citizens but is currently occupied by building guardians. The site is set back from the main Branch Hill road, with access via a driveway (Spedan Close). At the rear of the building's plot (south-western end), a car park basement is embedded underneath the garden.

Figure 2 - Branch Hill Manor House (left) with abutting Residential Structure (right)

1.3. Proposed Development

The proposed development comprises the construction of a new 3-5-storey block of residential dwellings with a single storey basement. The existing residential 1960s structure will be demolished, with the new development occupying the footprint of this site, abutting the original Branch Hill Manor House, which is to be preserved and renovated.

Figure 3 - Existing Site Footprint

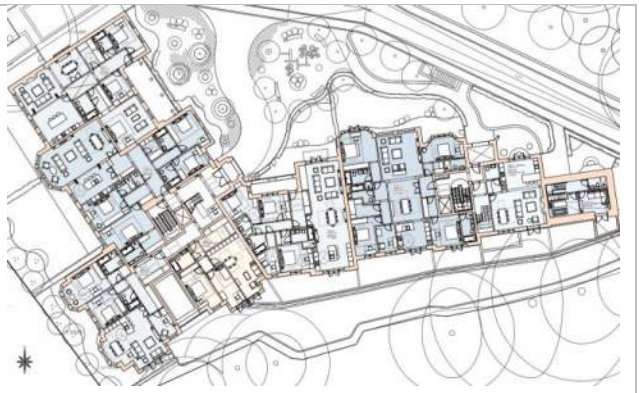


Figure 4 - Proposed Site Footprint

Figure 5 - Proposed North Elevation

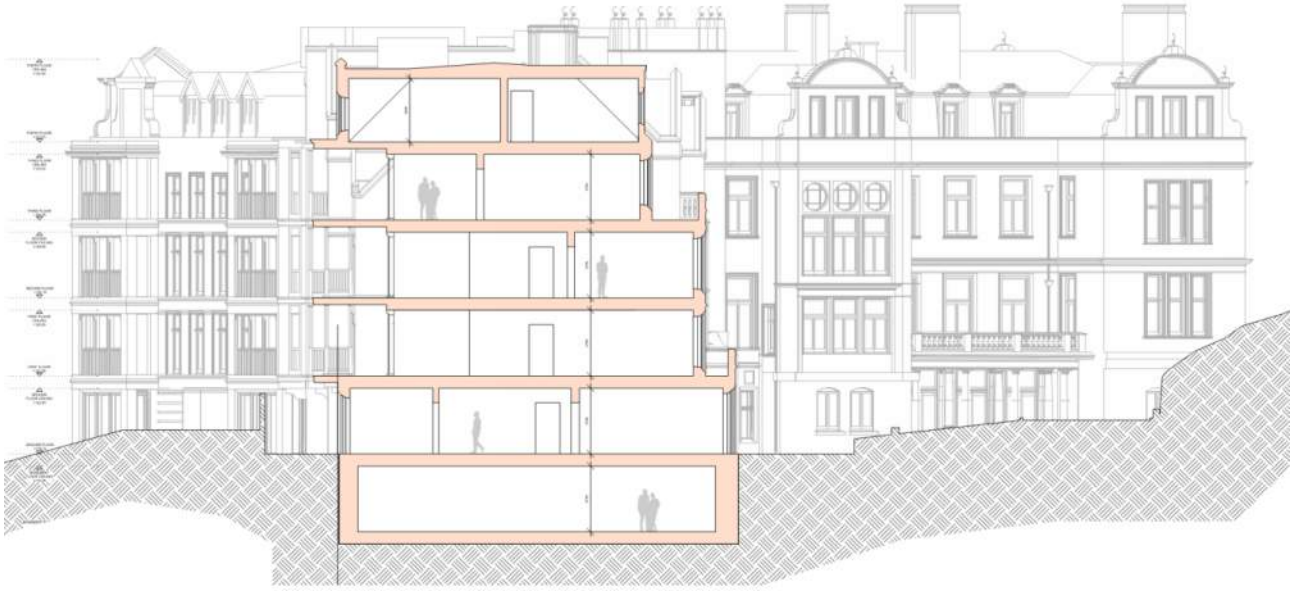


Figure 6 - Proposed Section with Basement

This report is specific to the proposed development and the advice herein should be reviewed once the development proposals have been finalised.

1.4. Assessments

The following assessments are presented:

- Desk Study
- Screening
- Scoping
- Additional evidence/assessments
- Site investigation
- Ground movement assessment
- Consultation with adjacent infrastructure/asset owners
- Flood risk assessments
- Surface water drainage strategy/SUDS assessment (see separate document on Surface Water Drainage).

- Others
- Impact Assessment

1.5. Authors

The authors of the assessments are William Springthorpe Meng MSc (1 year), Julian Rush BEng (Hons) (20 years) & Mathew Christie-Newman BSc(Hons) CEng MIStructE (8 years).

1.6. Ground and Groundwater Conditions

Groundwater was discovered at the following locations:

BH No.	Depth of Strike (mbgl)	Rose to (mbgl)
BH01	15.00 & 24.50	14.00 & 23.00
BH02	12.90 & 26.10	12.00 & 23.45
BH03	10.00	9.50

Correcting for the difference in ground level heights for the 3 boreholes, the ground water table can be assumed to be present at 10m below ground floor level of the proposed scheme.

As the depth of the basement is circa 4 metres below ground, ground water is not expected to be encountered during construction.

1.7. Construction Methods

The construction methods proposed for the single storey basement are as follows:

- Install piling mat.
- Place a contiguous piled wall around the perimeter of the new basement.
- Construct a concrete capping beam at ground level on top of the piles around the perimeter of the basement to tie the heads of the individual piles together.
- Internal bearing piles for the superstructure frame to be also piled from the existing ground level at the same time. Concrete mix for the top of the bearing piles within the depth of the basement to be changed to a pea shingle mix to allow the piles to be easily broken down during the bulk dig to the required cut off levels for the basement.
- Install reinforced concrete underpinning pits to gable wall to Branch Hill House. Underpinning to be installed in multiple phases to reach new basement level.
- Excavate soil within the piled perimeter, installing temporary propping to restrain the capping beams to the perimeter piled retaining walls and the underpinning pits.
- Construct reinforced concrete inner walls around the building perimeter, within the contiguous piled wall.
- Continue with the construction of the basement structure. Construct the basement slab connected to the contiguous piled perimeter walls with stainless steel dowels.
- Waterproof the internal space with two types of waterproofing to comply with NHBC Chapter 5.4 for habitable spaces. Expected to include specialist waterproof membrane with a drained cavity wall.
- Proceed with the construction of the above ground structure. Construction of the ground floor slab which will be tied to the concrete capping beam at the head of the piles to provide a permanent restraint to the piles.
- Temporary props can then be removed once the ground floor is cast.

1.8. Structural Monitoring Strategy

The proposed single storey below ground basement is to be constructed immediately adjacent to the existing 4 storey red bricked Victorian Branch Hill House which is understood to date from the 1860's. The basement will extend below the depth of the existing footings to the House which have been exposed and found to consist of shallow corbelled brick footings on concrete strip footings. Prior to constructing the basement, the existing footings are to be underpinned down to the new basement level. This is to be achieved by traditional reinforced concrete pin underpinning. Due to the depth of underpinning required, the underpinning will be undertaken in stages to get down to formation depth for the new basement. Prior to the underpinning being undertaken, a temporary shoring frame will be provided to laterally restrain the party gable wall to Branch Hill House during the construction stage. Temporary propping will also be provided to laterally restrain the underpinning pits as the underpinning progresses down to the new basement level. The props will be restrained against temporary concrete thrust blocks cast into the base of the basement.

A Condition survey undertaken on the existing house by Ridge & Partners dated April 2019 has identified that there is cracking to the brickwork in places and movement of stone cornices at roof level. Prior to the works proceeding any areas of known significant visible damage, identified in the Condition Report, should either be repaired or removed to make safe. Prior to the works proceeding the Contractor should undertake their own investigations for any defects to the existing house which could present hazards to the health and safety of the site workers and any visitors to the site.

A structural monitoring strategy to control the works and impacts to the neighbouring structure of the Branch Hill House will be required. This is expected to include monitoring of vertical and lateral movements by theodolite at specific times during the works. Trigger levels for movements using a RED AMBER GREEN traffic light system will be agreed with an emergency preparedness plan in place to agree actions to take should movements occur.

1.9. Basement Impact Assessment (BIA)

The basement is to be constructed immediately adjacent and lower to the footings of the existing Victorian Branch Hill House which is to be retained. Along the south boundary of the new construction there is also a row of mature trees with tree protection orders. The method of construction for the basement mitigates the impacts on both the house and the trees.

The BIA has identified that the site is located directly above an aquifer. The BIA has investigated and determined that the basement will have no impact on the water table, local watercourse, pond catchment areas, surface water levels or increased ground water discharge levels.

As a result of these insignificant hydrogeological impacts, there are no mitigation measures necessary. There will be no residual impacts on the wider hydrogeological environment as a result of this basement construction.

The Branch Hill House site is situated within Flood Zone 1 indicating a low probability of flooding each year – 0.1% (or 1 in 1000 year). The site is appropriate for the intended use from a flood risk perspective.

For any adverse impacts on flood risk to the surrounding area, mitigation measures to address the increase in surface water runoff from the development will be included within the drainage design.

2. INTRODUCTION

The purpose of this assessment is to consider the effects of a proposed basement as part of the development of the land adjacent to Branch Hill House, London, NW3 7LS on the local hydrology, geology and hydrogeology and potential impacts to neighbours and the wider environment. The site location is presented in Figure 7.

The BIA approach follows current planning procedure for basements and lightwells adopted by LB Camden and comprises the following elements (CPG Basements):

- Desk Study;
- Screening;
- Scoping;
- Site Investigation, monitoring, interpretation and ground movement assessment;
- Impact Assessment

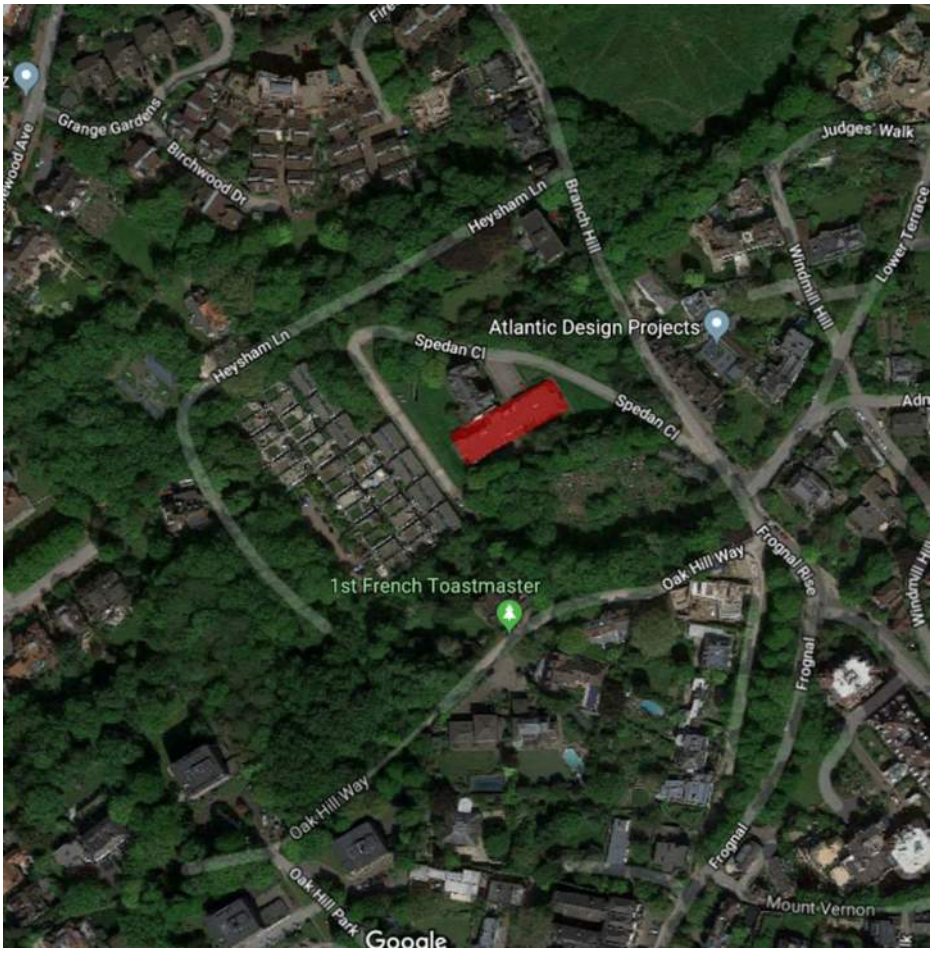


Figure 7 – Aerial view with approx. site area indicatively shown.

2.1. Authors

The BIA has been authored/reviewed/approved by:

- William Springthorpe MEng MSc (1 year)
- Julian Rush BEng (Hons) (20 years)
- Mathew Christie-Newman BSc (Hons) CEng MIStructE (8 years)

2.2. Sources of Information

The following baseline data have been referenced to complete the BIA in relation to the proposed development:

- Site walkover (14/03/2019)
- Current/historical mapping;
- Geological mapping (see appendix 2);
- Hydrogeological data (see appendix 2);
- Current/historical hydrological data (see appendix 2);
- Flood risk mapping (see appendix 1);
- LB Camden, Strategic Flood Risk Assessment (produced by URS, 2014);
- LB Camden, Floods in Camden, Report of the Floods Scrutiny Panel (2013);
- LB Camden, Planning Guidance (CPG) – Basements (March 2018);
- LB Camden, Camden Geological, Hydrogeological and Hydrological Study – Guidance for Subterranean Development (produced by Arup, 2010);
- LB Camden, Local Plan Policy A5 Basements (2017);
- LB Camden's Audit Process Terms of Reference;
- Other relevant technical references pertinent to the proposed development, construction methods, etc

2.3. Existing and Proposed Development

The Application site is located at the land adjacent to Branch Hill House, London, NW3 7LS. The site is within a wider hillside setting. Slope angles are approximately 6º. The site is on level ground at approximately 125m above sea level.

The current site arrangement comprises a 3-storey (+1 storey basement) masonry residential manor house constructed circa 1860s, with an abutting 2-storey concrete frame residential block constructed circa 1960s. The site has formerly been used as a residential facility for senior citizens but is currently occupied by building guardians. The site is set back from the main Branch Hill road, with access via a driveway (Spedan Close).

Neighbouring along the south-west of the property is the Branch Hill Estate (approx. 15m away), a multiplex of council-owned houses built upon a complex stepped-section of hill circa 1970s. The estate is likely founded on strip foundations and is in excellent condition. To the north of the property is West Heath Lodge (approx. 55m away), a 5-storey apartment block, constructed circa 1980s. The block is likely founded on piled foundations given its height and weight and is also in good condition. At the entrance to the Spedan Close driveway is a small gate house (approx. 70m away). Directly south is a residential property (approx. 70m away)

Neighbouring buildings include the following Listed properties:

- Branch Hill Estate: Grade II-listed (2010)

Neighbouring trees which have tree protection orders are also present along the south boundary to the site and will be protected during the construction works.

Underground infrastructure present/close to the site includes water supplies, natural gas supplies and electrical supplies. For complete information and mapping of these utilities, please see the Utilities Assessment for Planning report (Milieu Consult, 2019) in appendix 7. Data from TFL's Property Asset Register shows there are LUL tunnels 140 metres away from the Branch Hill site, which is beyond the defined LUL Zone of Influence.

The proposed new development is to demolish the existing 1960's extension which abuts the Victorian Branch Hill House which is to be retained. The demolished 1960's extension is to be replaced with a new building

circa 75 metres in length and circa 15 metres width comprising a single storey below ground basement with 3 to 5 storeys of residential units above.

The proposed form of construction is a reinforced concrete frame for the basement to 4th floor levels. The top storey is to be lighter steel frame construction with timber rafters forming the double pitched roofs. The single storey basement is to be formed with embedded contiguous piled walls around the perimeter of the basement.

Where the basement abuts Branch Hill House, the basement wall is to be formed by reinforced concrete underpinning as the basement level extends below the depth of the existing footings to Branch Hill House.

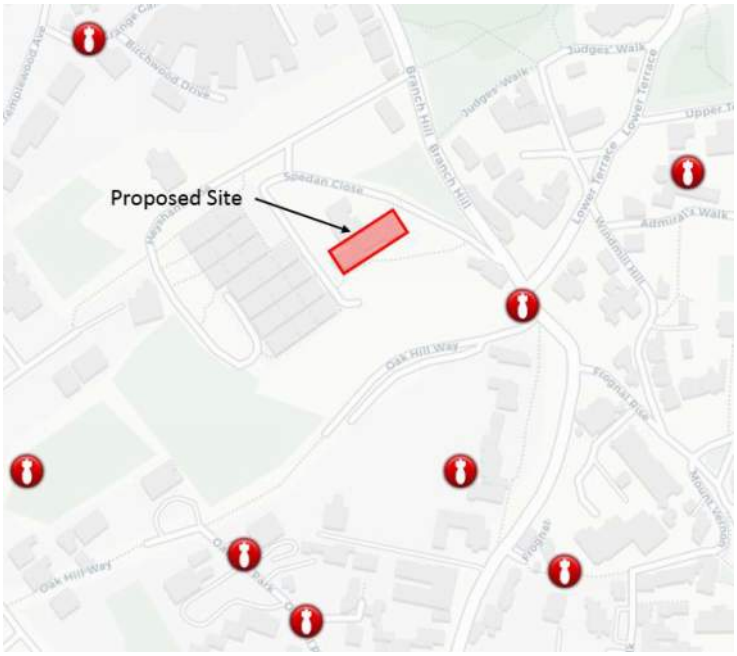
3. DESK STUDY

3.1. Site History

The land adjacent to Branch Hill House, London, NW3 7LS comprises equally hard surfaces and soft landscapes with the existing building(s) surrounded by trees and shrubs. The site was first built upon in the 1750s as a residential home. In the following 200 years, the main building evolved and extended into the current manor house complete with a single storey partial basement exposed on the south-eastern elevation. Abutting the original residence is a two-storey residential block constructed circa 1960s founded partially upon by stilts to accommodate the site's south-eastern slope. This 1960s structure occupies the entire footprint of the proposed basement and will be demolished. The new basement will occupy one storey beneath the existing main block's basement.

There is no evidence of any building construction taken place prior to the 1960s extension, suggesting the shallow made ground conditions.

The Aggregate Night-time Bomb Census was reviewed using the online Bomb Sight Map. Several highly explosive bombs were recorded to have been dropped near the site between 7th October 1940 to 6 June 1941. None were recorded to have fallen within the site boundary. Excavation is to proceed with caution regardless.



A utilities search was carried out by Milieu Consult to determine whether any tunnels or services ran through or near to the site. The Edgeware branch of the Northern Line is the only major feature passing close to the site. Data from TFL's Property Asset Register shows the tunnels are 140 metres away from the Branch Hill site, which is beyond the defined LUL Zone of Influence.

3.2. Geology

The following soil conditions were encountered during the investigation works. Please refer to the Borehole Logs included within Appendix 2 for a more detailed description.

1.1.1. Top Soil

Encountered in BH02 to a depth of 0.3mbgl, the Topsoil was described as brown sandy silt with abundant rootlets.

1.1.2. Macadam & Made Ground

Macadam and/or Made Ground were identified within all exploratory holes except BH02 from a depth of 0.10mbgl to a depth of 1.65mbgl. The Made Ground soils were largely described as brown occasionally orangish brown mottled dark blackish brown, speckled red, silty sand gravelly clay with coarse brick, concrete, flint and clinker.

1.1.3. Bagshot Formation

The Bagshot formation was identified within all exploratory holes except SA02 from a depth of 0.3mbgl (BH02) to a maximum depth of 15mbgl (BH02). The Bagshot Formation was largely described as loose to medium dense orangish brown and brownish orange mottled clayey silty fine and medium SAND interbedded with thinly bedded sandy CLAY.

1.1.4. Claygate Member

The Claygate Member was identified within BH01 & BH02 from a depth of 14.5mbgl (BH01) to the maximum drill depth of 30mbgl (BH02). The Claygate Member was largely described as medium dense dark grey very silty fine SAND to firm to stiff grey silty sandy CLAY.

3.3. Hydrogeology

The following observations are taken from the British Geological Survey (BGS) Geology of Britain Viewer (2019). The Geology of Britain Viewer indicates that the site is directly underlain by Bedrock Geology of the Bagshot Formation, which in turn is expected to be overlaying the Claygate Member of the London Clay Formation; no Superficial are recorded. Owing to constraints presented by the presence of the existing building, shallow intrusive investigations have only been possible to-date (see appendices for interim summary). These align with BGS findings, with windowless samples confirming presence of gravelly sands (Hackney Gravels) to circa 4.0m depth.

The Environment Agency's online mapping suggests the underlying superficial soils are classified as a Minor Aquifer High in terms of groundwater vulnerability.

The bedrock is classified as unproductive typical for clays and the superficial gravels are classified as a secondary (A) aquifer, which are non-permeable layers capable of supporting water suppliers at a local or strategic scale and could in some cases form an important source of base flow to rivers.

The table below identifies the expected composition of the published strata and associated aquifer classification.

BEDROCK GEOLOGY	
Unit Name	Bagshot Formation
Geology Description	Composed of pale-yellow brown to pale grey or white, locally orange or crimson, fine- to coarse-grained sand that is frequently micaceous and locally clayey, with sparse glauconite and sparse seams of gravel
Aquifer Classification	Secondary A
Aquifer Description	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers
Unit Name	Claygate Member
Geology Description	Dark grey clays with sand laminae, passing up into thin alternations of clays, silts and fine-grained sand, with beds of bioturbated silt
Aquifer Classification	Secondary A
Aquifer Description	As above

3.4. Hydrology, Drainage and Flood Risk

The property is located on the London Clay Formation. London Clay is classified as ‘unproductive strata’.

The site is not located within proximity of any known surface water features.

With regard to historical watercourse, the lost River Westbourne passes close to the proximity of the site.

The site is not within the catchment of the Hampstead Heath Pond Chain, which is 1km to the West.

The site surface area is currently 100% permeable, being a paved surface on which the existing 1960s residential block resides. The existing site is assumed to be connected to the existing combined public sewerage network operated by Thames Water.

The site is classified as low risk and is within a Local Flood Risk Zone 1.

The site is not within a Critical Drainage Area.

3.5. Other Information

The investigation undertaken identified localised contamination of Made Ground pertaining to lead, TPH and PAH. This material has been highlighted as a potential source of contamination. A risk assessment has been produced to refine the preliminary risks; the pertinent points are discussed in the Ground Investigation Report (appendix 2).

There is no expected archaeological potential to be encountered at the site.

4. SCREENING

A screening process has been undertaken and the findings are described below.

4.1. Hydrogeology and Groundwater Flooding

QUESTION	RESPONSE	DETAILS
1a. Is the site located directly above an aquifer?	Yes	DEFRA Website, Secondary A Classification
1b. Will the proposed basement extend beneath the water table surface?	No	Groundwater Strikes occurred at 9.5-12mbgl. The basement is only 3.2m deep.
2. Is the site within 100mof a watercourse, well (used / disused) or potential spring line?	No	None shown on OS Map
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No	Site located on other side of hill to pond chains
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	No	Basement is underneath current building location
5. As part of site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS)?	No	Soakaways are not considered suitable for the site; therefore, no extra water will be discharged into the ground.
6. 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 (not just the pond chains on Hampstead Heath) or spring line?	No	Lowest Point of basement is over 1m above nearest pond level
a. Camden Geological, Hydrogeological, and Hydrological Study, Arup, 2010. (Fig. 8) b. Camden Geological, Hydrogeological, and Hydrological Study, Arup, 2010. (Fig. 11) c. Camden Geological, Hydrogeological, and Hydrological Study, Arup, 2010. (Fig. 14)		

Table 1 – Extract from Maund Geo-Consulting Hydrogeology and Land Stability Report

4.2. Slope Stability

QUESTION	RESPONSE	DETAILS
1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8)?	No	Site has been profiled from existing building.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8)?	No	Site is on existing profiled site.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8)?	Yes	Approximately 3 m drop between site and ground level adjacent apartments downhill.
4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8)?	Yes	OS map shows a slope of approximately 1 in 7
5. Is the London Clay the shallowest strata at the site?	No	Site Investigation revealed Bagshot Formation and Claygate Member to at least 30mbgl.
6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained?	No	New building is to be placed mostly on same area as old building.
7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site?	No	Bagshot formation comprises sand and moderately plastic clay.
8. Is the site within 100m of a watercourse or a potential spring line?	No	None shown on Ordnance Survey maps
9. Is the site within an area of previously worked ground?	Yes	Footprint of new building is mostly on footprint of old building.
10. Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	Yes	It is within an aquifer, but above the groundwater level. Dewatering should not be required.
11. Is the site within 50m of the Hampstead Heath Ponds?	No	OS Map shows over 600m away
12. Is the site within 5m of a highway or pedestrian right of way?	No	Highway is 15m away, no pedestrian right of way.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	No	Neighbouring properties are sufficiently far away as to not be affected by basement.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines?	No	Northern Line is over 200m to the East

Table 2 – Slope Stability

4.3. Surface Water and Flooding

QUESTION	RESPONSE	DETAILS
1. Is the site within the catchment of the ponds chains on Hampstead Heath?	No	Site is on the other side of the hill to the ponds
2. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route?	No	Proposed building is on same footprint as old building.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas?	No	Building footprint is located on old building footprint
4. 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	Basement does not extend into groundwater.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No	Basement does not extend into groundwater.
6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk from flooding, for example because the proposed basement is below the static water level of nearby surface water feature.	No	Site is located on a slope

Table 3

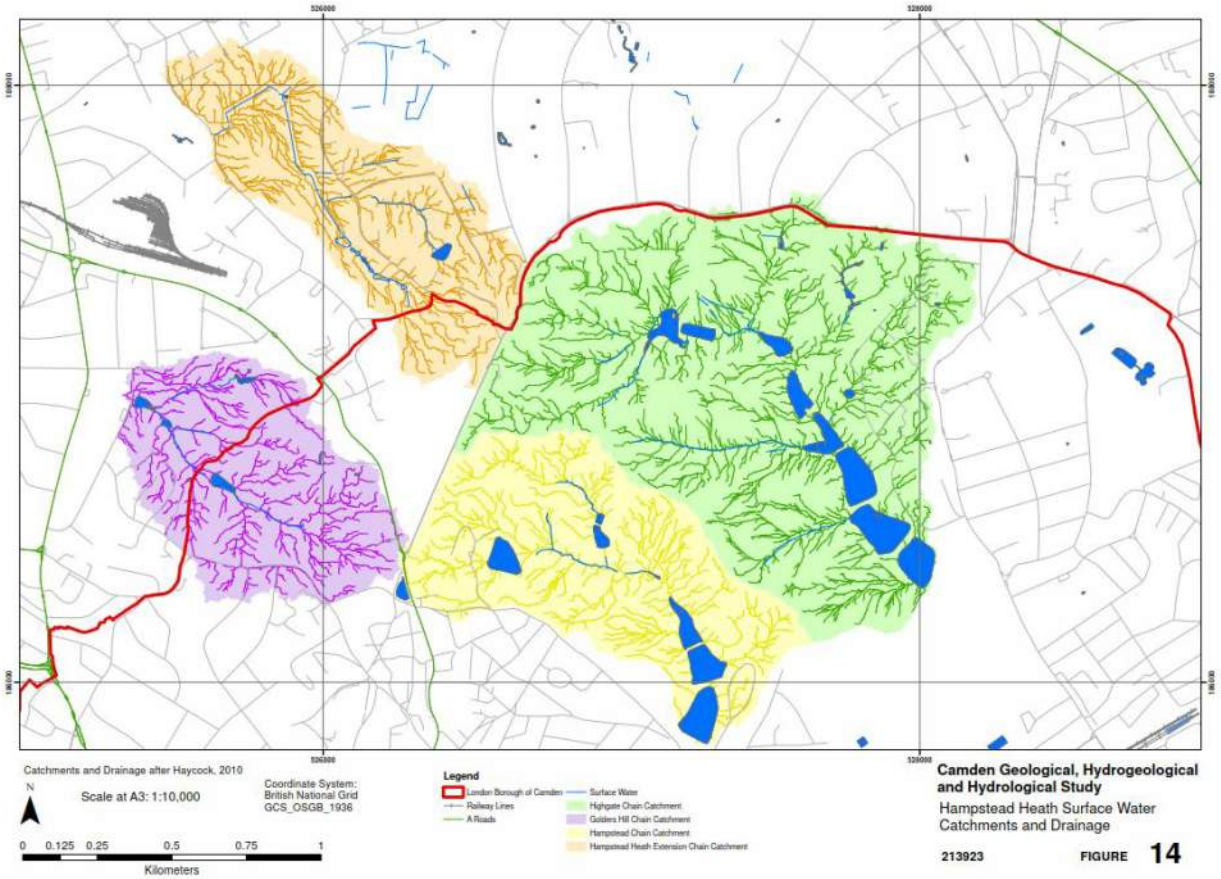


Figure 8 – Marked-up extract from the Camden Geological, Hydrogeological and Hydrological Study (Arup, 2010)

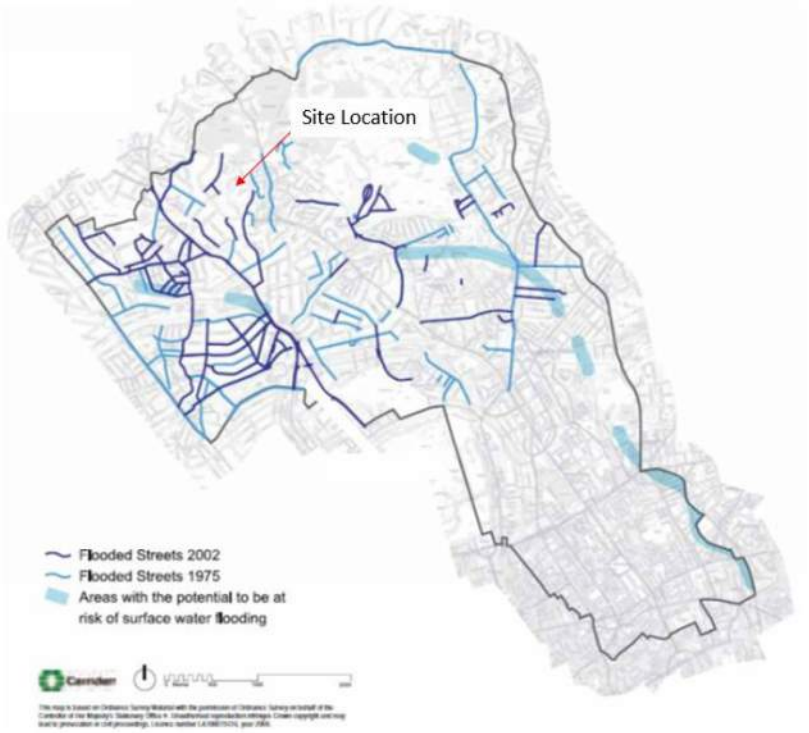


Figure 9 – Marked-Up extract from the Camden Geological, Hydrogeological and Hydrological Study (Arup, 2010)

4.4. Non-Technical Summary of Screening Process

The screening process identifies the following issues to be carried forward to scoping for further assessment:

- Site is located directly above an aquifer.
- The site lands on a slope that is greater than 1 in 7.
- Wider hillside is on a slope that is greater than 1 in 7.

The other potential concerns considered within the screening process have been demonstrated to be not applicable or not significant when applied to the proposed development.

5. SCOPING

The following issues have been brought forward from the Screening process for further assessment:

5.1. Aquifers

5.1.1. Site is located directly above an aquifer

5.1.2. With reference to DEFRA website, the site area is indicated to be above an aquifer. The depth at which groundwater is encountered is over 100mbgl, whereas the basement will not exceed 3.5m in depth.

5.1.3. No further assessment is considered necessary. There will be no impacts to groundwater.

5.2. Site on a slope greater than 1 in 7

5.2.1. The site lands on a slope that is greater than 1 in 7.

5.2.2. Whilst the entire site is on top of a slope that is greater than 1 in 7, the footprint of the building is relatively flat.

5.2.3. No further assessment is considered necessary.

5.3. Wider hillside on a slope greater than 1 in 7

5.3.1. The wider hillside is on a slope that is greater than 1 in 7.

5.3.2. Whilst the wider hillside is on a slope that is greater than 1 in 7, the local area has been profiled to less than a 1 in 7 slope.

5.3.3. No further assessment is considered necessary.

6. SITE INVESTIGATION / ADDITIONAL ASSESSMENTS

6.1. Site Investigation

The Branch Hill House BIA site investigation comprises several stages including:

- Desk study, including intrusive investigation
- Field investigation, including intrusive investigation
- Monitoring
- Reporting
- Interpretation

The desk study stage has comprised the review and analysis of existing literature pertaining to the site (historical maps, satellite imagery etc) along with sources of information relating to the subterranean construction.

The field investigation stage has consisted of intrusive investigations within the boundary of the site. This stage has comprised a building condition survey of the existing Branch Hill Manor house, and a ground investigation report.

With the data from the ground investigation report, assessment can be made as to the potential impacts identified through the scoping exercise.

6.2. Additional Assessments

Flood Risk Assessment

Given the desired development has a basement, planning policy dictates that a Flood Risk Assessment (FRA) be undertaken. The Branch Hill House site is situated within Flood Zone 1 indicating a low probability of flooding each year – 0.1% (or 1 in 1000 year). The complete FRA report completed by Ridge can be found in appendix 6. The flood risk to site is summarised below:

- The risk of fluvial flooding is considered to be **very low**;
- The risk of tidal flooding is considered to be **very low**;
- The risk of pluvial (surface water) flooding is considered to be **very low**;
- The risk of sewer flooding is considered to be **moderate**;
- The risk of groundwater flooding is considered to be **low**;

From the FRA, the following conclusions and recommendations are made with regard to flooding:

- The site is appropriate for the intended use from a flood risk perspective.
- To mitigate, as much as reasonably practicable, the risk of sewer flooding, the proposed discharge from the site will be less than that of the existing. A 50% betterment of surface water will be achieved, reducing the discharge into the existing combined sewer network.
- The low risk of surface water flooding can be incorporated into the surface water drainage design to mitigate the risk.
- For any adverse impacts on flood risk to the surrounding area, mitigation measures to address the increase in surface water runoff from the development will be included within the drainage design.

7. CONSTRUCTION METHODOLOGY / ENGINEERING STATEMENTS

7.1. Outline Geotechnical Design Parameters

Reasonably conservative geotechnical parameters have been determined, based on the site investigation data presented in Appendix 2 – Site Investigation Data. A summary table of the key Characteristic Geotechnical Parameters is provided below, Table 4.

Stratum	Parameter		Source	Value
Made Ground/ Topsoil	Not used in foundation design			
Bagshot Formation (Clay)	Unit Weight (kN/m³)		Triaxial Testing	19kN/m³
	Undrained Shear Strength	c_u (kN/m²)	BS:8002	75kN/m²
Bagshot Formation (Sand)	Unit Weight (kN/m³)		Triaxial Testing	19kN/m³
	Angle of Shear Resistance	°	Triaxial Testing	37°
Claygate Member (Clay)	Unit Weight (kN/m³)		Triaxial Testing	18.1kN/m³
	Undrained Shear Strength	c_u (kN/m²)	BS:8002	110kN/m²
Claygate Member (Sand)	Unit Weight (kN/m³)		Triaxial	19.6kN/m³
	Angle of Shear Resistance	°	Triaxial Testing	34°

Table 4 – Characteristic Geotechnical Parameters.

7.2. Outline Temporary and Permanent Works Proposals

The works proposals include the construction of a single storey basement.

The most suitable construction method for forming the basement structure is **Bottom-up construction**. In this approach, the soil within the enclosed pile sidewall is gradually excavated, and, as the excavation deepens, temporary support to the sidewalls using props and struts will be installed. Once the excavation has reached the depth of the basement base, the basement floor slab is cast in place and connected to the piled wall with stainless steel dowels. Once cured, this slab immediately starts to help support the sidewalls, and the slab augments the props. Being a single storey basement, the ground floor slab is subsequently cast, and any remaining props are removed.

With this construction method, the wall is designed for the worst-case excavation and propping (temporary/construction stage). Specifically, the wall embedment is designed to facilitate the fully excavated basement with a single prop resisting the top of the wall.

The following sequence provides an approach which will allow the basement design to be correctly considered during construction, and the temporary support to be provided during the works. The Main Contractor once appointed will be responsible for the works on site and the final temporary works methodology and design.

The approach followed in this design is:

- Demolish the existing 1960s extension.
- Grub out and remove existing footings or break down existing piles if present to below the level of the proposed new basement slab.
- Install piling mat.
- Place a contiguous piled wall around the perimeter of the new basement.
- Construct a concrete capping beam to tie the heads of the individual piles together.
- Internal bearing piles for the superstructure frame to be also piled from the existing ground level at the same time. Concrete mix for the top of the bearing piles within the depth of the basement to be changed

to a pea shingle mix to allow the piles to be easily broken down during the bulk dig to the required cut off levels for the basement.

- Install underpinning pits to gable wall to Branch Hill House. The underpinning will be carried out in accordance with normal industry practice, with the pin width limited to 1000mm length and limited number of pins excavated at any given time to ensure ground stability is maintained. Prior to underpinning starting temporary shoring will be installed to laterally restrain the existing gable wall above ground. Due to the height of the basement the underpinning will need to be installed in phases. At least 3 phases are assumed which will be confirmed with the Contractor.
- Excavate soil within the piled perimeter, installing temporary propping to restrain the capping beams to the perimeter piled retaining walls and the underpinning pits.
- Construct reinforced concrete inner walls around the building perimeter, within the contiguous piled wall.
- Continue with the construction of the basement structure. Construct the basement slab connected to the contiguous piles with stainless steel dowels.
- Waterproof the internal space with two types of waterproofing to comply with NHBC Chapter 5.4 for habitable spaces. Expected to include specialist waterproof membrane with a drained cavity wall.
- Construction of the ground floor slab which will be tied to the concrete capping beam at the head of the piles to provide a permanent restraint to the piles.
- Temporary props can then be removed once the ground floor is cast.
- Proceed with the construction of the above ground superstructure reinforced concrete flat slab frame.

7.3. Ground Movement and Damage Impact Assessment

A Ground Movement Assessment (GMA) has been carried out in accordance with CIRIA C760 (C760, 2017). and considers the construction methodology and site-specific ground and groundwater conditions, see appendix 2 – site investigation data.

All structures / properties within the zone of influence have been assessed. This includes the original Branch Hill Manor House.

The following reasonably conservative assumptions have been made within the GMA:

1. A zone of influence equal to 2 times the wall piled wall depth.
2. An excavation depth of 4m (basement depth + basement slab + over dig).
3. Ground movements arise from wall installation and excavation in front of the wall.
4. Ground movements behind the wall have a horizontal and vertical component.
5. The wall type is a CFA piled wall.

The horizontal ground movements resulting from the works are:

- Installation stage = **3.8mm**
- Excavation stage = **6mm** (contour plots, sections, justification and/or calculations to be presented).

The vertical ground movements resulting from the works are:

- Installation stage = **3.8mm**
- Excavation stage = **3.1mm** (contour plots, sections, justification and/or calculations to be presented).

As the only structure within the zone of influence, the Branch Hill Manor house has been assessed. The house resides immediately adjacent to the CFA pile wall, and at approximately 23m width, much of the house is vulnerable to ground movement as a result of the basement construction.

In accordance with the Burland Scale, the damage impacts are assessed as negligible, with only hairline cracks less than 0.1mm expected; full calculations are presented in Ground Movement Assessment (see appendix 4)

Although the ground movement is expected to render negligible damage, the building-end party wall dividing the existing manor house from the basement will be monitored as the building survey revealed this structure as in need of attention/repair.

7.4. Control of Construction Works

The construction works will be closely controlled in accordance with the Construction, Design & Management Regulations (CDM) 2015 to ensure safe construction methods are adopted.

The demolition of the existing 1960s building and site excavations and substructure works for the new works up to finished ground slab stage have the potential to cause vibration and ground movements due to the following:

i. Ground heave from removal of weight of existing building,
ii. Possible risk of accidental uncontrolled collapse of large sections of the existing 1960s building during demolition,
iii. Removal of any existing redundant foundations/obstructions,
iv. Installation of deep underpinning to existing gable party wall to Branch Hill House,
v. Installation of piles for foundations and perimeter basement walls,
vi. Excavation of basement,

Prior to the substructure works proceeding precise level monitoring points should be installed on the face of the existing Branch Hill House at key locations. For the party gable wall immediately adjacent to the new construction at least 4 monitoring points will be provided located at the mid points of the head, base and side edges of the wall. The monitoring points will comprise retro targets which will allow vertical and horizontal movements of the House to be measured

.

The survey control used for monitoring any movements of the House will comprise a series of Primary Control Monitoring Stations established in locations outside the area of potential influence. These points would be used as a stable base from which to monitor movement of the House.

Prior to the works starting at least 3 sets of base survey readings at weekly intervals will be undertaken and the mean of the 3 readings used for the basis of further comparisms.

During the demolition stage readings should be taken on a weekly basis. During the substructure works for the underpinning, piling, excavation for the basement and construction of the basement up to construction of the ground floor monitoring should be undertaken daily. If readings are consistent, the monitoring regime for the subsequent construction works could be relaxed to less frequent intervals such as weekly.

The survey observations will be carried out by a specialist independent surveyor using Precise Leica Surveying equipment or similar capable of attaining very accurate readings.
An emergency preparedness plan will be prepared by the person undertaking the monitoring. Trigger levels for movement of the house will be established. A traffic light warning system (Green, Amber, Red) will be put in place with procedures to follow if the Amber and Red trigger levels are met.

8. BASEMENT IMPACT ASSESSMENT

8.1. Introduction

- A ground investigation that included 3 boreholes was undertaken by Ridge & Partners Ltd in July 2019. The Report and borehole logs are available in appendix 2.

The site geology as found by the ground investigation may be summarized as:

Topsoil: to 0.3metres
Made Ground: silty, sandy gravelly clay with coarse brick, concrete, flint and clinker to 1.6metres
Bagshot formation: clayey, silty fine and medium sand interbedded with thinly bedded sandy clay to 15 metres
Claygate member: medium dense very silty fine sand or firm to stiff silty sandy clay to 30 metres

- The monitored groundwater level is approximately 10 metres below ground level.
- The site is generally flat across the grounds and then steeply slopes down to lower levels along the west and south boundaries of the site.
- The existing building is founded approximately 1.35 metres below ground level. The level at the underside of the footing is approximately +118.35.
- The proposed development will be founded at +116.25 approximately 3.5 metres below ground level.
- The distance to the Spedan Close estate road located within the Branch Hill House grounds is circa 6 metres. The distance to the nearest public highway/footpath; Branch Hill, is circa 45 metres. The site is therefore not within 5 metres of a public highway.
- A utilities search was carried out by Milieu Consult to determine whether any tunnels or services ran through or near to the site. The Edgeware branch of the Northern Line is the only major feature passing close to the site. Data from TFL's Property Asset Register shows the tunnels are 140 metres away from the Branch Hill site, which is beyond the defined LUL Zone of Influence.
- There are trees close by along the south boundary to the new construction which have tree protection orders. The closest tree is circa 8 metres away from the outline of the proposed basement.
- Potential impacts are damage to the existing Branch Hill House and trees with tree protection orders due to ground movements.
- Proposed mitigation is provided temporary propping and control measures to limit ground movements.
- Residual impacts are none expected.

8.2. Land Stability / Slope Stability

The site investigation has identified a suitable founding stratum of Claygate member soils located at depths exceeding 15 metres below existing ground level. The clay has been found to be of high shrinkage potential. The foundation design will take this shrinkability into account.

A Ground Movement Assessment has concluded that ground movements caused by the excavation and construction of the proposed development will be negligible. The Damage Impact to surrounding structures within the zone of influence has been assessed as Category 0 in accordance with the Burland Scale.

The BIA has concluded that there will not be risk(s) or stability impact(s) to the development and/or adjacent sites due to slopes.

8.3. Hydrogeology and Groundwater Flooding

The BIA has concluded there is a low risk of groundwater flooding.

The BIA has concluded there are no impacts to the wider hydrogeological environment.

8.4. Hydrology, Surface Water Flooding and Sewer Flooding

The BIA has concluded there is a low risk of surface water flooding and a medium risk of sewer flooding. To mitigate, as much as reasonably practicable, the risk of sewer flooding, the proposed discharge from the site will be less than that of the existing. A 50% betterment of surface water will be achieved, reducing the discharge into the existing combined sewer network.

The BIA has concluded there are no impacts to the wider hydrological environment.

9. REFERENCES

Arup. (2010). Camden Geological, Hydrogeological and Hydrological Study .

C760, C. (2017). Guidance on embedded retaining wall design.

Milieu Consult. (2019). Branch Hill House, Hampstead: Utilities Assessment for Planning.

APPENDIX 1
DESK STUDY REFERENCES

APPENDIX 2
SITE INVESTIGATION DATA

RIDGE

GROUND INVESTIGATION REPORT
BRANCH HILL HOUSE

ALMAX GROUP LIMITED

July 2019

GROUND INVESTIGATION REPORT
BRANCH HILL HOUSE

July 2019

Prepared for

Almax Group Limited
4 Old Park Lane
London
W1K 1QW

Prepared by

Ridge and Partners LLP
Partnership House
Moorside Road
Winchester
Hampshire
SO23 7RX

Tel: 01962 834400

Contact

Ryan Gunn
Geo-Environmental Engineer
rgunn@ridge.co.uk
07824 491350

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CONTENTS

1. INTRODUCTION

1.1. Brief

Ridge and Partners LLP (Ridge) were commissioned by Almax Group Ltd to undertake a Ground Investigation at Branch Hill House, Hampstead Heath, London, NW3 7LS (hereafter referred to as "the site") and to prepare a report on the findings. A site location plan is included as Figure 1.

The brief was to undertake a Ground Investigation to support the assessment of ground and structural conditions on site, in light of the proposals.

This report provides an assessment of ground conditions encountered, laboratory testing results and basic recommendations. A full contaminated land Risk Assessment and Conceptual Site Model falls outside the scope of this report. However, a basic contamination screen has been undertaken to provide supplementary information.

The report is prepared in line with the agreed brief and is subject to report conditions shown in Appendix 1.

1.2. Proposals

Current proposals include the construction of a new building comprising a single storey basement with 3 to 5 storeys of residential units above. The existing 4-story building is understood to remain as part of the final proposals. Site Plans are included as Figure 2.

1.3. Report Scope and Limitation

This report is based upon a review of readily available information and the site investigation data detailed herein. The report presents an interpretation of the Ridge Site Investigation undertaken on 8-15th & 25th April 2019. In addition, this report outlines the basic ground conditions encountered in the exploratory holes and the results of laboratory testing. This information has been collated, processed and used to provide an interpretation of the ground conditions.

The recommendations and opinions expressed in this report are based on the strata observed in the exploratory holes, the results of the site and laboratory tests, and information obtained as part of the desk study or provided by others. Ridge takes no responsibility for conditions that have not been revealed by the exploratory holes, or which occur between them or for features which may be more widespread to those found.

Whilst efforts have been made to interpret the conditions between investigation locations, such information is only indicative and liability cannot be accepted for its accuracy. Information provided from other sources is taken in good faith and Ridge cannot guarantee its accuracy.

The information contained in this report is intended for the use of **Almax Group Limited** and Ridge can take no responsibility for the use of this information by any other party or for uses other than that described in this report.

2. SITE SETTING

2.1. Site Location and Description

The site is located within the London Borough of Camden on an approximate grid reference TQ 260 860. It is situated at approximately 120m AOD (Above Ordnance Datum).

The site comprises a 3- to 4-storey brick-built building, which used to be a former care home. The building is now mostly unoccupied with guardian supervision. An extension to the aforementioned structure is located beside the southern elevation. According to available historical maps this extension was built circa 1960-1970s. Similarly, this building is no longer actively used, instead being occupied by guardians.

Access to site is via either Branch Hill Road or Frognal Rise, which both lead to Spedan Close. This close loops around the site and is laid to hardstanding, predominantly macadam.

The surrounds are predominantly residential. Branch Hill Estate is located immediately to the west of the study site.

3. PHYSICAL SETTING

3.1. Geology and Hydrogeology

The following observations are taken from the British Geological Survey (BGS) Geology of Britain Viewer (2019). The Geology of Britain Viewer indicates that the site is directly underlain by Bedrock Geology of the Bagshot Formation, which in turn is expected to be overlying the Claygate Member of the London Clay Formation; no Superficial are recorded. The table below identifies the expected composition of the published strata and associated aquifer classification.

BEDROCK GEOLOGY	
Unit Name	Bagshot Formation
Geology Description	Composed of pale-yellow brown to pale grey or white, locally orange or crimson, fine- to coarse-grained sand that is frequently micaceous and locally clayey, with sparse glauconite and sparse seams of gravel
Aquifer Classification	Secondary A
Aquifer Description	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers
Unit Name	Claygate Member
Geology Description	Dark grey clays with sand laminae, passing up into thin alternations of clays, silts and fine-grained sand, with beds of bioturbated silt
Aquifer Classification	Secondary A
Aquifer Description	As above

Table 3.1: Geology and Hydrogeology

3.1.1. Published Borehole Records

To provide some indication as to the underlying soils four available published borehole records have been reviewed. The four borehole records are located in, or within a 20.00m radius of site, and are as follows: TQ28NE101, TQ28NE102, TQ28NE103 and TQ28NE104.

In summary these boreholes recorded superficial deposits (i.e. Topsoil, Made Ground etc.) over brown sandy clay to depths ranging approximately 3.00m to 10.0mbgl (meters below ground level). This is considered to be the Bagshot Formation. This material was generally found to be overlying a grey and blue sandy silty clay and silt at depths ranging 10.00 to 18.00mbgl, presumably the Claygate Member. A firm blue clay with layers of sand was identified at a depth in the order of 20.00mbgl, which is presumably the London Clay Formation.

Groundwater is not recorded within any of the borehole records, although a grey silt (liquid) is detailed at a depth of approximately 15.00mbgl, within the Claygate Member, in one of the borehole records TQ28NE104.

4. PREVIOUS REPORT

A previous Geo-Environmental Assessment has been completed at the study site by Idom Merebrook Ltd (Report reference: GEA-17905-D-16-363, dated: September 2016) and made available to Ridge for review. It is recommended that this document is read in conjunction with this report. This report has been summarised below:

4.1. Scope

Idom Merebrook Limited (Merebrook) were commissioned to provide a site investigation at the site to advise on any geo-environmental issues which may affect the sale and subsequent residential redevelopment on site. Furthermore, basic preliminary geotechnical recommendations were made. The report refers to a previously issues Phase 1 Desktop Site Appraisal (Reference: DS-MER00590-13-73) completed by Merebrook in April 2013.

4.2. Desktop Appraisal

The Desktop Appraisal (DS-MER00590-13-73) outlined the previous usage, environmental setting and likely associated contaminative status of the study site.

According to historical maps the site has been residential since circa 1860s, comprising a residential structure (labelled 'Branch Hill Lodge') with private gardens. An extension to this building was built around the late 1960s and early 1970s and was relabelled Branch Hill House.

The overall contaminative status, as identified within the Desktop Appraisal (DS-MER00590-13-73), was recognised as Low to Negligible for all highlighted pollutant pathways; this included current and future residential uses and controlled waters those from.

4.3. Fieldwork

The Merebrook intrusive location was undertaken on 15th August 2016 and comprised seven windowless sample boreholes to depths of 5.00mbgl (metre below ground level) and one hand excavated trial pit. Standard Penetration Tests were completed at regular intervals within the boreholes. Three of the boreholes were installed with dual-purpose gas and groundwater monitoring wells.

4.4. Fieldwork

The following ground conditions were encountered during the aforementioned fieldworks. Made Ground described as dark brown sandy clay with flint, concrete and brick within landscaped areas, and gravelly sand with concrete and brick in areas of hardstanding. This material was identified from ground level to a maximum depth of 1.10mbgl.

The initial natural material was identified as the Bagshot Formation at ground level to a maximum depth of 5.00mbgl. This was described as a predominantly orangish brown sandy clay.

Groundwater was not encountered during the Merebrook investigation. No visual and olfactory evidence of contamination was noted other than the Made Ground.

4.5. Geotechnical Recommendations

The following recommendations were made based on vague proposals for residential redevelopment at the site; these do not account for the recent drawings and should be treated so. It is recommended the reader refer to Section 8 for further information regarding foundations.

4.5.1. Foundations

It was recommended that for proposed structures of medium to high-rise construction that a piled foundation solution is considered.

4.5.2. Excavations

Based on the encountered ground conditions, excavations should be supported by shoring or battered back to a safe angle in order to avoid collapsing.

4.5.3. Buried Concrete

A Design Sulphate Class of DS-2, with an Aggressive Chemical Environmental for Concrete (ACEC) class of AC-3z was recommended for buried concrete.

4.6. Environmental Assessment

4.6.1. Soil

A screening exercise of common contaminants was undertaken on nine soil samples. Please refer to the aforementioned report for a detailed description of the contaminant suite. Results were compared against respective screening criteria using a conservative 'Residential with home-grown produce' land-use setting.

Elevated concentrations of lead, TPH (Total Petroleum Hydrocarbons) and PAHs (Poly-cyclic Aromatic Hydrocarbons) were identified within Made Ground soils. Results from the tested natural material returned no exceedances of the respective screening criteria.

4.6.2. Ground Gas

Whilst a low risk was identified associated with ground gas the works involved one round of gas monitoring in order to target the potential for ground gas migration from nearby infilled ground.

Ground gas monitoring was undertaken on one occasion on 18th August 2016 at a barometric pressure in the order of 995mb. Maximum methane (CH_4) and carbon dioxide (CO_2) concentrations of 0% and 4.7%, respectively, were recorded. No flow was recorded.

4.7. Risk Assessment

The Merebrook investigations identified localised contamination of Made Ground pertaining to lead, TPH and PAH. This material was highlighted as a potential source of contamination. A risk assessment was produced to refine the preliminary risks as outlined within the Desktop Appraisal; the pertinent points are discussed below.

A low to moderate risk was identified to human health (future residential end users) from contact, ingestion and inhalation of contaminated soils associated with the elevated heavy metals and hydrocarbons within the Made Ground.

The risk to controlled waters were considered low. The risk from soil vapour is considered low. A Gas Screening Value of 0.0047 l/hr was identified indicating a Characteristic Situation 1. Further ground gas monitoring was recommended to refine this.

4.8. Remediation

Remediation has been recommended to mitigate the identified risks as outlined within the refined risk assessment. In summary, a capping layer and dig-and-dump exercise were suggested. The reader should refer to the aforementioned document for further details regarding remediation on site.

5. FIELDWORK SUMMARY OF SCOPE AND RATIONALE

5.1. Site Management and Preparation

Suitably experienced Ridge staff oversaw the intrusive investigation, which was undertaken during two separate phases, 8-15th and 25th April 2019. Methods employed during the investigation were carried out in general accordance with statutory guidance including BS5930:1999 *Code of Practice for Site Investigations (Amendment 3: 2015)*, BS10175:2011+A1:2013 *Investigation of Potentially Contaminated Sites: Code of Practice* and BRE Digest 365 *Soakaway Design*.

5.1.1. Utility Clearance

Each test location was scanned with a Cable Avoidance Tool (CAT) prior to breaking ground, and accessible manhole covers lifted to assess the location and direction of drainage runs. Furthermore, each borehole was subject to a hand dug buried service inspection pit prior to drilling

5.2. Rationale and Summary of Scope

The Site Investigation scope was devised by Ridge and agreed by the Client. The scope of works was to include advancing intrusive locations to assist with the geotechnical design. This was to be achieved with the completion of boreholes to assess the nature of the underlying soils and groundwater conditions, the completion of soakage testing to inform soakaway design, along with specified in-situ testing and sample collection. A site investigation plan is appended to Figure 3

5.2.1. Cable Percussive Boreholes

Three cable percussive boreholes (BH01-BH03) were advanced to a maximum depth of 30mbgl using a traditional shell and auger (cable percussive) rig. The boreholes were positioned across external areas with enough space to erect the derrick. Standard Penetration Tests (SPTs) were completed throughout drilling, varying between U100 sampling/testing within the cohesive material. Testing was undertaken at 1.00m centres to a depth of 5.00m, and thereafter increasing to >1.50m intervals.

5.2.2. Soakage Tests

Two trial pits SA01-SA02) were advanced using a tracked excavator, where access allowed to enable infiltration/ soakage testing. The pits were advanced to depths in the order of 2mbgl. Soil infiltration testing was undertaken in general accordance with BRE Digest 365. Testing involved the squaring of the excavation sides and subsequent rapid filling of each pit with potable water. The fall in water level was monitored over a nominal period, with the aim to reach 75% and 25% effective depth/ water column. Upon completion both pits were backfilled in reverse order with arisings and reinstated in respect of existing conditions.

5.2.3. Foundation Pits

Advanced with hand digging tools, these pits allowed the assessment of existing foundations on site. Three pits were excavated (TP1-3) at the south-western corner of the existing brick-built structure (former care home). The findings are detailed in Appendix 2.

5.3. Soil Sampling

All intrusive locations were logged, and visual/olfactory evidence of contamination noted in accordance with best practice. Selected samples were placed in sealable bags, sealed glass jars or plastic tubs (dependent on

the exact laboratory requirement and analysis to be undertaken) and stored in a temperature-controlled environment before transit. Environmental samples were handled using a fresh pair of nitrile gloves.

6. GROUND CONDITIONS ENCOUNTERED

6.1. Soil Conditions

The following soil conditions were encountered during the investigation works. Please refer to the Borehole Logs included within Appendix 2 for a more detailed description. The layout of the exploratory positions is presented in Figure 3.

6.1.1. Topsoil

Encountered in BH02 to a depth of 0.3mbgl, the Topsoil was described as brown sandy silt with abundant rootlets.

6.1.2. Macadam & Made Ground

Macadam and/or Made Ground were identified within all exploratory holes except BH02 from a depth of 0.10mbgl to a depth of 1.65mbgl. The Made Ground soils were largely described as brown occasionally orangish brown mottled dark blackish brown, speckled red, silty sandy gravelly clay with coarse brick, concrete, flint and clinker.

6.1.3. Bagshot Formation

The Bagshot Formation was identified within all exploratory holes except SA02 from a depth of 0.3mbgl (BH02) to a maximum depth of 15mbgl (BH02). The Bagshot Formation was largely described as loose to medium dense orangish brown and brownish orange mottled clayey silty fine and medium SAND interbedded with thinly bedded sandy CLAY.

6.1.4. Claygate Member

The Claygate Member was identified within BH01 & BH02 from a depth of 14.5mbgl (BH01) to the maximum drill depth of 30mbgl (BH02). The Claygate Member was largely described as medium dense dark grey very silty fine SAND or firm to stiff grey silty sandy CLAY.

6.2. In Situ Testing

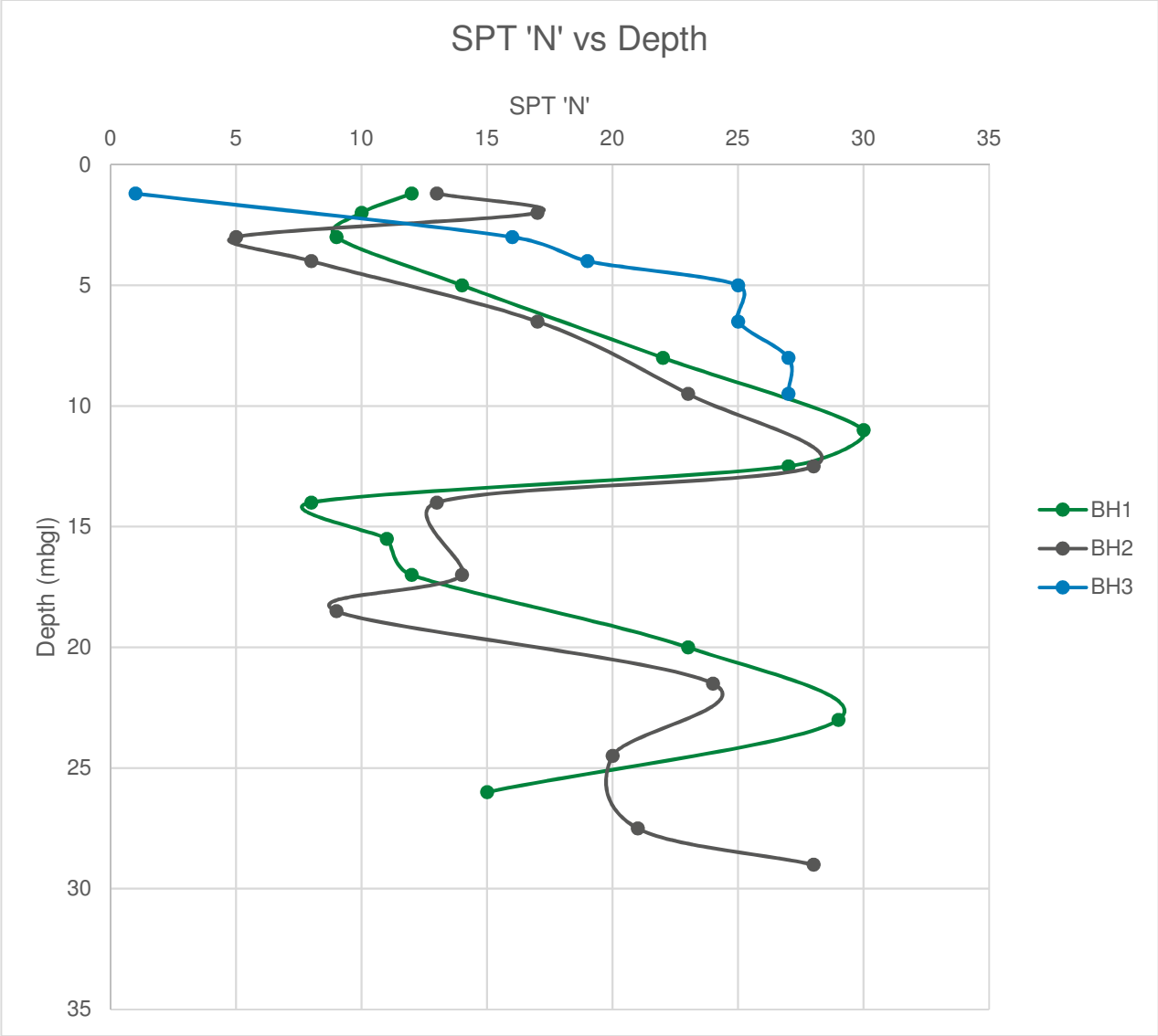
6.2.1. Standard Penetration Testing (SPT)

SPT were carried out throughout the boreholes and windowless boreholes and gave SPT 'N' values of between 5 and 30 in the Bagshot Formation & 9 and 29 in the Claygate Member.

The distribution of SPT N-values is shown in Table 6.1 and Graph 6.1. Engineering logs are showing the full test results are included in Appendix 2.

BH No.	Depth (mbgl)	Strata	SPT 'N' Value	Main Constituent
BH01	1.2	Bagshot Formation	12	CLAY
	2.0		10	
	3.0		9	
	5.0		14	
	8.0		22	
	11.0		30	SAND
	12.5		27	
	14.0		8	CLAY
	15.5	Claygate Member	11	SAND
	17.0		12	
	20.0		23	CLAY
	23.0		29	SAND
	26.0		15	CLAY
BH02	1.2	Bagshot Formation	13	SAND
	2.0		17	
	3.0		5	
	4.0		8	
	6.5		17	
	9.5		23	
	12.5		28	
	14.0		13	
	17.0	Claygate Member	14	
	18.5		9	
	21.5		24	CLAY
	24.5		20	
	27.5		21	SAND
	29		28	
BH03	1.2	Bagshot Formation	15	CLAY
	3.0		16	
	4.0	Claygate Member	19	SAND
	5.0		25	
	6.5		25	
	8.0		27	
	9.5		27	

Table 6.1: SPT 'N' Value Distribution



Graph 6.1: SPT 'N' Value Distribution

6.3. Groundwater Conditions

Groundwater was discovered at the following locations:

BH No.	Depth of Strike (mbgl)	Rose to (mbgl)
BH01	15.00 & 24.50	14.00 & 23.00
BH02	12.90 & 26.10	12.00 & 23.45
BH03	10.00	9.50

Table 6.2: Groundwater Locations and Strikes

6.4. Visual/ Olfactory Evidence of Contamination

Other than anthropogenic materials noted within the Made Ground soils, there was no other visual/olfactory evidence of contamination.

7. CONTAMINANT ASSESSMENT

7.1. General

Ridge have undertaken a screen of common contaminants for the purposes of due diligence, and to help assess the potential risk from exposure to the Made Ground soils on site to groundworkers. Furthermore, the results from the laboratory testing have been used to assess any hazardous properties of the Made Ground soil on site.

Soil laboratory results will be compared to generic assessment criteria. Generic assessment criteria (GAC) are conservative contaminant concentration values used for comparison purposes to assess the risk associated with contaminant concentrations found on site and are derived using non-site-specific information.

In order to assess the soil results with regard to potential human health risks, Ridge has adopted published guidance criteria widely referred to by professionals within the industry, which include the following:

- Suitable 4 Use Levels (S4ULs) Generic Assessment Criteria (GAC) developed by the Chartered Institute of Environmental Health (CIEH) in partnership with Land Quality Management Ltd. (LQM);
- Category 4 Screening Levels (C4SL) for lead, produced by CL:AIRE (2014); and
- The UK Soil Guideline Values (SGVs) for selected metals, BTEX and phenols, produced by the EA and Department of Environment, Food and Rural Affairs (2009).

For reference purposes, comparisons have been made against the 'Residential with homegrown produce' land use setting. Results were compared to the conservative 1% soil organic matter value unless otherwise stated.

7.2. Soil Assessment

Four soil samples collected during the investigation exclusive to Made Ground soils at depths of 0.30m and 0.50mbgl were submitted to a UKAS accredited laboratory for analysis for a generic contamination suite. The suite comprised of heavy metals, phenols, speciated polyaromatic hydrocarbons (PAHs), fractionated total petroleum hydrocarbons (TPH) BTEX and MTBE compounds, as well as an asbestos screen. Samples were chosen from shallow (<1.00m) Made Ground soils; the most likely soils to be encountered by groundworkers during proposed works and probable worst-case conditions. Laboratory analysis certificates are included as Appendix 4 .

7.2.1. Discussion of Results

There were two exceedances of the C4SL for lead exclusive to TP2 at 0.50m and TP3 at 0.30mbgl. Concentrations of lead were recorded ranging 506-557mg/kg, exceeding the screening value of 200mg/kg. It should be noted that these values also exceed the less stringent GAC - 'Residential without homegrown produce'. Whilst there were no other exceedances, levels of PAH and TPH determinands were recorded as elevated within sample SA2 at 0.50m. Asbestos was not detected within any of the of the tested soil samples.

The findings of this recent investigation are similar to those outlined by Merebrook in that concentrations of lead exceeded the GAC. Whilst there were no PAH and TPH exceedances, these determinands were recorded as elevated within one sample. Furthermore, these contaminants are often found elevated within Made Ground soils.

Therefore, it is considered that this contaminant screen is reflected by the findings of the previous report, and the relevant conclusions drawn. Consequently, it is deemed unnecessary at this stage to update the specific remediation recommendations within the Geo-Environmental Assessment document (Report reference: GEA-17905-D-16-363).

7.3. Waste Material

Results from one of the tested soil samples (SA2 at 0.50m) was input into a Soils Characterisation Assessment Tool (CAT-Waste Soil) to identify whether soils on site have hazardous properties. The sample was obtained from shallow (<1.00m) Made Ground soils with abundant anthropogenic materials. Therefore, probable worst-case scenario should there be a requirement to remove soils during future groundworks. The sample returned **Non-Hazardous properties**. The CAT-Waste Soil output sheet is included as Appendix 5.

The second part of the assessment process is a review of Waste Acceptance Classification (WAC) testing, which was also carried out on the soil sample above. The results indicate that the sample obtained from these Made Ground soils is **Inert**.

Test certificates should be supplied to hauliers and landfill operators to confirm this classification, should there be the requirement to remove shallow soils during any future groundworks.

7.4. Ground Gas Assessment

7.4.1. Design of Monitoring Programme

In accordance with the recommendations made by Merebrook (Report reference: GEA-17905-D-16-363), and in line with BS8576:2013 *Guidance on investigations for ground gas – permanent gases and volatile organic compounds*, it was deemed necessary to undertake additional ground gas monitoring to refine the ground gas potential on site. The extent of monitoring deemed necessary to assess the ground gas and vapour regime is determined by the generation potential of the source, i.e. what is the risk that large volumes of gas can be generated and can plausibly migrate to pose a credible hazard to the identified receptors. This is known as a multiple-lines-of-evidence approach.

Factors detailed in the table below were pertinent in the design of the gas monitoring programme. Information detailed in the table has either been taken from the previous reports and/or interpreted from the intrusive investigation conducted.

Factor	More Monitoring Required	Less Monitoring Required
Landfills and Waste Facilities	-	There are no current or historical records within 500m
Made Ground Organic Content	-	Following laboratory analysis of samples collected during the Ridge Investigation, Total Organic Carbon (TOC) was reported below 7%
Natural Soils Organic Content	-	There was no evidence of degradable organic material in logged soils.
Volatiles	-	Whilst slightly elevated, levels of hydrocarbon specific determinands were relatively low-

Table 7.8: Factors influencing Design of Gas Monitoring Program

7.4.2. Generation Potential of Source

Based on the information within Table 7.8 and the aforementioned Geo-Environmental Report (Report reference: GEA-17905-D-16-363), the generation potential is considered to be **Very Low** and according to guidance this would equate to 'gas monitoring might not be necessary'.

7.4.3. Monitoring Programme

Initially, it was considered appropriate to carry out two rounds of monitoring, with a subsequent assessment of consistency of data.

7.4.4. Monitoring Results

The results from the two monitoring rounds are summarised in the tables below. Atmospheric pressure was noted to be steady during both monitoring rounds. Monitoring sheets can be viewed in Appendix 6 .

	BH02	BH03
Max. Flow Rate (L/hr)	-0.1	0
Peak CH_4 (%)	0	0
Peak CO_2 (%)	0.7	1.8
Min. O_2 (%)	20	18.7
Max. H_2S (ppm)	0	0
Max. CO (ppm)	0	2

Table 7.9: Monitoring Round 1 – 17/04/2019

	BH02	BH03
Max. Flow Rate (L/hr)	-0.1	-0.3
Peak CH_4 (%)	0	0
Peak CO_2 (%)	0.7	4.8
Min. O_2 (%)	20.1	15.2
Max. H_2S (ppm)	0	0
Max. CO (ppm)	0	0

Table 7.10: Monitoring Round 2 – 21/05/2019

Results returned across the monitoring program are fairly consistent from round to round. This provides confidence that the results are indicative of site conditions.

Elevated carbon monoxide results that may have been observed during the first monitoring round decreased for monitoring round 2 – often there is a spike in results during the first monitoring event due to drilling disturbance and/ or the installation process.

A maximum flow rate of -0.3L/hr was observed within BH03 during monitoring round 2. Methane was recorded as 0% across the entire Ridge monitoring programme.

A maximum carbon dioxide concentration of 4.8% was observed in BH03 during the second monitoring round. This result is similar to the maximum CO_2 concentration of 4.7% recorded during the Merebrook investigation; this furthermore provides confidence with the results.

7.4.5. Gas Screening Value

Worst case gas levels and flow rates identified across the programme can be used to calculate a conservative Gas Screening Value (GSV) as defined in CIRIA C665 *Assessing Risks Posed by Hazardous Ground Gases to Buildings* (2002).

Gas Screening Value

GSV = (worst case CO_2 or CH_4 concentration/ 100) x worst case flow rate

GSV = (4.80%/ 100) x 0.30L/hr

GSV = 0.01

According to the guidance, the GSV equates to Characteristic Situation 1 as it is below the upper threshold of 0.07, and therefore no protection measures considered necessary.

8. GEOTECHNICAL TESTING AND ASSESSMENT

8.1. Introduction

This geotechnical assessment will use the findings of the ground investigation and the results of the in-situ and laboratory geotechnical testing carried out in the intrusive locations and on representative samples of the materials encountered across the site.

8.2. Geotechnical Tests

Details of the specific procedure used in each case are shown below in Table 8.1, with the geotechnical test certificates presented in Appendix 3

Test	Standard (BS1377:1990) unless otherwise indicated	Scheduled	Completed
Atterberg Limits	Part 2: Clauses 3.2, 4.3 & 5.3	12	12
Particle Size Distribution (wet sieve)	Part 2: 9.2	12	12
PSD Wet Sieve Method	Part 2: 9.2	6	6
pH	Part 3: 9.5	12	12
Sulphate Testing	Part 3: 5.3	12	12
Consolidated Drained Triaxial Compression Test	Part 8:7	5	5

Table 8.1: Geotechnical Test Procedure and Standards

8.2.1. Atterberg Tests

Twelve samples of the underlying cohesive material were submitted to determine their plasticity index values. The results are summarised in Table 8.2.

Sample	Depth (mbgl)	Strata	Natural Moisture Content, w (%)	Liquid Limit wL (%)	Plastic Limit wP (%)	Passing 425µm sieve (%)	Plasticity Index IP (%)	Modified Plasticity Index (%)
BH01	1.2	Brown Silty Sandy Clay	22	52	22	100	30	30
	8.0		17	45	20		25	25
	9.0		20	46	22		24	24
	19.0	Brownish grey Silty Sandy Clay	30	72	20		52	52
	26.0		25	53	21		32	32
BH02	2.0	Brown slightly Clayey Sand	18	-	NP		-	-
	7.0	Brown Silty Sandy Clay	23	46	20		26	26
	13.0	Brown slightly Clayey Sand	32	-	NP		-	-
	28.0	Brownish grey Sandy Clay	31	50	17		33	33
BH03	3.0	Brown slightly Clayey Sand	9	-	NP		-	-
	7.0		25	-	NP		-	-
	9.0		30		NP			

Table 8.2: Plasticity Index Values

The Atterberg limits testing returned seven plasticity indices in the range of 24 to 33%, which are indicative of high plasticity soils. Five results returned non-plastic results. Modified plasticity indices are between 24-33%, which are in the range defined as medium volume change potential in accordance with NHBC guidelines.

8.2.2. Particle Size Distribution

Six samples of the granular material were submitted for classification by wet sieving to determine the percentage and range of particle size. The results are summarised in Table 8.3.

Sample	Depth (mbgl)	% Sample				Description
		Gravel	Cobbles	Sand	Fines	
BH01	2.5	0	0	74	26	Brown clayey/ silty fine to medium SAND
BH01	7.0	0	0	67	33	Brown clayey/ silty fine to coarse SAND
BH01	24.5	0	1	57	42	Brown slightly fine gravelly clayey/silt fine to coarse SAND
BH02	14.0	0	0	70	30	Brown clayey/ silty fine to coarse SAND
BH02	26.0	0	0	55	45	
BH03	2.0	0	0	6	94	Brown slightly fine to coarse sandy SILT/CLAY

Table 8.3: Particle Size Distribution

8.2.3. Aggressive Ground Soil Chemistry

Chemical testing was carried out on three soil samples of the encountered materials in accordance with BRE Special Digest 1. The results are summarised in Table 8.4.

Location	Depth (mbgl)	pH	Soluble Sulphate (mg/l)
BH01	2.0	6.85	40
	10.0	7.29	40
	15.5	7.46	30
	20.0	7.82	30
	25.5	8.01	30
BH02	1.0	7.20	20
	5.0	7.26	30
	10.0	7.39	20
	29.0	8.14	30
BH03	2.0	7.59	30
	6.0	7.69	30
	10.0	7.86	30

Table 8.4: Chemical testing for concrete classification

Tables C1 and C2 of BRE SD1 gives a Design Sulphate Classification of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-1 for all soils; assuming mobile groundwater conditions above the groundwater table and using a worst-case soluble sulphate value of 40mg/l and a pH >6.85.

8.2.4. Consolidated Undrained Triaxial Compression Test

Five U100 samples from were submitted to the laboratory to determine their consolidation coefficient. The results are shown in the table below.

Location	Depth (mbgl)	Density (kN/m^3)	Moisture Content (%)	Consolidation Coefficient						Cohesion (kPa)	Angle of Shear Resistance (°)
				1st Pressure		2nd Pressure		3rd Pressure			
BH01	4.0	19.3	22	30kPa	1.59m^2/yr	60kPa	0.47m^2/yr	120kPa	0.33m^2/yr	15	37.5
	18.5	19.1	24	180kPa	0.04 m^2/yr	360kPa	0.02 m^2/yr	720kPa	0.02 m^2/yr	70	16.2
	21.5	19.6	22	180kPa	0.17 m^2/yr	360kPa	0.03 m^2/yr	720kPa	0.02 m^2/yr	45	16.2
BH02	15.5	18.1	27	140kPa	2.94 m^2/yr	280kPa	0.87 m^2/yr	560kPa	0.38 m^2/yr	0	24.7
	20.0	19.8	26	180kPa	0.31 m^2/yr	360kPa	0.1 m^2/yr	720kPa	0.02 m^2/yr	25	17.0

Table 8.5: Consolidated Undrained Triaxial Compression Test

8.1. Characteristic Geotechnical Parameters

Based on the laboratory test results, in-situ testing and subsequent analysis a range of characteristic geotechnical parameters, which should be used in the subsequent geotechnical and foundation design calculations are presented in Table 8.6.

Stratum	Parameter		Source	Value
Made Ground/ Topsoil	Not used in foundation design			
Bagshot Formation (Clay)	Unit Weight (kN/m^3)		Triaxial Testing	19kN/m^3
	Undrained Shear Strength	c_u (kN/m^2)	BS:8002	75kN/m^2
Bagshot Formation (Sand)	Unit Weight (kN/m^3)		Triaxial Testing	19kN/m^3
	Angle of Shear Resistance	°	Triaxial Testing	37°
Claygate Member (Clay)	Unit Weight (kN/m^3)		Triaxial Testing	18.1kN/m^3
	Undrained Shear Strength	c_u (kN/m^2)	BS:8002	110kN/m^2
Claygate Member (Sand)	Unit Weight (kN/m^3)		Triaxial	19.6kN/m^3
	Angle of Shear Resistance	°	Triaxial Testing	34°

Table 8.6: Characteristic Geotechnical Parameters

8.2. Piled Foundations

The selection and design of foundations and ground-floor slab construction is beyond the scope of current instructions and is the responsibility of the designers of the proposed building. The following recommendations, deriving from observations made during the investigation and testing are provided to assist the design process.

Based on anticipated high structural loads from the proposed building, it is considered that the ground conditions identified are not suitable for traditional foundations for the proposed development.

It is therefore recommended that an alternative foundation solution is pursued. It is considered that this will likely comprise piled foundations within the Claygate Member.

The ground model used in the pile design is presented in Table 8.7, below.

Ground Model	Stratum	Thickness	Notes
GM1	Made Ground	1.65m	Granular SPT = 5
	Bagshot Formation (Sand)	15m	Granular SPT = 15
	Claygate Member (Clay)	11-20m	Cu = 110kN/m^2

Table 8.7. Ground Model

8.3. Pile Calculations

The following factors have been used in the derivation of pile loads as detailed below.

Compression – Overall FOS = 2.50

Compression – Additional FOS Combination

FOS on shaft resistance = 1.00
FOS on end bearing = 3.00

Tension – Factor applied to skin friction

FOS on shaft resistance = 3.00

Group action – Factors on group action

FOS on side resistance 2.50
FOS on base bearing 2.50
FOS on soil weight 1.20

Partial material factors on soil strength for ultimate limit state calculations

Factor on strength of granular soils = 1.00
Factor on strength of other soil types = 1.00

Higher carrying capacities are often achieved by driven piles, however, as the use of driven piles can cause environmental issues (noise and vibration) the initial axial resistance calculations have been carried out on CFA piles.

Pile Dia. (m)	Length of Pile (m)	Ultimate end bearing (kN)	Ultimate Shaft resistance (kN)	Compression (kN)	Tension (kN)
0.75	30	1011	5358	2548	1868
	20	786	3070	1543	1083
	10	2209	1008	1287	373
0.60	30	647	4286	1973	1481
	20	503	2456	1184	857
	10	1414	806	888	292
0.45	30	365	3215	1432	1101
	20	283	1842	850	635
	10	795	605	560	215

Table 8.8. Design Pile Resistances – Length of Pile

It should be acknowledged that the carrying capacity of a pile group is generally less than the sum of the individual piles. Therefore, it is recommended that a pile group analysis is carried out if load bearing piles are placed closer than 1.5 x pile diameter.

The clay has been found to be of medium shrinkage potential. Heave protection, new tree planting and ground floor slab design should take this shrinkage potential into account.

Groundwater was recorded at two strata within the ground- ~10mbgl and ~25mbgl. and is not therefore is expected to be encountered in shallow excavations for drainage or similar.

8.4. Soakaways

Due to very slow infiltration it was not possible to complete a full soakaway test in the tested trial pits. The ground conditions **do not** therefore appear favourable for the use of soakaway drains for infiltration drainage. Soakaway results are presented in Appendix 7. It is therefore recommended that a positive surface water drainage system is progressed.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. Geotechnical

The ground investigation revealed Macadam and Made Ground in all exploratory hole locations except BH02. The Made Ground was fairly limited in thickness, extending to 1.65mbgl in SA2. The Bagshot Formation was revealed in all exploratory holes and was proved to a maximum depth of 15.0m. The Claygate Member was revealed in all boreholes except SA1 & SA2 to the maximum drill depth of 30mbgl. The strength of both the Bagshot Formation and Claygate Member was found to typically increase with depth.

Based on the thickness of made ground, and anticipated loads from the proposed building it is recommended that a piled foundation solution is adopted for the proposed building.

The clay has been found to be of high shrinkage potential and subsequent foundation and floor slab designs should take this shrinkability into account.

The materials encountered are not considered suitable for the use of soakaway drains for surface water disposal. It is recommended that the existing drainage network is investigated and capacity assessed to establish if surface water from the proposed building can be accommodated.

It will be necessary during demolition and site clearance for all sub-structure to be removed from site, so that obstructions are not left for ongoing piling works. It would be prudent at that time for a series of trial holes to be excavated across the whole footprint of the site to prove the depth of made ground in areas of the site that are currently inaccessible.

Any voids or basements will need to be reinstated with approved granular materials compacted in layers to ensure that soft spots are not left on site which would be a hazard to tracking plant, piling rig etc.

9.2. Groundwater

Groundwater was encountered during the investigation at depths between 10.00 and 26.10mbgl. Subsequent monitoring found groundwater at 12.56mbgl in BH02. Therefore, pumping to keep excavations clear of water should be allowed, particularly during periods of inclement weather.

9.3. Waste Removal

Results from one of the tested soil samples (SA2 at 0.50m) was input into a Soils Characterisation Assessment Tool (CAT-Waste Soil) to identify whether soils on site have hazardous properties. The sample returned **Non-Hazardous** properties. The CAT-Waste Soil output sheet is included as Appendix 4. The second part of the assessment process is a review of Waste Acceptance Classification (WAC) testing, which was also carried out on the soil sample above. The results indicate that the sample obtained from these Made Ground soils is **Inert**.

Test certificates should be supplied to hauliers and landfill operators to confirm this classification, should there be the requirement to remove shallow (<1.50m) soils during any future groundworks

9.4. Contamination

The findings of this recent investigation are similar to those outlined by Merebrook in that concentrations of lead exceeded C4SL. Whilst there were no PAH and TPH exceedance, these determinands were recorded as

elevated within one sample. Furthermore, these contaminants are often found elevated within Made Ground soils.

A GSV of 0.01 has been calculated, which equates to Characteristic Situation 1 as it is below the upper threshold of 0.07. Therefore, no gas specific protection measures are considered necessary within building design. Nevertheless, it can be expected that a damp-proof membrane will be incorporated into the design, which will provide some level of mitigation against any salient risk.

Therefore, it is considered that this contaminant screen is reflected by the findings of the previous report, and the relevant conclusions drawn. Consequently, it is deemed unnecessary at this stage to update the specific remediation recommendations within the Geo-Environmental Assessment document (Report reference: GEA-17905-D-16-363).

9.4.1. Watching Brief

A Watching Brief should be maintained on site during development works by the Site Manager/ Supervisor. This must be undertaken so actions are implemented correctly in the instance that there are any previously unidentified areas of contamination.

9.4.2. Discovery Strategy

If any material is noted to show visual and/ or olfactory evidence of contamination, in the first instance this material should be stockpiled separately on plyboard or sheeting.

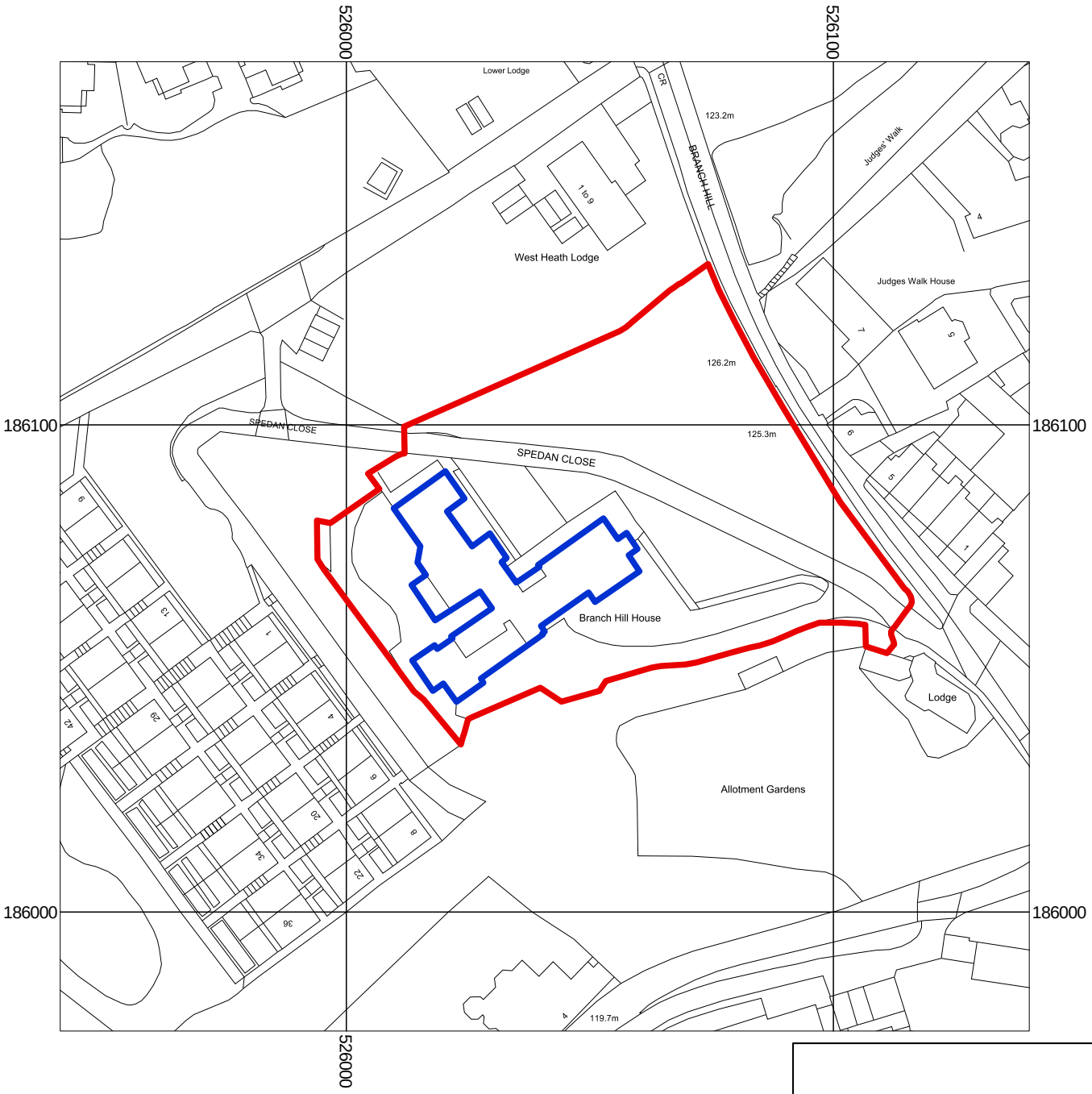
An Environmental Consultant such as Ridge should be contacted to advise what further work is required but this would likely involve characterisation of soils through laboratory analysis prior to removal off site. Local Authorities will be notified and a future plan of action will be agreed.

9.5. Health and Safety

In order to mitigate generic/salient risks associated with development works the following mitigation measures are recommended:

- Compliance with relevant Health and Safety procedures during construction works;
- Contractors on site should wear appropriate PPE to mitigate any risks from chemical and physical impacts of Made Ground at the site; and,
- Adhere to Discovery Strategy as detailed above.

FIGURE 1 – SITE LOCATION PLAN



SITE BOUNDARY

EXISTING BUILDING

0 25m 50m 75m 100m

N

S

BRANCH HILL HOUSE

LONDON

SITE LOCATION PLAN

DRNG No	SCALE	DATE
PL-01	1:1250 @ A4	SEPT-19

Stanhope Gate Architecture

5 ST. JAMES'S SQUARE
LONDON SW1Y 4JU
T 020 7451 0955 mail@stanhopegate.co.uk
www.stanhopegatearchitecture.com

FIGURE 2 – SITE PLANS

NOTES:
1. Do not scale from this drawing.
2. Always work to noted dimensions.
3. All dimensions are in millimetres unless otherwise stated.
4. All setting out, levels and dimensions to be agreed on site.
5. The dimensions of all materials must be checked on site before being laid out.
6. This drawing must be read with the relevant specification clauses and detail drawings.
7. Order of construction and setting out to be agreed on site.

KEY

Extent of Proposed Landscape Works

Revision	Date	Description	Drawn	Apprvd.
S1-P02	16-12-19	Arrival Gardens Update	SH	AN

Planit I.E. Limited
E: info@planit-ie.com **W:** planit-ie.com
MANCHESTER
2 Back Grafton St , Altrincham, WA14 1DY
T: 0161 928 9281
LONDON
Unit 6 Waterside, 44-48 Wharf Road, London, N1 7UX
T: 0207 253 5678
LIVERPOOL
Tempest 5.3, 12 Tithebarn Street, Liverpool, L2 2DT
T: 0151 363 1230

Client Almax Group

Project Branch Hill House

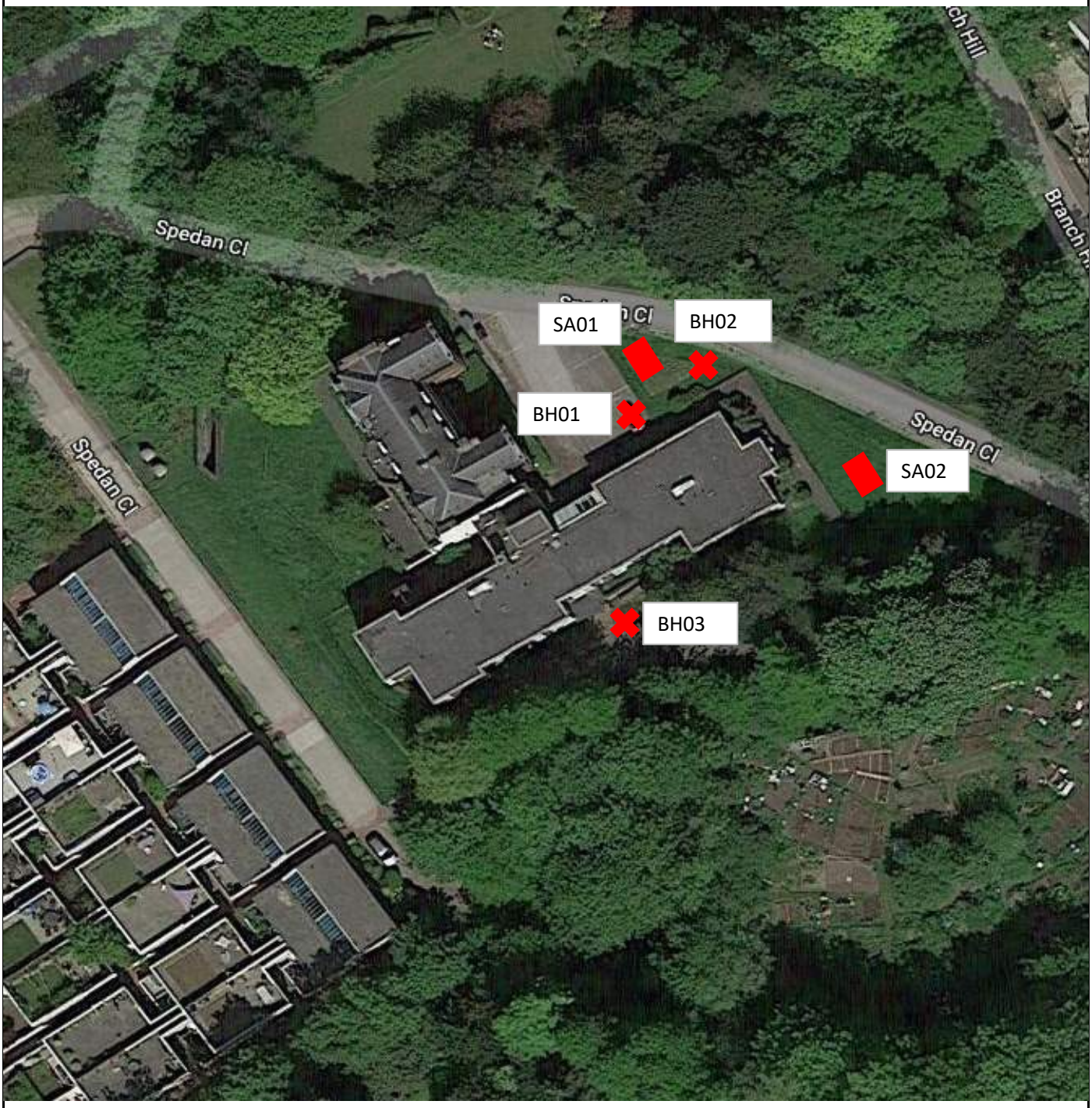
Drg Title Landscape General Arrangement

Created on	Created by	Approved by
12.12.19	SH	AN

Scale	Size	Workstage
1:200	A1	PLANNING

Drg No.	Suitability	Revision
1926-PLA-00-GF-DR-L-0001	S1	P02

FIGURE 3 – TEST LOCATION PLAN



PROJECT Branch Hill House		DRAWING 5008338-03				
	CLIENT Almax	SCALE NTS	DATE 25/07/2019		DRAWN BY PB	CHECKED BY RJH
		TITLE EXPLORATORY HOLE LOCATION PLAN				REV -

RIDGE
PARTNERSHIP HOUSE TEL: 01962 834400
MOORSIDE ROAD FAX: 01993 815001
WINCHESTER
HAMPSHIRE, SO23 7RX www.ridge.co.uk
Also at Reading, Bristol, London & Leicester

APPENDIX 1 – REPORT CONDITIONS

This report is produced solely for the benefit of Almax Group Ltd and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

This report refers, within the limitations stated, to the condition of the site at the time of the inspections. No warranty is given as to the possibility of future changes in the condition of the Site.

This report is based on a visual Site inspection, study of readily accessible referenced historical records, information supplied by those parties noted in the text and preliminary discussions with local and Statutory Authorities. Some of the opinions are based on unconfirmed data and information and are presented in good faith without exhaustive clarification. Where ground contamination is suspected but no physical Site test results are available to confirm this, the report must be regarded as initial advice only, and further assessment should be undertaken prior to detailed activities related to the Site. Where test results undertaken by others have been made available these can only be regarded as a limited sample. The possibility of the presence of contaminants, not revealed by this research cannot be discounted.

Whilst confident in the findings detailed within this report because there are no exact UK definitions of these matters, being subject to risk analysis, we are unable to give categoric assurances that they will be accepted by Authorities or Funds etc. without question, as such bodies may have unpublished, often more stringent objectives. This report is prepared for the proposed uses stated in the report and should not be used in a different context without reference to Ridge and Partners LLP. In time improved practices or amended legislation may necessitate a re-assessment.

The report is necessarily limited to those aspects of land contamination specifically reported on and no liability is accepted for any other aspect especially concerning gradual or sudden pollution incidents that may occur. The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous use and abuse of the Site and adjacent Sites. The report concentrates on the Site as defined in the report and provides an opinion on surrounding Sites. If migrating pollution or contamination (past or present) exists this can only practically be better assessed following extensive on and off Site intrusive investigations and monitoring.

APPENDIX 2 – BOREHOLE LOGS

Ridge

EXPLORATORY HOLE LOG

Project				EX. HOLE No
Branch Hill House				**BH01**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5008338	08-04-19 10-04-19			
Contractor				Sheet
Ridge and Partners LLP				1 of 2

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
						0.10	MACADAM.		
						0.60	MADE GROUND: Dark brown silty sandy angular to sub-rounded fine to coarse Gravel of flint, concrete and brick. Sand is fine to coarse.		
1.00	D						Loose to medium dense orangish brown and brownish orange mottled clayey silty fine and medium SAND inter-bedded with thinly bedded sandy CLAY. (BAGSHOT FORMATION).		
1.20		N12							
2.00	D								
2.00		N10							
3.00	D								
3.00		N9							
4.00	D								
4.00-4.45	U100	43 blows							
4.50	D								
5.00	D					(9.80)			
5.00		N14							
6.00	D								
6.50-6.95	U100	38 blows							
7.00	D								
8.00	D								
8.00		N22							
9.00	D								
9.50-9.95	U100	52 blows							
10.00	D					10.40			
							Medium dense brownish orange fine SAND. (BAGSHOT FORMATION).		
11.00	D								
11.00		N30							
12.00	D					(3.40)			
12.50		N27							
13.00	D								
			1			13.80			
14.00	D					14.50	Firm brown silty sandy CLAY. Sand is fine and medium. (BAGSHOT FORMATION).		
14.00		N8	1			15.10	Loose to medium dense dark grey very silty fine SAND. (CLAYGATE MEMBER).		
15.00	D								
15.50		N11					Medium dense greenish grey very clayey silty fine SAND. Locally dark grey very sandy Clay. (CLAYGATE MEMBER).		
16.00	D					(2.70)			
17.00	D								
17.00		N12				17.80			
18.00	D						Stiff grey silty CLAY. (CLAYGATE MEMBER).		
18.50-18.95	U100	61 blows							
19.00	D					(3.20)			

Boring Progress and Water Observations					
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth

Chiselling			Water Added	
From	To	Hours	From	To
			12	15

GENERAL REMARKS

CAT scanned prior to excavation. Groundwater strikes at 15.00mbgl and 25.40mbgl. Borehole terminated at 26.00mbgl due to running sands and complications with casing.

All dimensions in metres Scale 1:125	Client Almax Group Ltd	Method/ Plant Used Dando CP Rig	Logged By PB

Ridge

EXPLORATORY HOLE LOG

Project				EX. HOLE No
Branch Hill House				**BH01**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5008338	08-04-19 10-04-19			
Contractor				Sheet
Ridge and Partners LLP				2 of 2

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
20.00	D						Stiff grey silty CLAY. (CLAYGATE MEMBER). *(continued)*		
20.00		N23				21.00			
21.00	D						Dark grey silty fine SAND. (CLAYGATE MEMBER).		
21.50-21.95	U100	75 blows							
22.00	D					(3.90)			
23.00	D		2						
23.00		N29							
24.00	D								
24.50-24.95	U100	60 blows	2			24.90			
25.00	D					(1.10)	Firm to stiff grey sandy CLAY. Sand is fine. (CLAYGATE MEMBER).		
26.00	D					26.00			
26.00		N15							

Boring Progress and Water Observations						Chiselling			Water Added	
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To

GENERAL REMARKS

CAT scanned prior to excavation. Groundwater strikes at 15.00mbgl and 25.40mbgl. Borehole terminated at 26.00mbgl due to running sands and complications with casing.

All dimensions in metres Scale 1:125	Client Almax Group Ltd	Method/ Plant Used Dando CP Rig	Logged By PB

Ridge

EXPLORATORY HOLE LOG

Project				EX. HOLE No
Branch Hill House				**BH02**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5008338	10-04-19 12-04-19			
Contractor				Sheet
Ridge and Partners LLP				1 of 2

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
						0.30	Turfed grass over TOPSOIL: Brown sandy Silt with abundant roots.		
1.00	D						Loose to medium dense orangish brown and brownish orange mottled clayey fine and medium SAND inter-bedded with thinly bedded sandy CLAY. (BAGSHOT FORMATION).		
1.20		N13							
2.00	D								
2.00		N17							
3.00	D								
3.00		N5							
4.00	D								
4.00		N8							
5.00	D								
5.00-5.45	U100	31 blows							
5.50	D								
6.00	D					(11.70)			
6.50		N17							
7.00	D								
8.00	D								
8.00-8.45	U100	43 blows							
8.50	D								
9.00	D								
9.50		N23							
10.00	D								
11.00	D								
11.00-11.45	U100	63 blows				12.00			
11.50	D						Medium dense brownish orange fine SAND. (BAGSHOT FORMATION).		
12.00	D		1						
12.50		N28				(2.40)			
13.00	D								
14.00	D					14.40			
14.00		N13				15.00	Medium dense brown clayey silty find and medium SAND. (BAGSHOT FORMATION).		
15.00	D						Firm brownish grey and greyish brown silty sandy CLAY. Sand is fine. (CLAYGATE MEMBER).		
15.50-15.95	U100	45 blows				(2.00)			
16.00	D					17.00			
17.00	D						Medium dense dark grey very silty fine SAND. Locally dark grey very sandy Clay. (CLAYGATE MEMBER).		
17.00		N14				(2.00)			
18.00	D								
18.50		N9				19.00			
19.00	D						Firm to stiff grey silty sandy CLAY. Sand is fine. (CLAYGATE MEMBER).		

Boring Progress and Water Observations					
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

CAT scanned prior to excavation. Groundwater strikes at 12.90mbgl and 26.10mbgl.

All dimensions in metres Scale 1:125	Client Almax Group Ltd	Method/ Plant Used Dando CP Rig	Logged By PB

Ridge

EXPLORATORY HOLE LOG

Project				EX. HOLE No
Branch Hill House				**BH02**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5008338	10-04-19 12-04-19			
Contractor				Sheet
Ridge and Partners LLP				2 of 2

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
20.00	D						Firm to stiff grey silty sandy CLAY. Sand is fine. (CLAYGATE MEMBER). *(continued)*		
20.00-20.45	U100								
20.50	D								
21.00	D								
21.50		N24				(6.00)			
22.00	D								
23.00	D								
23.00-23.45	U100	83 blows	2						
23.50	D								
24.00	D					25.00			
24.50		N20					Medium dense greenish grey very clayey silty fine SAND. (CLAYGATE MEMBER).		
25.00	D		2						
26.00	D								
26.00-26.45	U100	54 blows							
27.00	D								
27.50		N21				(5.00)			
28.00	D								
29.00	D								
29.00		N28				30.00			
30.00	D								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	CAT scanned prior to excavation. Groundwater strikes at 12.90mbgl and 26.10mbgl.

All dimensions in metres Scale 1:125	Client Almax Group Ltd	Method/ Plant Used Dando CP Rig	Logged By PB

Ridge

EXPLORATORY HOLE LOG

Project				EX. HOLE No
Branch Hill House				**BH03**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5008338	15-04-19 15-04-19			
Contractor				Sheet
Ridge and Partners LLP				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
						0.10	MACADAM.		
						(1.10)	MADE GROUND: Brown speckled red clayey fine to coarse Sand. Frequent gravel of flint, brick and concrete.		
1.00	D					1.20			
1.20		N15					Firm orangish brown silty sandy CLAY. Sand is fine and medium. (BAGSHOT FORMATION).		
2.00	D					(1.80)			
2.00-2.45	U100	80 blows							
2.50	D					3.00			
3.00	D						Medium dense brown clayey silty fine SAND. (BAGSHOT FORMATION).		
3.00		N16							
4.00	D								
4.00		N19							
5.00	D								
5.00		N25							
6.00	D								
6.50		N25				(7.00)			
7.00	D								
8.00	D								
8.00		N27							
9.00	D								
9.50		N27	1						
10.00	D					10.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	CAT scanned prior to excavation. Groundwater strike at 10.00mbgl.

All dimensions in metres Scale 1:125	Client Almax Group Ltd	Method/ Plant Used Dando CP Rig	Logged By PB

Ridge

EXPLORATORY HOLE LOG

Project				EX. HOLE No
Branch Hill House				**SA1**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5008338	17-04-19 17-04-19			
Contractor				Sheet
Ridge and Partners LLP				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
0.30	ES					0.20	TOPSOIL: Dark brown slightly clayey slightly sandy Silt with abundant roots and rootlets. Sand is fine.		
0.80	ES					0.60			
1.00	B					(1.40)	MADE GROUND: Yellowish brown / brownish yellow locally mottled light grey locally very clayey fine and medium Sand. Occasional angular to sub-rounded fine to coarse gravel of brick.		
						2.00	Brownish yellow mottled orangish brown and light grey clayey fine and medium SAND. Locally very clayey.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	
											CAT scanned prior to excavation. Groundwater not encountered.

All dimensions in metres Scale 1:125	Client Almax Group Ltd	Method/ Plant Used Kubota U27-4	Logged By RG

Ridge

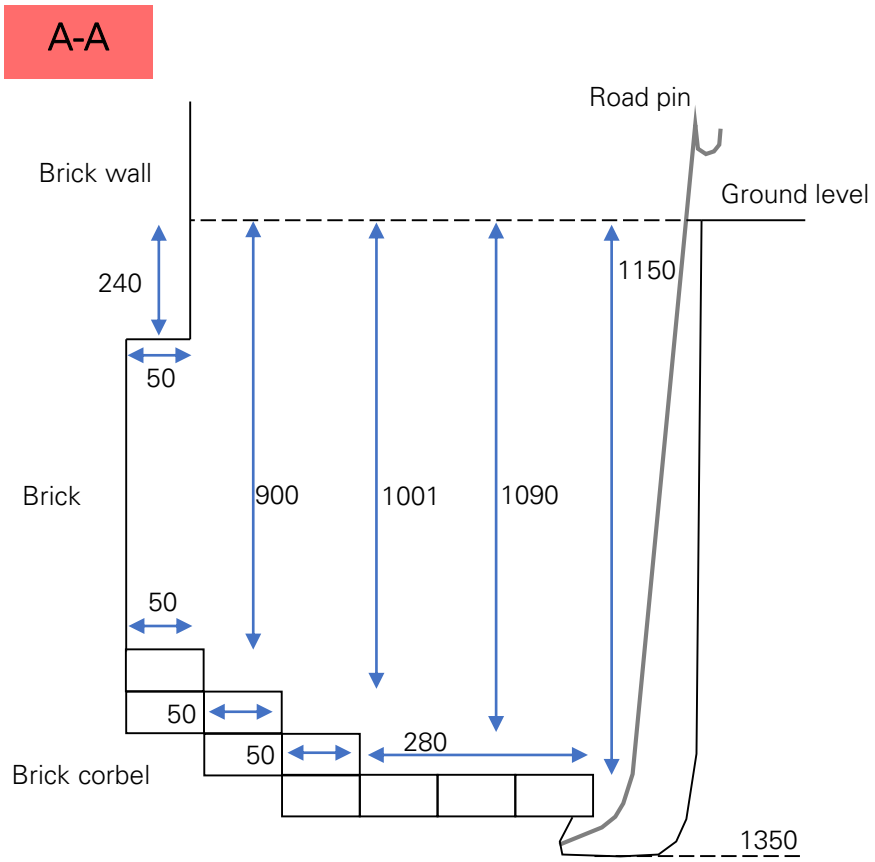
EXPLORATORY HOLE LOG

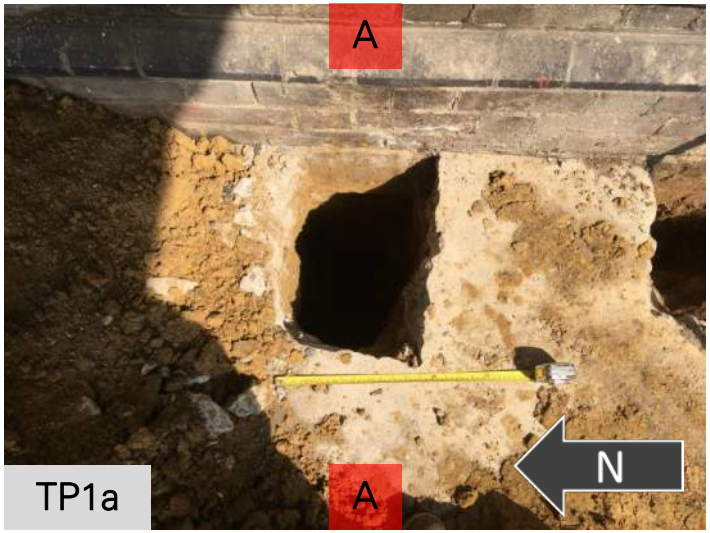
Project				EX. HOLE No
Branch Hill House				SA2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5008338	17-04-19 17-04-19			
Contractor				Sheet
Ridge and Partners LLP				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
0.50	ES					0.20 (1.45) 1.65	TOPSOIL: Dark brown slightly clayey slightly sandy Silt with abundant roots and rootlets. Sand is fine. MADE GROUND: Brown occasionally orangish brown mottled dark blackish brown, speckled red, silty sandy gravelly Clay. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse brick, concrete, flint and clinker. Frequent cobbles of brick and concrete. Occasional wood pieces. Occasional pieces of concrete paving slabs and tarmacadam. Rare sub-rounded medium gravel of chalk. Asphalt/concrete slab at base.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	CAT scanned prior to excavation. Groundwater not encountered. Terminated at a depth of 1.65m due to presence of asphalt/concrete slab.

All dimensions in metres Scale 1:125	Client Almax Group Ltd	Method/ Plant Used Kubota U27-4	Logged By RG





Log

Ground level to 0.14m:
CONCRETE.

0.14m to 1.35m:
MADE GROUND: Light brown mottled grey slightly clayey fine and medium Sand. Occasional angular to sub-rounded fine and medium gravel of brick, concrete and flint.

Project:	Branch Hill House	**Title:**	TP1a – Foundation Pit
Job Number:	5008338	**Client:**	Almax Group Ltd
Drawing:	5008338-01-TP1a	**Revision:**	-
Drawn:	RG	**Date:**	April 2019
Checked by:	RJH	**Scale:**	NTS

Ridge and Partners LLP
Partnership House
Moorside Road
Winchester
Hampshire
SO23 7RX
TEL: 01962 834300
www.ridge.co.uk

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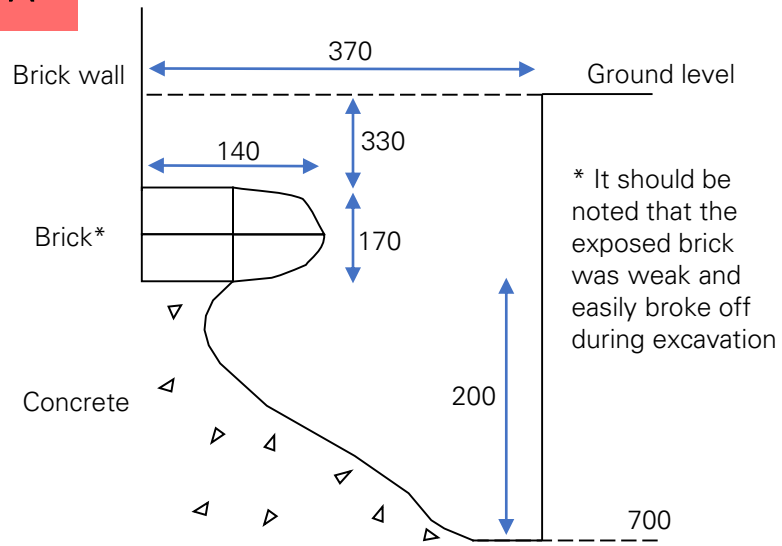
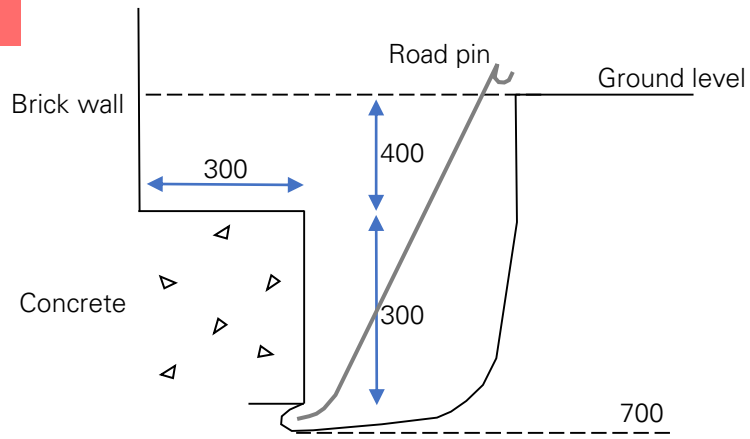
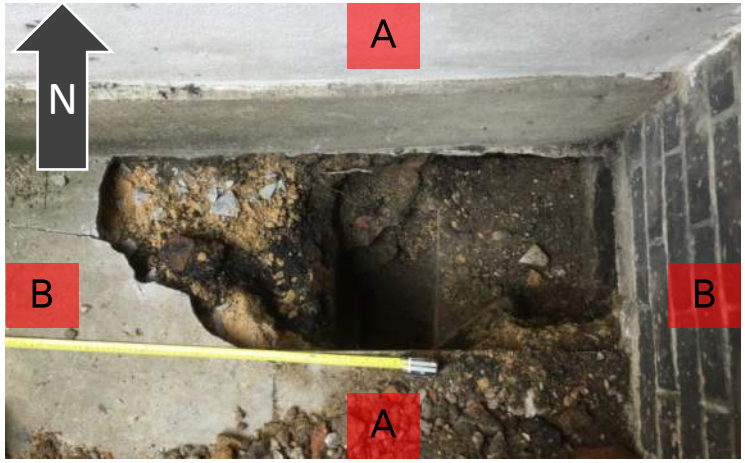
A-A



* It should be noted that the exposed brick was weak and easily broke off during excavation

B-B





Log

Ground level to ~0.70m:
Paving slab over MADE GROUND: Dark blackish brown speckled red silty sandy angular to sub-rounded fine to coarse Gravel of brick, concrete and flint. Sand is fine to coarse.

Project:	Branch Hill House	**Title:**	TP2 – Foundation Pit
Job Number:	5008338	**Client:**	Almax Group Ltd
Drawing:	5008338-01-TP2	**Revision:**	-
Drawn:	RG	**Date:**	April 2019
Checked by:	RJH	**Scale:**	NTS

Ridge and Partners LLP
Partnership House
Moorside Road
Winchester
Hampshire
SO23 7RX
TEL: 01962 834300
www.ridge.co.uk

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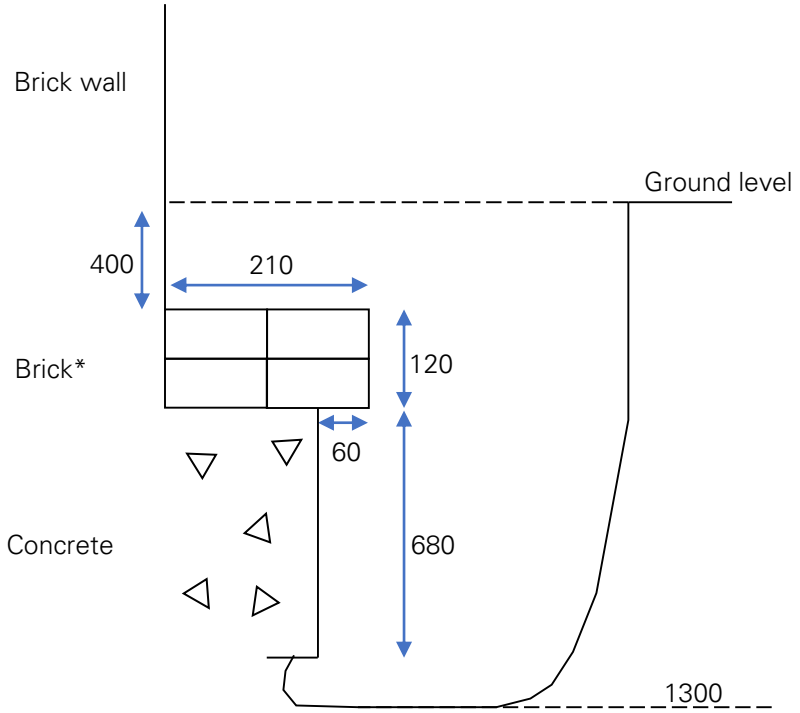
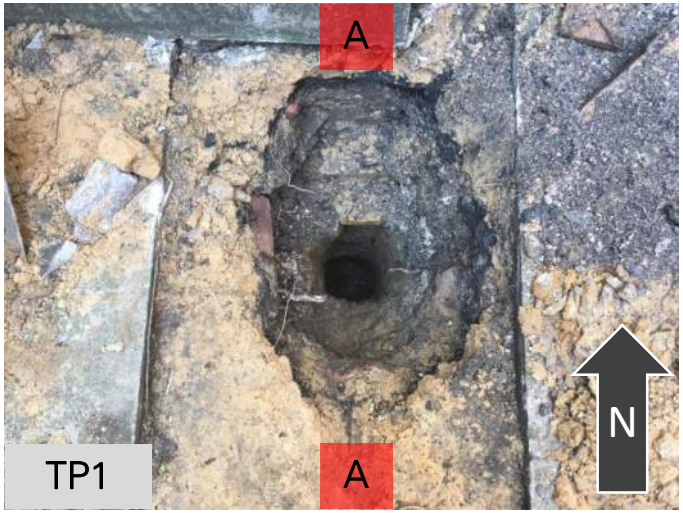
A-A





* It should be noted that the exposed brick was weak and easily broke off during excavation

Log

Ground level to ~0.50m:
Paving slab over MADE GROUND: Dark blackish brown speckled red silty sandy angular to sub-rounded fine to coarse Gravel of brick, concrete and flint. Sand is fine to coarse.

~0.50m to 1.30m:
MADE GROUND: Orangish brown mottled light grey clayey fine and medium Sand. Occasional angular to sub-rounded fine to coarse gravel of brick, concrete and flint.

Project:	Branch Hill House	**Title:**	TP3 – Foundation Pit
Job Number:	5008338	**Client:**	Almax Group Ltd
Drawing:	5008338-01-TP3	**Revision:**	-
Drawn:	RG	**Date:**	April 2019
Checked by:	RJH	**Scale:**	NTS

Ridge and Partners LLP
Partnership House
Moorside Road
Winchester
Hampshire
SO23 7RX
TEL: 01962 834300
www.ridge.co.uk

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APPENDIX 3 – LABORATORY CERTIFICATES

Laboratory Report

UKAS TESTING
2788

GSTL
GEO Site & Testing Services Ltd

Contract Number: 43978

Client Ref:
Client PO:

Report Date: **30-05-2019**

Client **Ridge**
Partnership House
Moorside Road
Winchester
SO23 7RX

Contract Title: **Branch Hill house**
For the attention of: **Peter Bufton**

Date Received: **23-04-2019**
Date Commenced: **23-04-2019**
Date Completed: **30-05-2019**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	12
4 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.3 & 5.3 - * UKAS	12
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	6
Water Soluble Sulphate 2:1 extract BS 1377:1990 - Part 3 : 5.3 - @ Non Accredited Test	12
pH value of soil BS 1377:1990 - Part 3 : 9.5 - @ Non Accredited Test	12
CD 100mm Consolidated drained Triaxial compression test on a single 100 mm diameter specimens Multistage loading with the measurement of volume change and pore water pressure including saturation and consolidation, test duration FOUR days. **PLEASE NOTE IT IS LIKELY THIS TEST WILL INCUR EXTRA OVER DAY CHARGES.** BS 1377:1990 - Part 8 : 7	5

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Ben Sharp (Contracts Manager) - Emma Sharp (Office Manager) - Paul Evans (Quality/Technical Manager)
Richard John (Advanced Testing Manager) - Sean Penn (Administrative/Accounts Assistant) - Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

Laboratory Report

2788

GEO Site & Testing Services Ltd

Contract Number: 43978

Test Description	Qty
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Ben Sharp (Contracts Manager) - Emma Sharp (Office Manager) - Paul Evans (Quality/Technical Manager)
Richard John (Advanced Testing Manager) - Sean Penn (Administrative/Accounts Assistant) - Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5) DESCRIPTIONS	
Contract Number	**43978**	
Site Name	**Branch Hill house**	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Descriptions
BH1		D	1.20	-		Brown silty sandy CLAY
BH1		D	8.00	-		Brown silty sandy CLAY
BH1		D	9.00	-		Brown silty sandy CLAY
BH1		D	19.00	-		Brownish grey silty sandy CLAY
BH1		D	26.00	-		Brownish grey silty sandy CLAY
BH2		D	2.00	-		Brown slightly clayey SAND
BH2		D	7.00	-		Brown silty sandy CLAY
BH2		D	13.00	-		Brown slightly clayey SAND
BH2		D	28.00	-		Brownish grey sandy CLAY
BH3		D	3.00	-		Brown slightly clayey SAND
BH3		D	7.00	-		Brown slightly clayey SAND
BH3		D	9.00	-		Brown slightly clayey SAND
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		

Operators	Checked	30/05/2019	Paul Evans (Quality/Technical Manager)
Darren Bourne	Approved	30/05/2019	Emma Sharp (Office Manager)

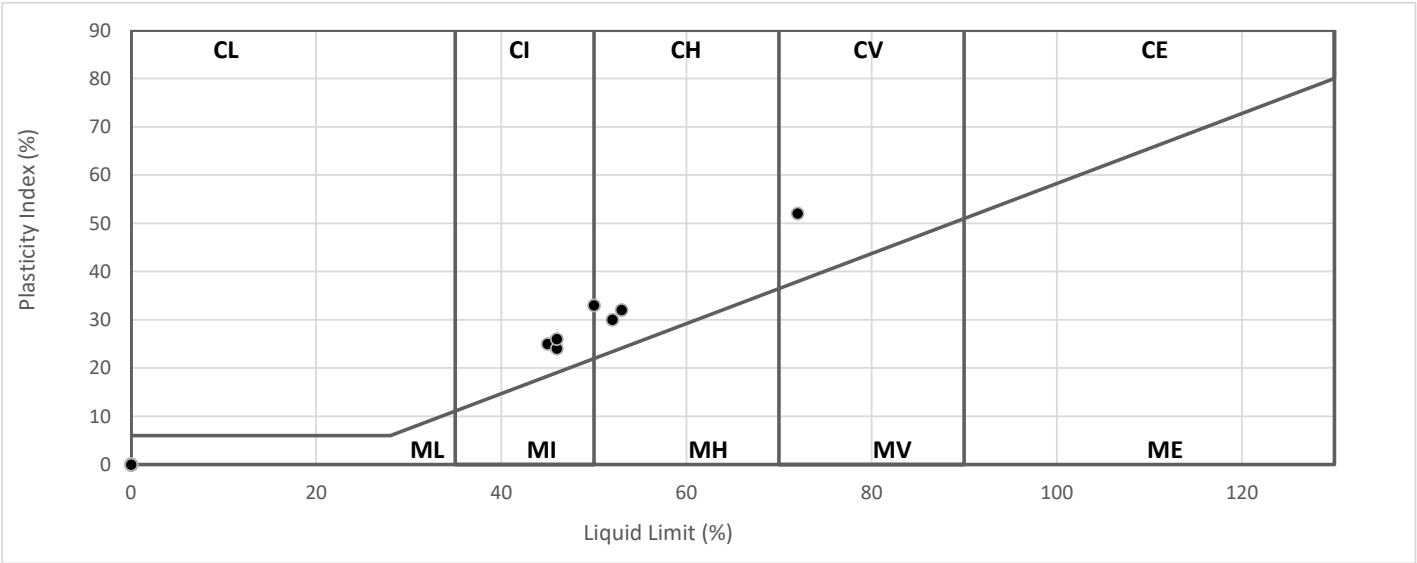
UKAS TESTING 2788

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	**43978**	
Site Name	**Branch Hill house**	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing 0.425mm %	Remarks
BH1		D	1.20	-		22	52	22	30	100	CH High Plasticity
BH1		D	8.00	-		17	45	20	25	100	CI Intermediate Plasticity
BH1		D	9.00	-		20	46	22	24	100	CI Intermediate Plasticity
BH1		D	19.00	-		30	72	20	52	100	CV Very High Plasticity
BH1		D	26.00	-		25	53	21	32	100	CH High Plasticity
BH2		D	2.00	-		18		NP		100	
BH2		D	7.00	-		23	46	20	26	100	CI Intermediate Plasticity
BH2		D	13.00	-		32		NP		100	
BH2		D	28.00	-		31	50	17	33	100	CI/H Inter/High Plasticity
BH3		D	3.00	-		9.0		NP		100	
BH3		D	7.00	-		25		NP		100	
BH3		D	9.00	-		30		NP		100	
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

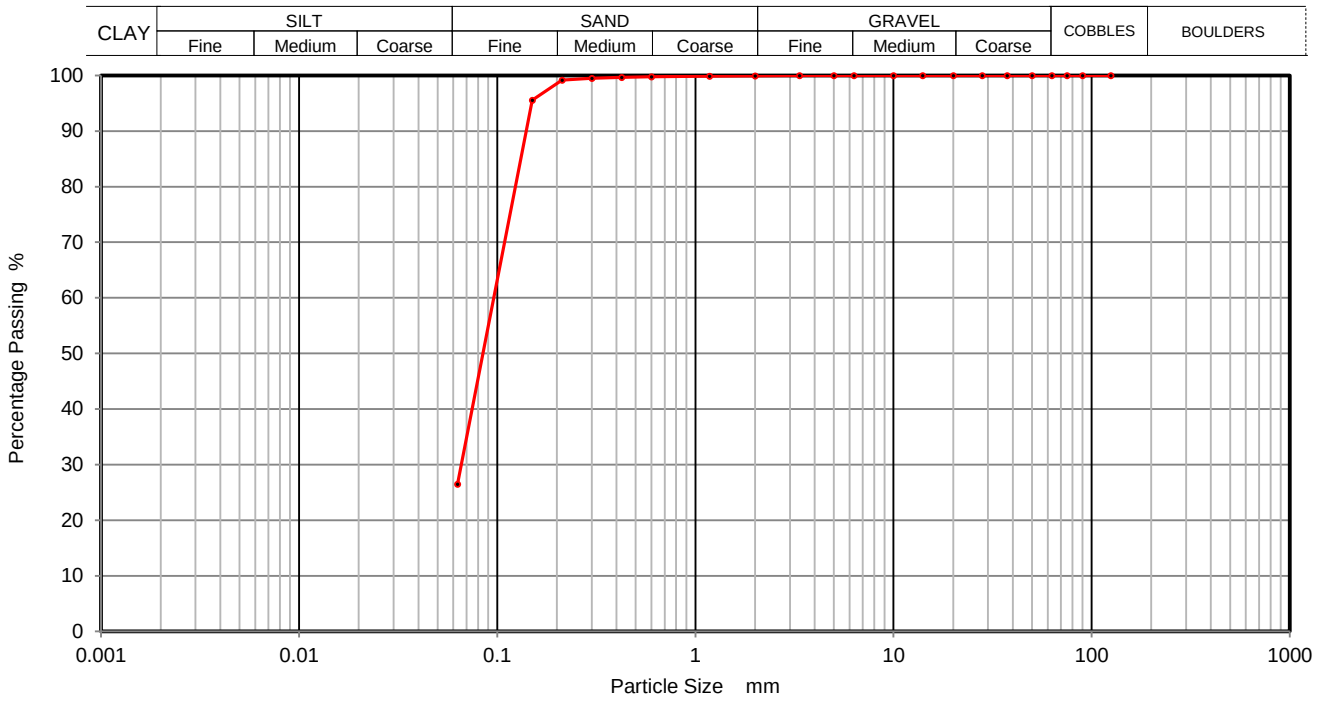
PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	30/05/2019	Paul Evans (Quality/Technical Manager)
Darren Bourne	Approved	30/05/2019	Emma Sharp (Office Manager)

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	43978
		Borehole/Pit No.	BH1
Site Name	**Branch Hill house**	Sample No.	
Soil Description	Brown clayey/silty fine to medium SAND	Depth Top	2.50
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	99		
0.15	96		
0.063	26		

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	74
Silt and Clay	26

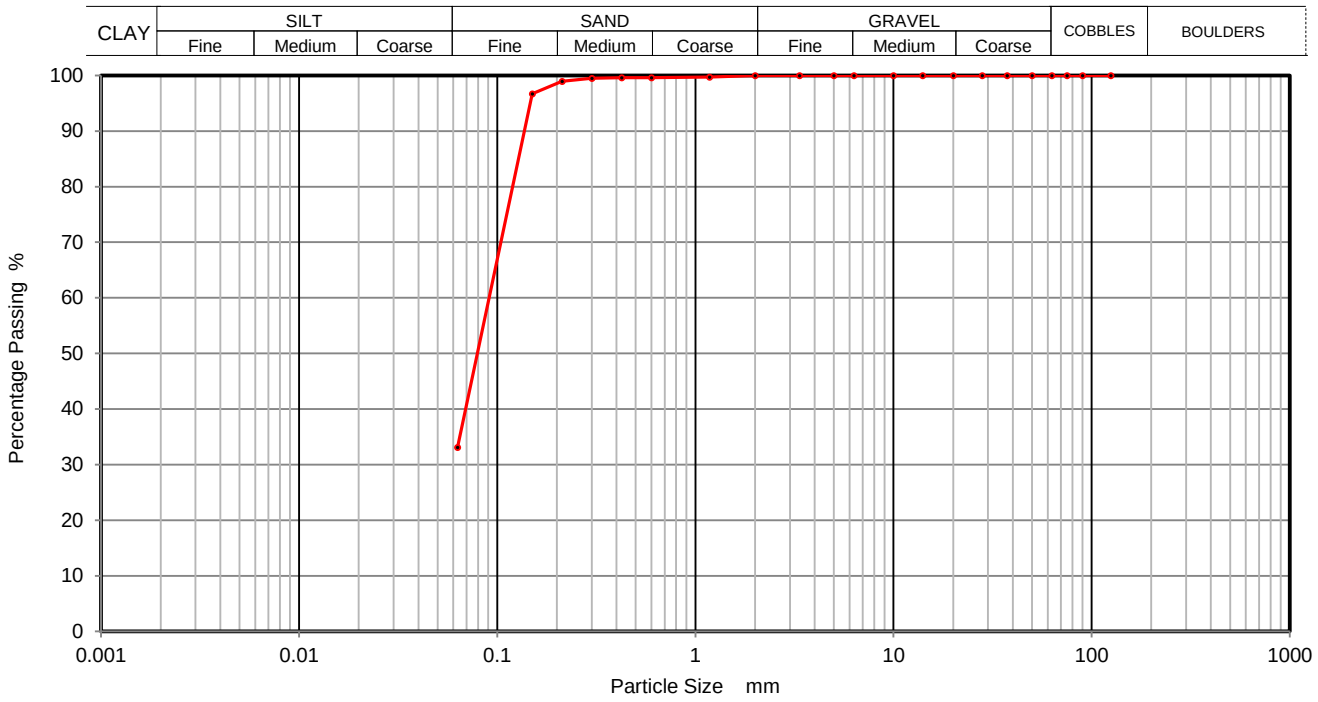
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	29/05/2019	Ben Sharp	
RO/MH	Approved	30/05/2019	Paul Evans	D P Evans

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	43978
		Borehole/Pit No.	BH1
Site Name	**Branch Hill house**	Sample No.	
Soil Description	Brown clayey/silty fine to coarse SAND	Depth Top	7.00
		Depth Base	
		Sample Type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	99		
0.212	99		
0.15	97		
0.063	33		

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	67
Silt and Clay	33

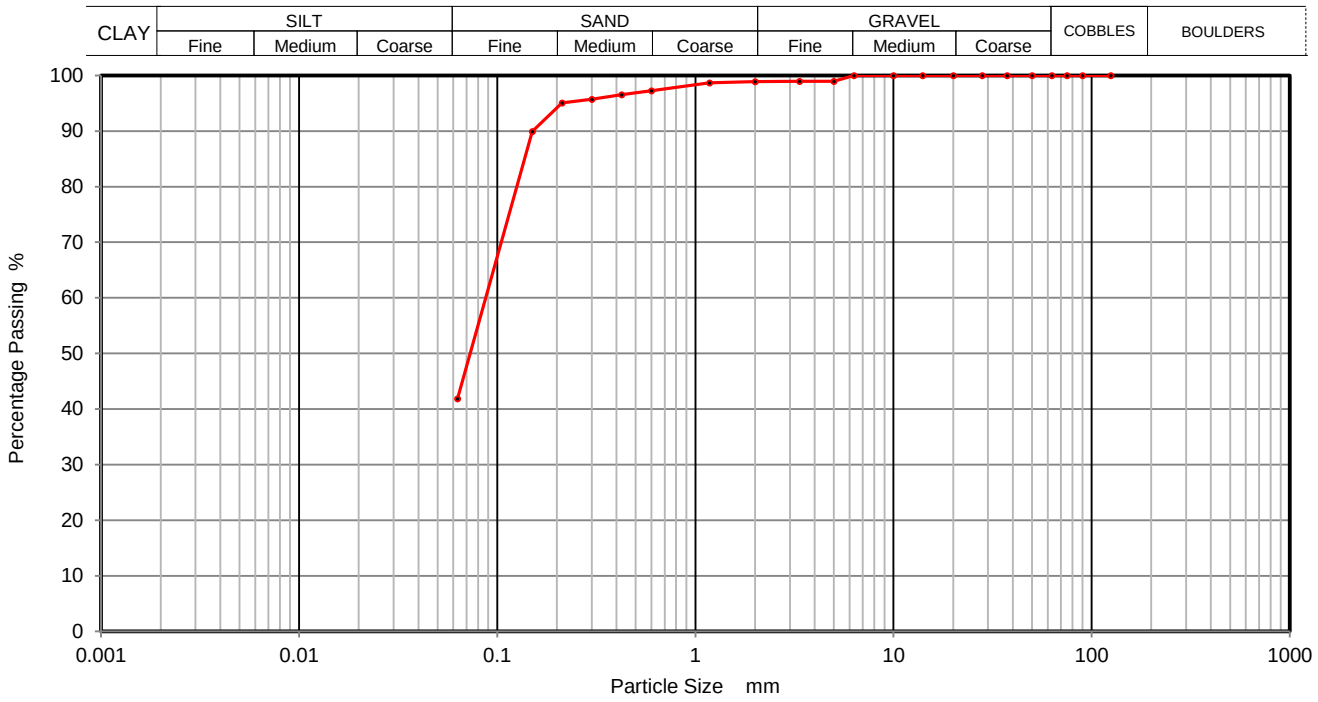
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	29/05/2019	Ben Sharp	
RO/MH	Approved	30/05/2019	Paul Evans	D P Evans

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	43978
		Borehole/Pit No.	BH1
Site Name	**Branch Hill house**	Sample No.	
Soil Description	Brown slightly fine gravelly clayey/silty fine to coarse SAND	Depth Top	**24.50**
		Depth Base	**24.95**
		Sample Type	**B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	99		
3.35	99		
2	99		
1.18	99		
0.6	97		
0.425	97		
0.3	96		
0.212	95		
0.15	90		
0.063	42		

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	57
Silt and Clay	42

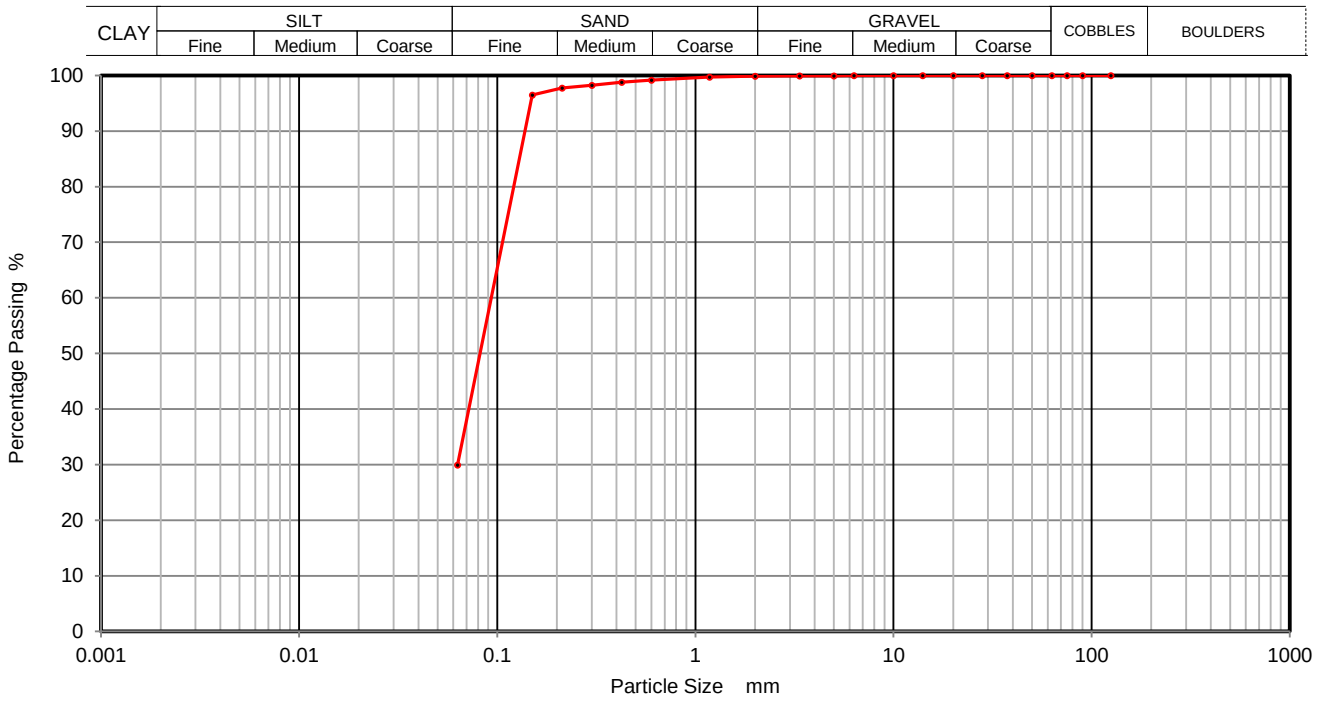
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	29/05/2019	Ben Sharp	
RO/MH	Approved	30/05/2019	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	43978
		Borehole/Pit No.	BH2
Site Name	**Branch Hill house**	Sample No.	
Soil Description	Brown clayey/silty fine to coarse SAND	Depth Top	**14.00**
		Depth Base	**14.45**
		Sample Type	**D**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99		
0.425	99		
0.3	98		
0.212	98		
0.15	96		
0.063	30		

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	70
Silt and Clay	30

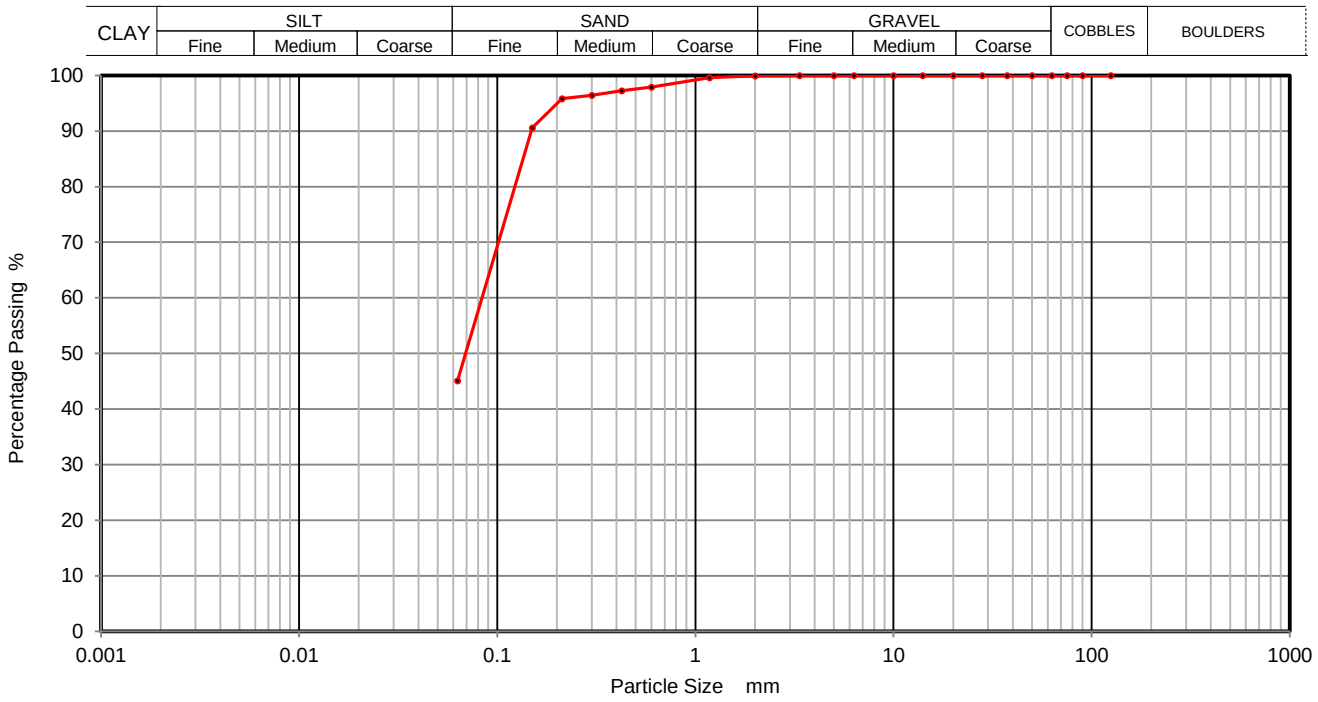
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	29/05/2019	Ben Sharp	
RO/MH	Approved	30/05/2019	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	43978
		Borehole/Pit No.	BH2
Site Name	**Branch Hill house**	Sample No.	
Soil Description	Brown clayey/silty fine to coarse SAND	Depth Top	**26.00**
		Depth Base	**26.45**
		Sample Type	**B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	98		
0.425	97		
0.3	96		
0.212	96		
0.15	91		
0.063	45		

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	55
Silt and Clay	45

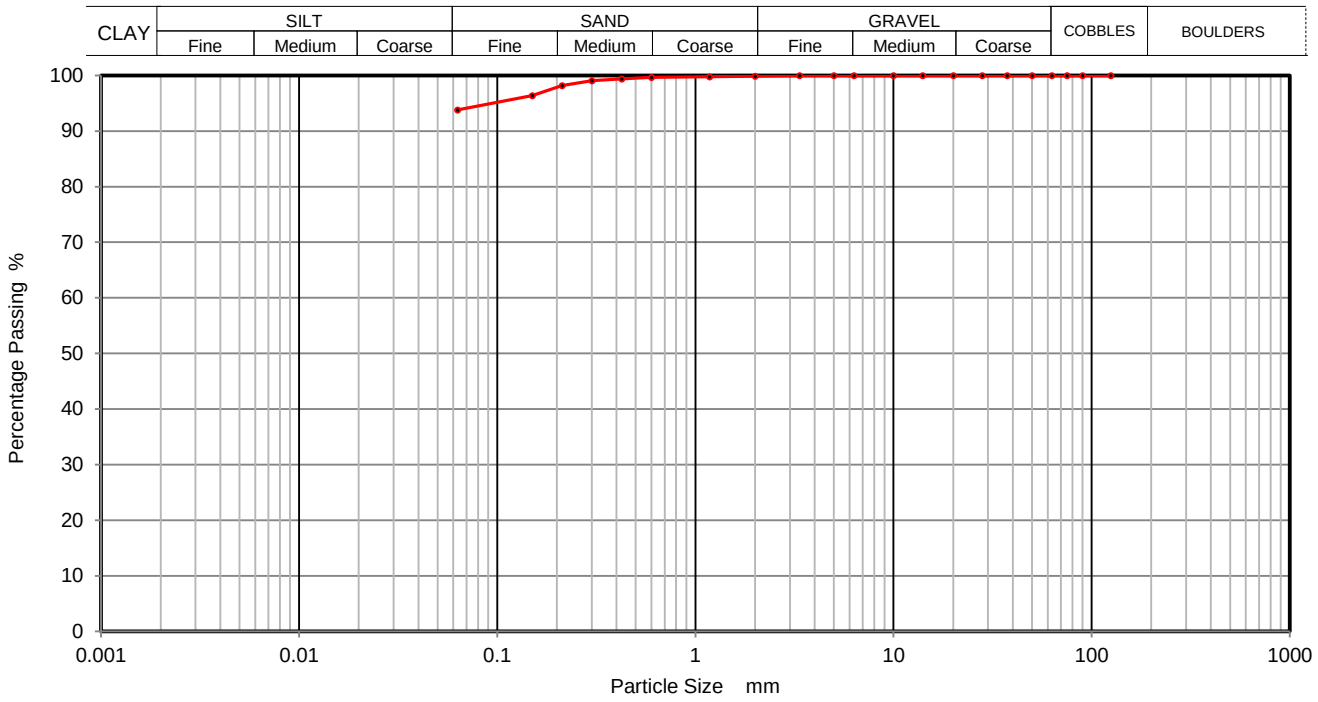
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	29/05/2019	Ben Sharp	
RO/MH	Approved	30/05/2019	Paul Evans	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	43978
		Borehole/Pit No.	BH3
Site Name	Branch Hill house	Sample No.	
Soil Description	Brown slightly fine to coarse sandy SILT/CLAY	Depth Top	2.00
		Depth Base	2.45
		Sample Type	U100



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	99		
0.3	99		
0.212	98		
0.15	96		
0.063	94		

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	6
Silt and Clay	94

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	29/05/2019	Ben Sharp	
RO/MH	Approved	30/05/2019	Paul Evans	D P Evans

UKAS TESTING 2788

GSTL	Certificate of Chemical Analysis BS1377 Part 3 1990	Contract Number	43978
		Client Reference	
Client	Ridge	**Date Received**	
Site Name	Branch Hill House	**Date Started**	25/04/2019
		Date Completed	30/05/2019
		No. of Samples	12

Hole Number	Sample Number	Sample Type	Depth (m)			Acid Soluble Sulphate	Aqueous Extract Sulphate	Water Soluble Chloride	PH Value	Organic Matter Content	Acid Soluble Chloride	Loss On Ignition
BH1		D	2.00	-			0.04		6.85			
BH1		D	10.00	-			0.04		7.29			
BH1		D	15.50	-			0.03		7.46			
BH1		D	20.00	-			0.03		7.82			
BH1		D	25.00	-			0.03		8.01			
BH2		D	1.00	-			0.02		7.20			
BH2		D	5.00	-			0.03		7.26			
BH2		D	10.00	-			0.02		7.39			
BH2		D	29.00	-	29.45		0.03		8.14			
BH3		D	2.00	-			0.03		7.59			
BH3		D	6.00	-			0.03		7.69			
BH3		D	10.00	-			0.03		7.86			
				-								
				-								
				-								
				-								
				-								
				-								
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				-								

Key	**Reported As**	**Clause**
Acid Soluble Sulphate	% SO_3	Clause 5.2 & 5.5
Aqueous Extract Sulphate	g/l SO_4	Clause 5.3 & 5.5
Water Soluble Chloride	%	Clause 7.2
PH Value	@ 25°	Clause 9.5
Organic	%	Clause 3
Acid Soluble Chloride	%	Clause 7.3
LOI	%	Clause 4

Remarks

NCP = No Chloride Present

Test Operator	Checked and Authorised by		Ben Sharp	
Darren Bourne	Date	30/05/2019		

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019
Disturbed / Undisturbed		U

Description of Specimen

Brown sandy silty CLAY

Initial Specimen Conditions

Height	mm	210.00
Diameter	mm	104.00
Area	mm^2	8494.87
Volume	cm^3	1783.92
Mass	g	3434.70
Dry Mass	g	2820.00
Density	Mg/m^3	1.93
Dry Density	Mg/m^3	1.58
Moisture Content	%	22
Specific Gravity	kN/m^3	2.65
(assumed/measured)		assumed

Final Specimen Conditions

Moisture Content	%	24
Density	Mg/m^3	2.06
Dry Density	Mg/m^3	1.67

D P Evans

Checked and Approved By

30/05/19
Date

Client Ref

Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019

Test Setup

Date started	20/05/2019
Date Finished	28/05/2019
Top Drain Used	y
Base Drain Used	y
Side Drains Used	y
Pressure System Number	P1
Cell Number	C1

Saturation

Cell Pressure Incr.	kPa	100.00
Back Pressure Incr.	kPa	95.00
Differential Pressure	kPa	5.00
Final Cell Pressure	kPa	300.00
Final Pore Pressure	kPa	291.00
Final B Value		0.96

Consolidation

Effective Pressure	kPa	30.00	60.00	120.00
Cell Pressure	kPa	300.00	300.00	300.00
Back Pressure	kPa	270.00	240.00	180.00
Excess Pore Pressure	kPa	21.00	21.00	35.00
Pore Pressure at End	kPa	270.00	240.00	180.00
Consolidated Volume	cm^3	1749.92	1721.82	1690.92
Consolidated Height	mm	208.67	200.93	192.13
Consolidated Area	mm^2	8386.93	8569.82	8801.46
Vol. Compressibility	m^2/MN	0.07059	0.06691	0.09970
Consolidation Coef.	$m^2/yr.$	1.59040	0.46862	0.33362

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Branch Hill house

Contract No

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GSTL
GEO SITE & TESTING SERVICES LTD

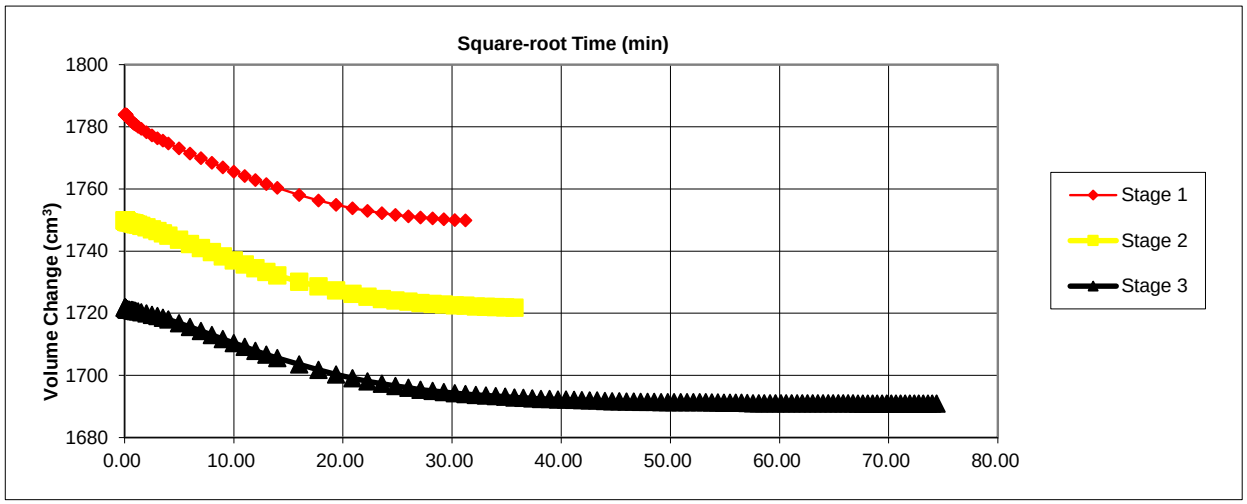
Consolidated Undrained Triaxial Compression Test

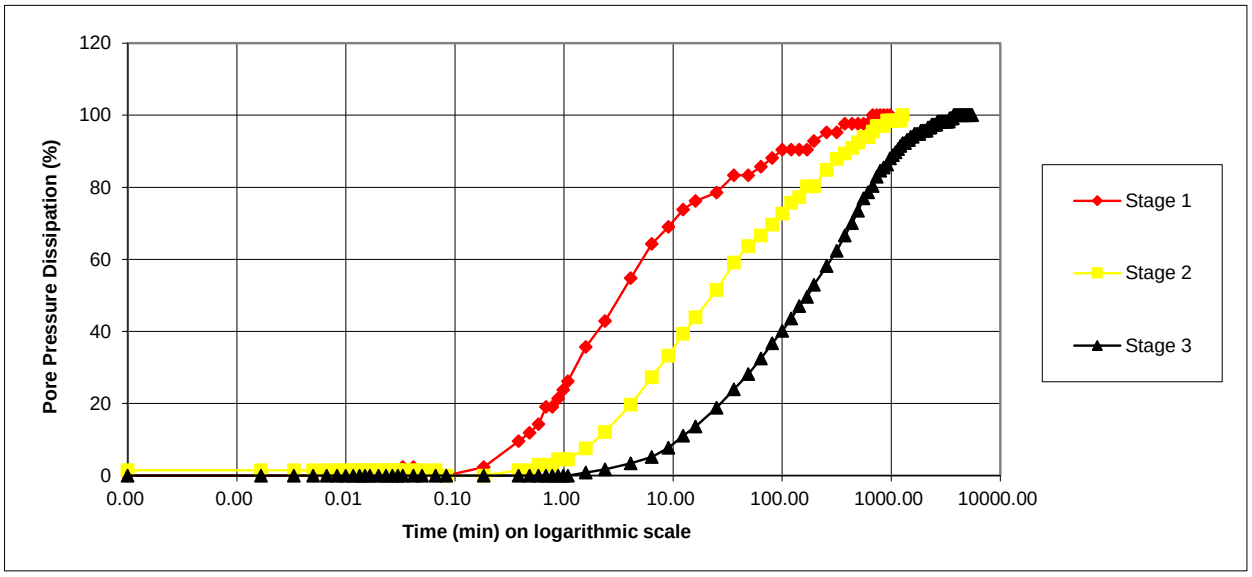
BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019

Consolidation Stage





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Branch Hill house

Contract No

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GEO SITE & TESTING SERVICES LTD

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019

Shearing

Initial Cell Pressure	kPa	300	300	300
Initial Pore Pressure	kPa	270	240	180
Rate of Strain	mm/min	0.0323	0.0092	0.0062
Max Deviator Stress				
Axial Strain		5.022	8.711	15.085
Axial Stress	kPa	109.281	190.11	325.44
Cor. Deviator stress	kPa	106.259	185.70	320.74
Effective Major Stress	kPa	120.259	225.70	403.74
Effective Minor Stress	kPa	15.000	40.00	83.00
Effective Stress Ratio		8.017	5.643	4.86
s'	kPa	67.629	132.85	243.37
t'	kPa	52.629	92.85	160.37
Max Effective Priciple Stress Ratio				
Axial Strain		4.673	8.059	15.085
Axial Stress	kPa	105.365	184.302	325.438
Cor. Deviator stress	kPa	101.368	179.962	320.736
Effective Major Stress	kPa	114.368	216.962	403.736
Effective Minor Stress	kPa	13.000	37.000	83.000
Effective Stress Ratio		8.798	5.864	4.864
s'	kPa	63.684	126.981	243.368
t'	kPa	50.684	89.981	160.368
Shear Resistance Angle	degs			37.5
Cohesion c'	kPa			15

D P Evans

Checked and Approved By

30/05/19
Date

Client Ref

Branch Hill house

Contract No

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GSTL
GEO SITE & TESTING SERVICES LTD

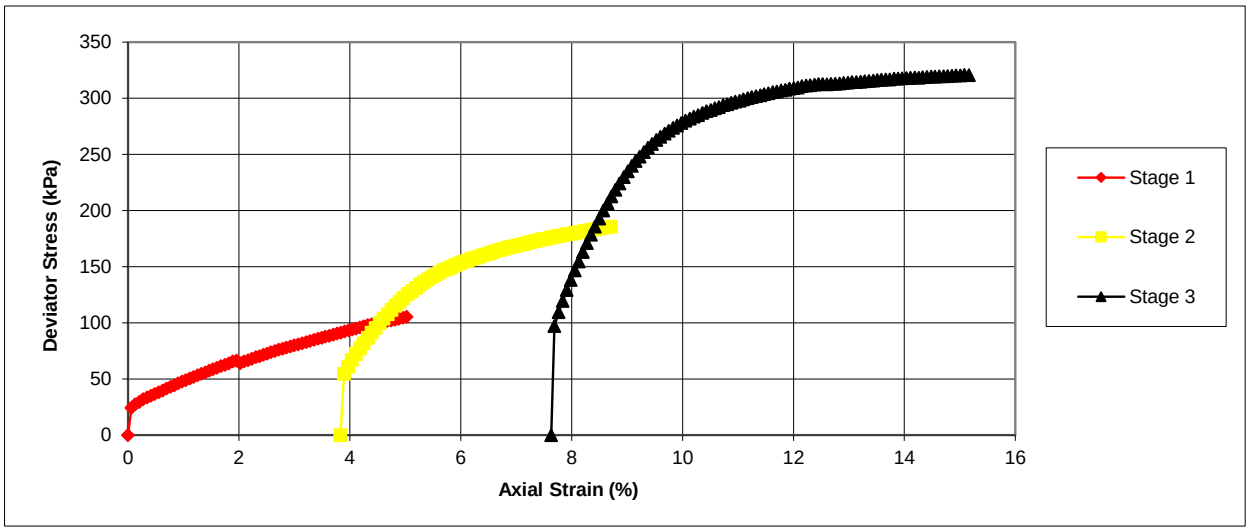
Consolidated Undrained Triaxial Compression Test

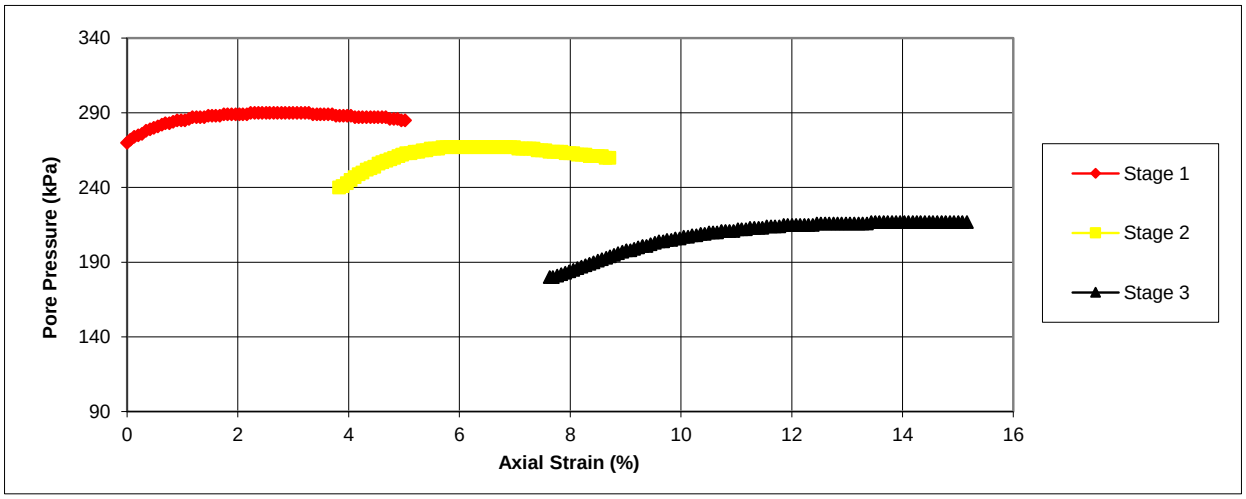
BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019

Shearing Stage





D P Evans

Checked and Approved By

30/05/19
Date

Client Ref

Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

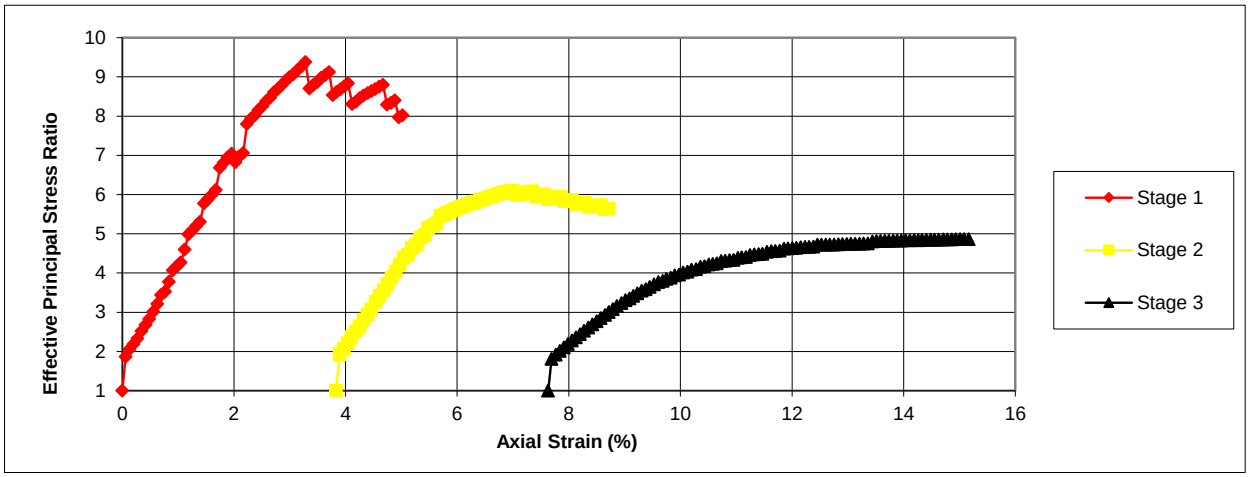
Consolidated Undrained Triaxial Compression Test

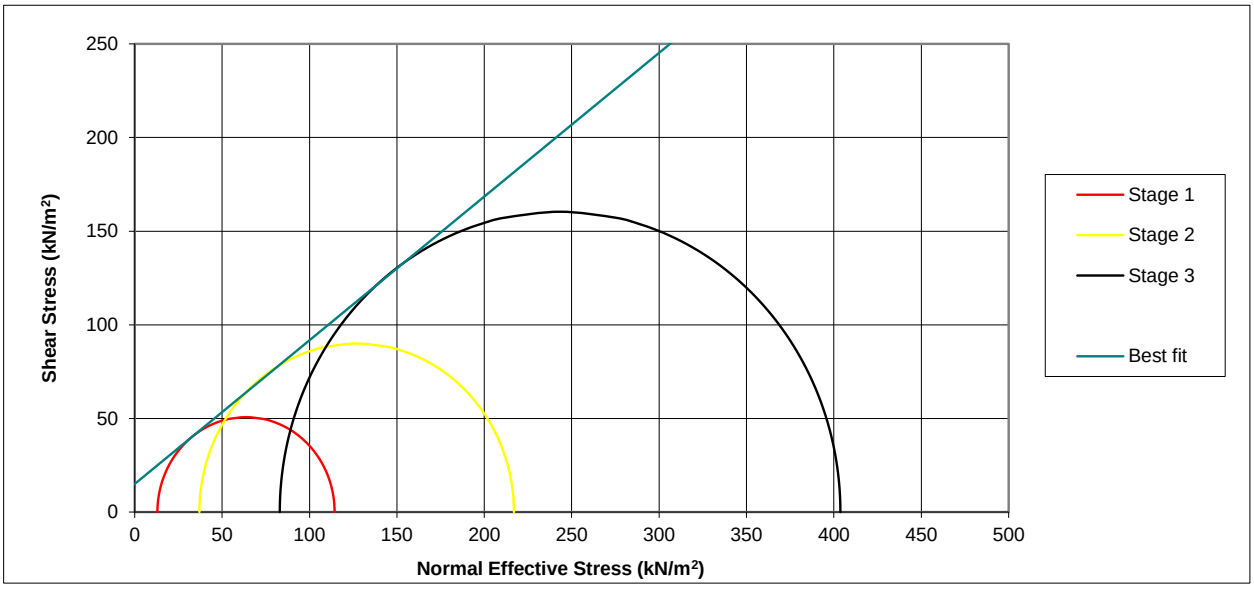
BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019

Shearing Stage





D P Gray

Checked and Approved By

30/05/19
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Client Ref

Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

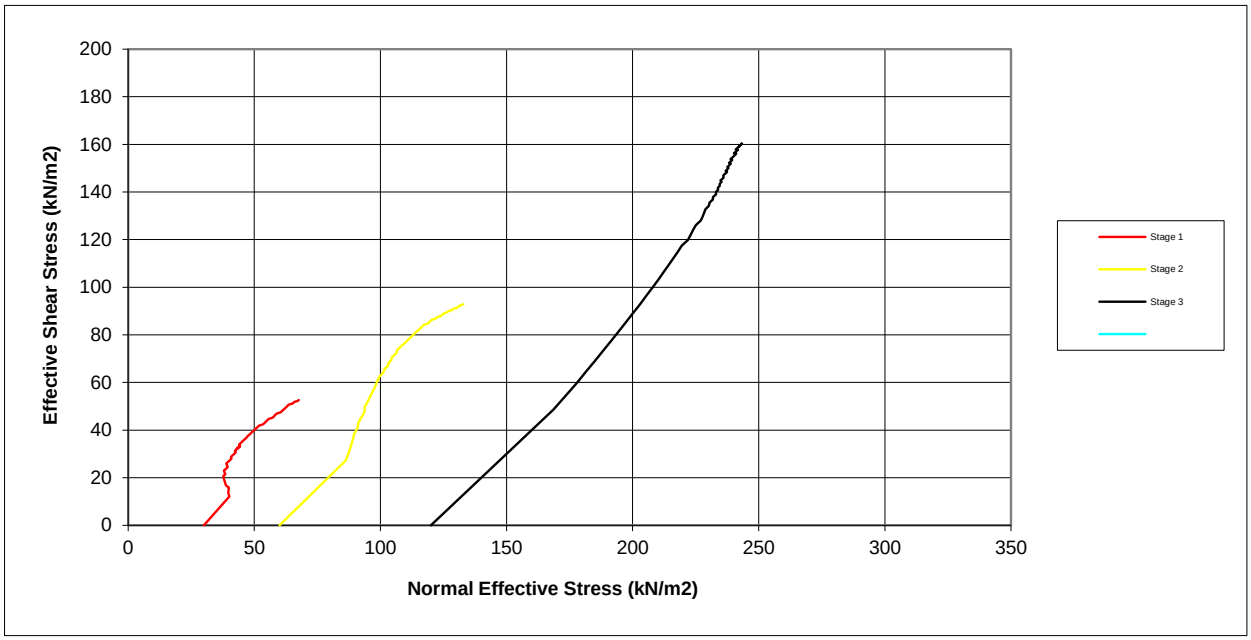
Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019

Shearing Stage



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30/05/19
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Client Ref

Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	4.00-4.45
Date		29/05/2019

D P Evans

Checked and Approved By

30/05/19
Date

Client Ref

Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019
Disturbed / Undisturbed		U

Description of Specimen

Brown silty CLAY

Initial Specimen Conditions

Height	mm	210.00
Diameter	mm	105.00
Area	mm^2	8659.01
Volume	cm^3	1818.39
Mass	g	3467.70
Dry Mass	g	2801.20
Density	Mg/m^3	1.91
Dry Density	Mg/m^3	1.54
Moisture Content	%	24
Specific Gravity	kN/m^3	2.65
(assumed/measured)		assumed

Final Specimen Conditions

Moisture Content	%	24
Density	Mg/m^3	2.12
Dry Density	Mg/m^3	1.71

D P Gans

Checked and Approved By

30/05/19
Date

Client Ref

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Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019

Test Setup

Date started	20/05/2019
Date Finished	28/05/2019
Top Drain Used	y
Base Drain Used	y
Side Drains Used	y
Pressure System Number	P2
Cell Number	C2

Saturation

Cell Pressure Incr.	kPa	100.00
Back Pressure Incr.	kPa	95.00
Differential Pressure	kPa	5.00
Final Cell Pressure	kPa	800.00
Final Pore Pressure	kPa	741.00
Final B Value		0.95

Consolidation

Effective Pressure	kPa	180.00	360.00	720.00
Cell Pressure	kPa	800.00	800.00	800.00
Back Pressure	kPa	620.00	440.00	80.00
Excess Pore Pressure	kPa	175.00	210.00	440.00
Pore Pressure at End	kPa	620.00	440.00	80.00
Consolidated Volume	cm^3	1721.49	1677.89	1642.69
Consolidated Height	mm	206.27	198.55	190.30
Consolidated Area	mm^2	8351.40	8451.99	8633.01
Vol. Compressibility	m^2/MN	0.08595	0.05756	0.26223
Consolidation Coef.	$m^2/yr.$	0.03899	0.02229	0.01532

D P Evans

Checked and Approved By

30/05/19
Date

Client Ref

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Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

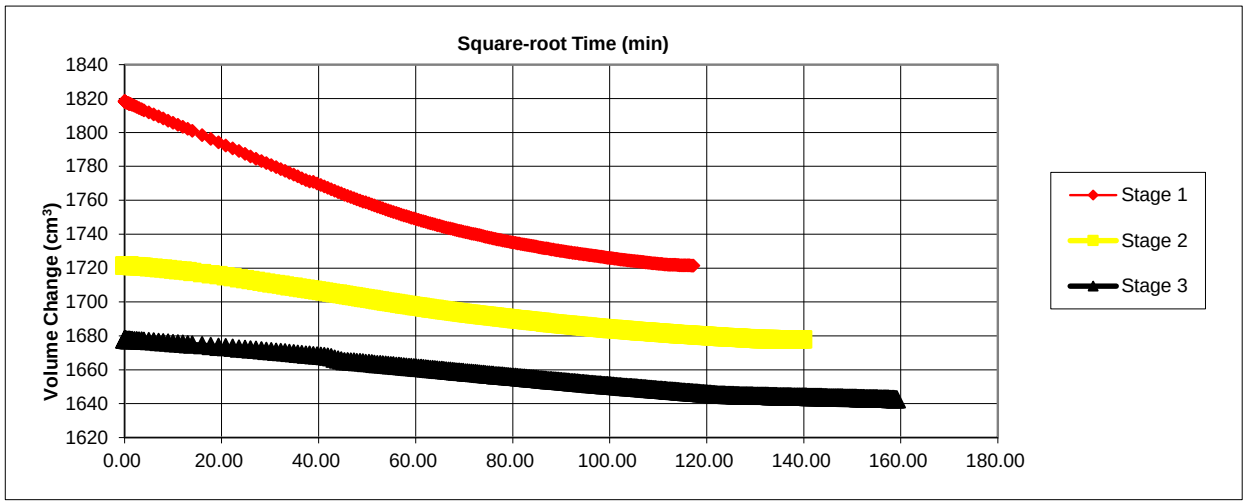
Consolidated Undrained Triaxial Compression Test

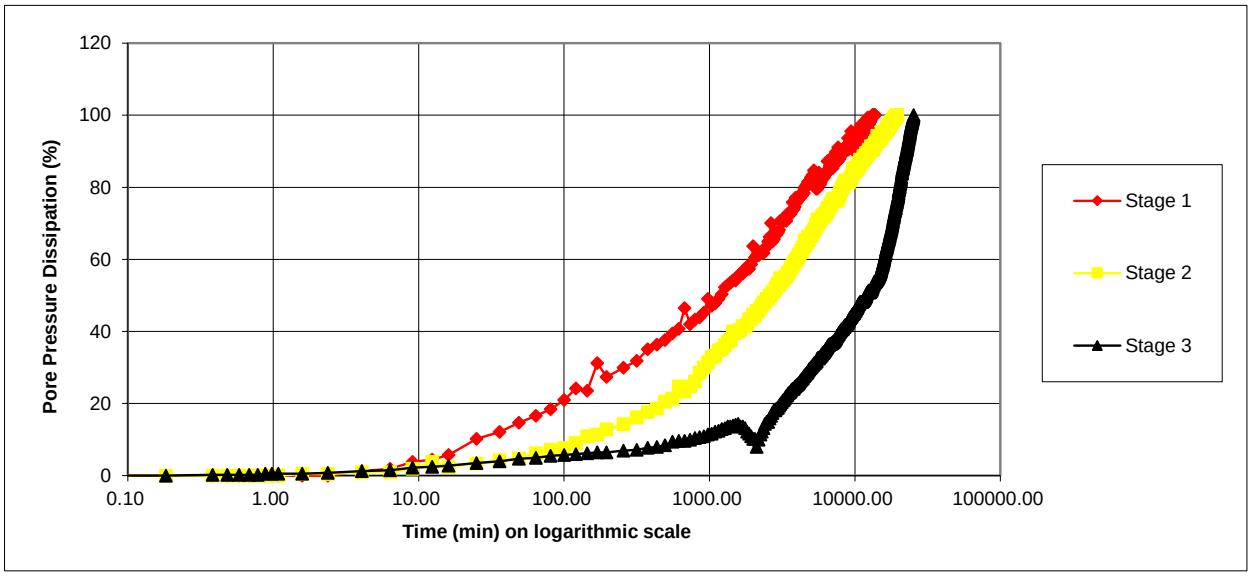
BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019

Consolidation Stage





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Client Ref

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Contract No

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Branch Hill house

GSTL
GEO SITE & TESTING SERVICES LTD

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019

Shearing

Initial Cell Pressure	kPa	800	800	800
Initial Pore Pressure	kPa	620	440	80
Rate of Strain	mm/min	0.0008	0.0004	0.0003
Max Deviator Stress				
Axial Strain		5.183	7.608	10.666
Axial Stress	kPa	268.624	361.77	638.01
Cor. Deviator stress	kPa	265.594	357.48	633.58
Effective Major Stress	kPa	353.594	574.48	1210.58
Effective Minor Stress	kPa	89.000	217.00	577.00
Effective Stress Ratio		3.973	2.647	2.10
s'	kPa	221.297	395.74	893.79
t'	kPa	132.297	178.74	316.79
Max Effective Priciple Stress Ratio				
Axial Strain		4.329	7.829	12.227
Axial Stress	kPa	264.397	361.149	622.942
Cor. Deviator stress	kPa	260.430	356.842	618.418
Effective Major Stress	kPa	348.430	572.842	1176.418
Effective Minor Stress	kPa	88.000	216.000	558.000
Effective Stress Ratio		3.959	2.652	2.108
s'	kPa	218.215	394.421	867.209
t'	kPa	130.215	178.421	309.209
Shear Resistance Angle	degs			16.2
Cohesion c'	kPa			70

D P Evans

Checked and Approved By

30/05/19
Date

Client Ref

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Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

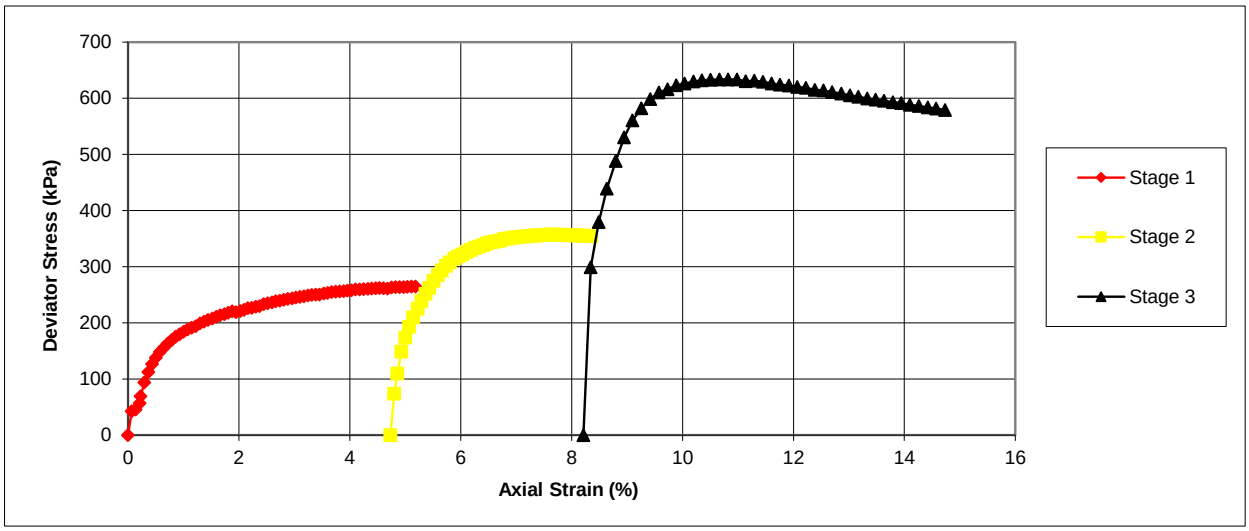
Consolidated Undrained Triaxial Compression Test

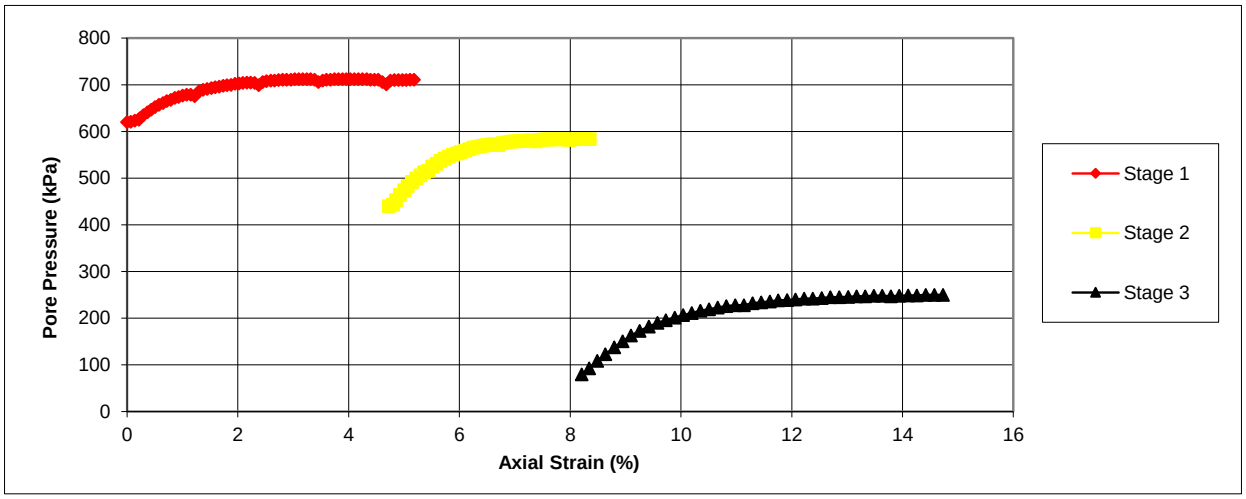
BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019

Shearing Stage





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Checked and Approved By

30/05/19
Date

Client Ref

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Branch Hill house

Contract No

43978

GSTL
GEO SITE & TESTING SERVICES LTD

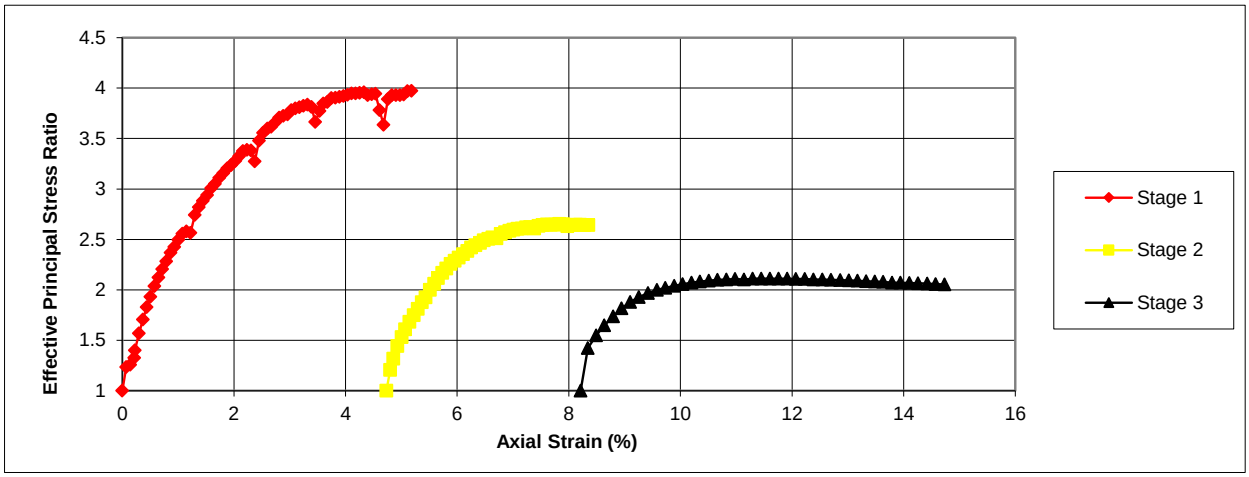
Consolidated Undrained Triaxial Compression Test

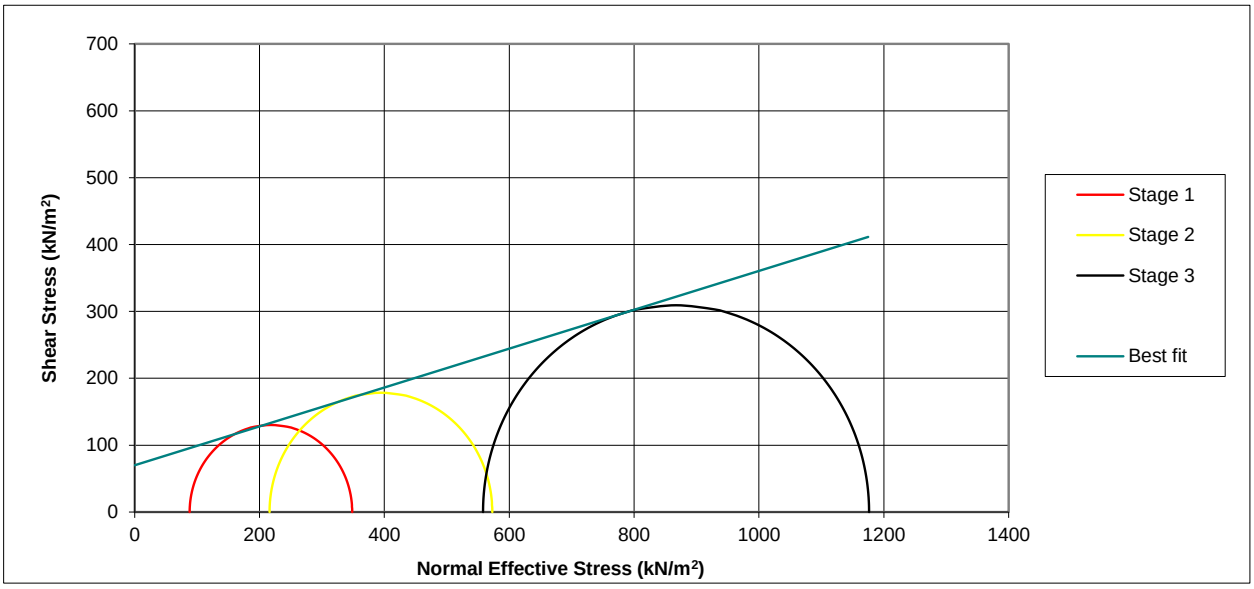
BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019

Shearing Stage





Checked and Approved By

30/05/19
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Client Ref

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Contract No

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Branch Hill house

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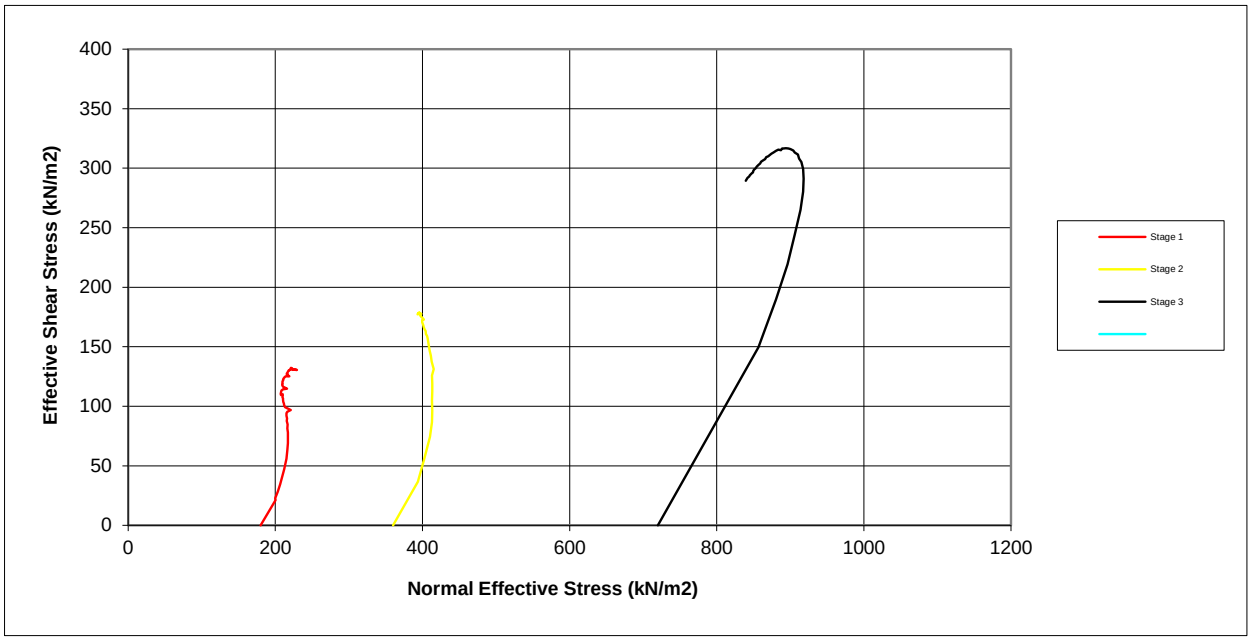
Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019

Shearing Stage



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Branch Hill house

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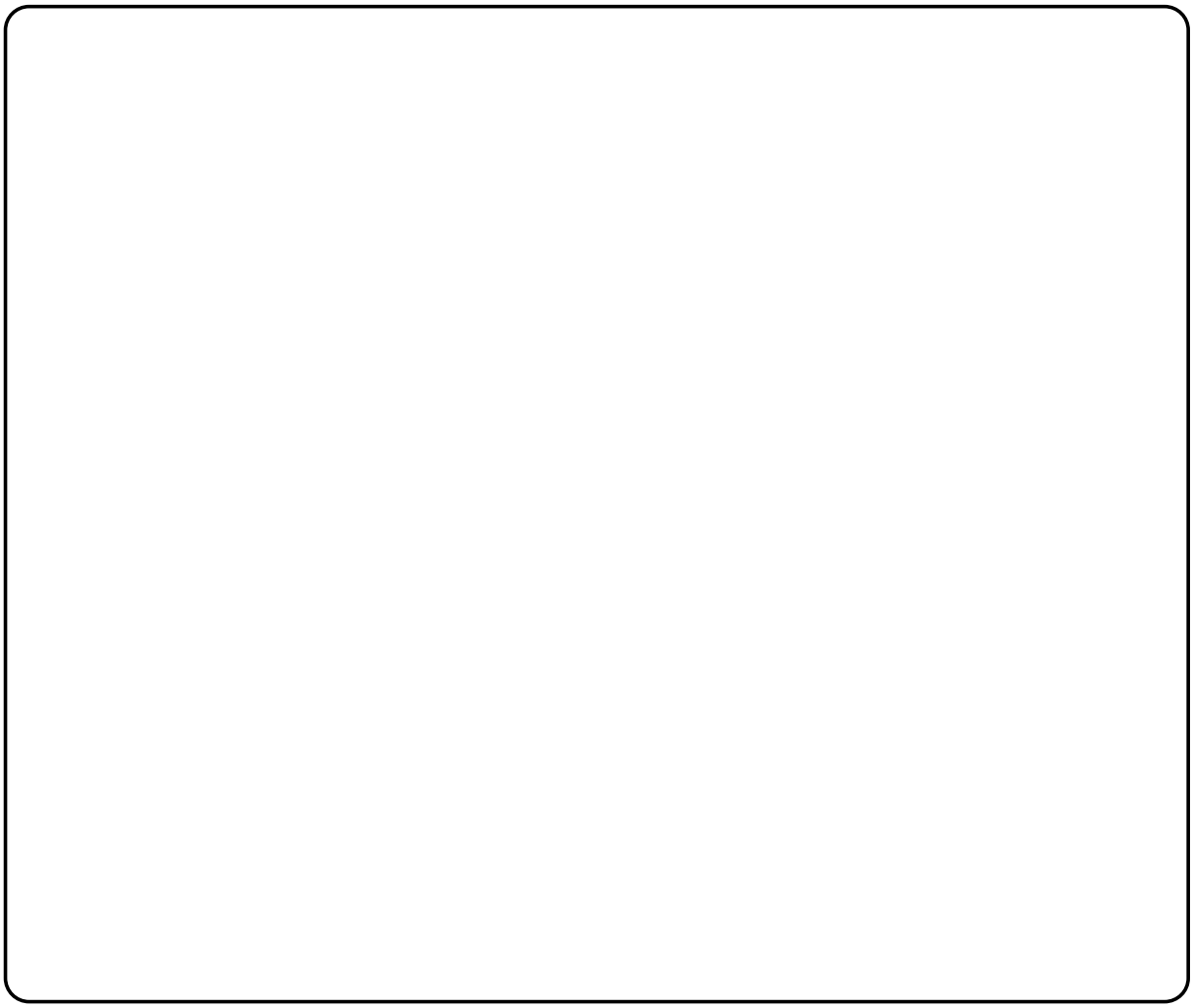
Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	m	18.50-18.95
Date		29/05/2019



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Branch Hill house

Contract No

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GSTL
GEO SITE & TESTING SERVICES LTD

Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95
Date		29/05/2019
Disturbed / Undisturbed		U

Description of Specimen

Brown silty CLAY

Initial Specimen Conditions

Height	mm	210.00
Diameter	mm	104.00
Area	mm^2	8494.87
Volume	cm^3	1783.92
Mass	g	3493.70
Dry Mass	g	2865.00
Density	Mg/m^3	1.96
Dry Density	Mg/m^3	1.61
Moisture Content	%	22
Specific Gravity	kN/m^3	2.65
(assumed/measured)		assumed

Final Specimen Conditions

Moisture Content	%	23
Density	Mg/m^3	2.10
Dry Density	Mg/m^3	1.71

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Consolidated Undrained Triaxial Compression Test

BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95

Test Setup

Date started	20/05/2019
Date Finished	28/05/2019
Top Drain Used	y
Base Drain Used	y
Side Drains Used	y
Pressure System Number	P3
Cell Number	C3

Saturation

Cell Pressure Incr.	kPa	100.00
Back Pressure Incr.	kPa	95.00
Differential Pressure	kPa	5.00
Final Cell Pressure	kPa	800.00
Final Pore Pressure	kPa	693.00
Final B Value		0.96

Consolidation

Effective Pressure	kPa	180.00	360.00	720.00
Cell Pressure	kPa	800.00	800.00	800.00
Back Pressure	kPa	620.00	440.00	80.00
Excess Pore Pressure	kPa	180.00	180.00	365.00
Pore Pressure at End	kPa	620.00	440.00	80.00
Consolidated Volume	cm^3	1737.92	1710.52	1675.92
Consolidated Height	mm	208.19	199.48	191.66
Consolidated Area	mm^2	8348.83	8575.55	8745.28
Vol. Compressibility	m^2/MN	0.04159	0.03583	0.25285
Consolidation Coef.	$m^2/yr.$	0.16870	0.03189	0.01756

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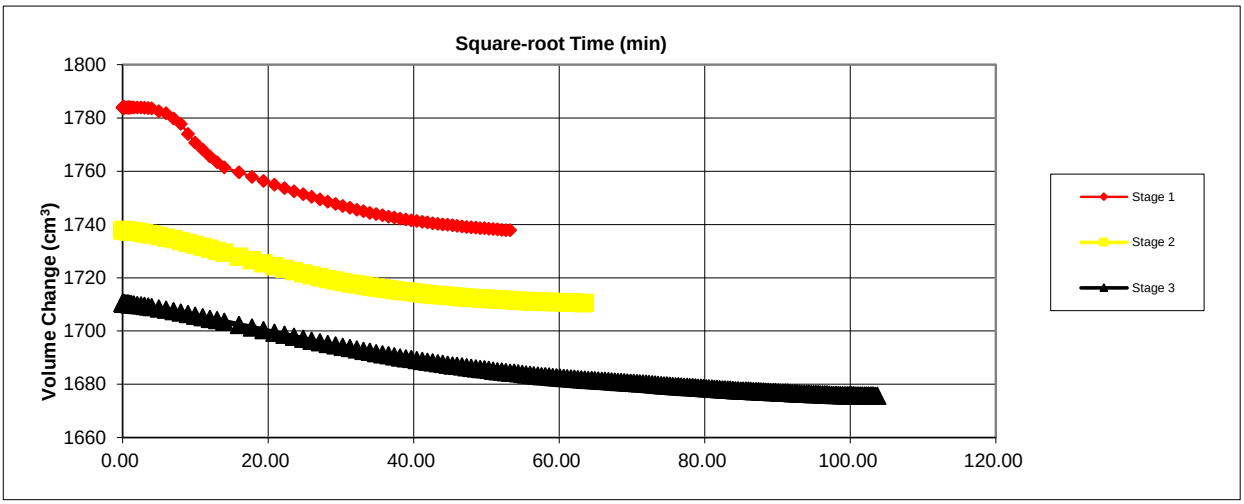
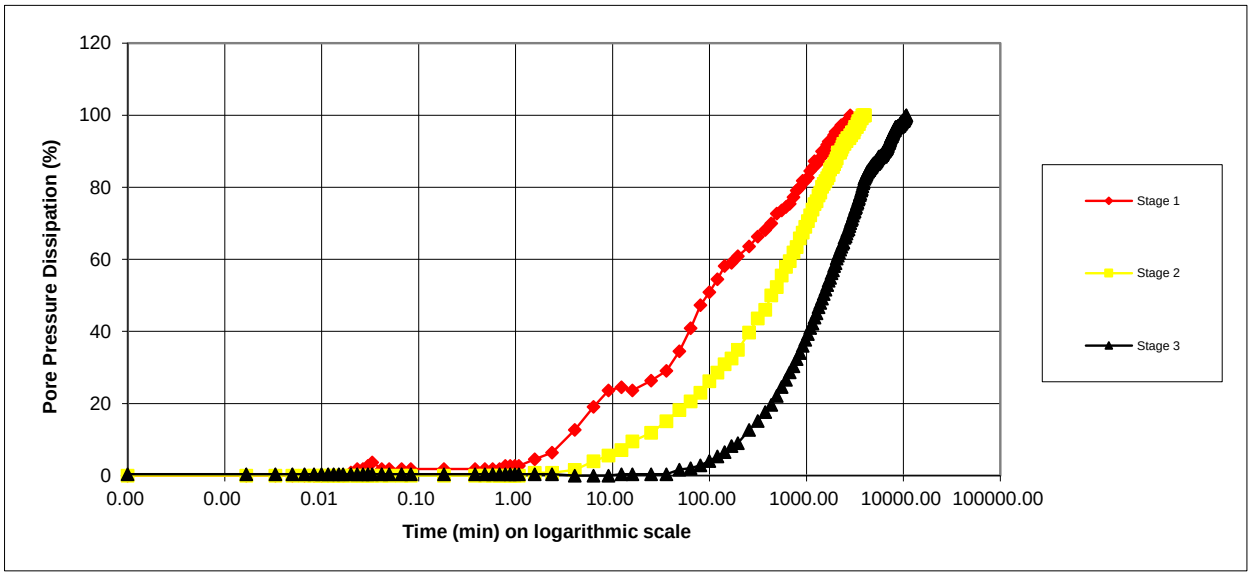
Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95

Consolidation Stage





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BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95

Shearing

Initial Cell Pressure	kPa	800	800	800
Initial Pore Pressure	kPa	620	440	80
Rate of Strain	mm/min	0.0034	0.0006	0.0003
Max Deviator Stress				
Axial Strain		4.669	7.461	10.050
Axial Stress	kPa	245.053	367.36	602.68
Cor. Deviator stress	kPa	236.057	363.08	598.27
Effective Major Stress	kPa	387.057	669.08	1208.27
Effective Minor Stress	kPa	152.000	306.00	610.00
Effective Stress Ratio		2.546	2.187	1.98
s'	kPa	269.528	487.54	909.14
t'	kPa	117.528	181.54	299.14
Max Effective Priciple Stress Ratio				
Axial Strain		4.246	7.020	9.842
Axial Stress	kPa	236.046	353.741	600.438
Cor. Deviator stress	kPa	232.082	349.510	596.044
Effective Major Stress	kPa	382.082	648.510	1209.044
Effective Minor Stress	kPa	150.000	299.000	613.000
Effective Stress Ratio		2.547	2.169	1.972
s'	kPa	266.041	473.755	911.022
t'	kPa	116.041	174.755	298.022
Shear Resistance Angle	degs			16.2
Cohesion c'	kPa			45

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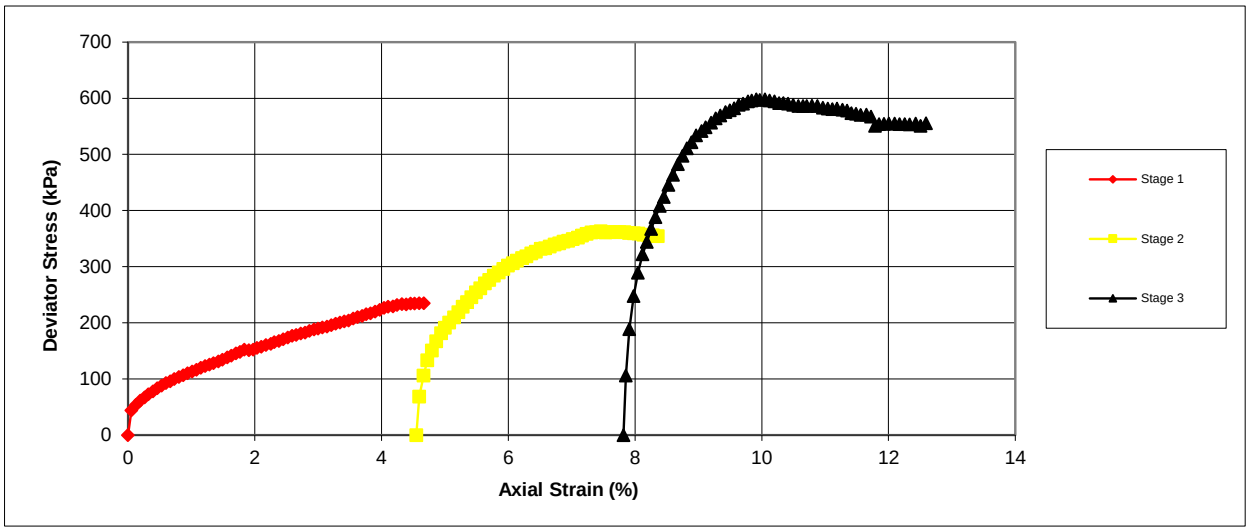
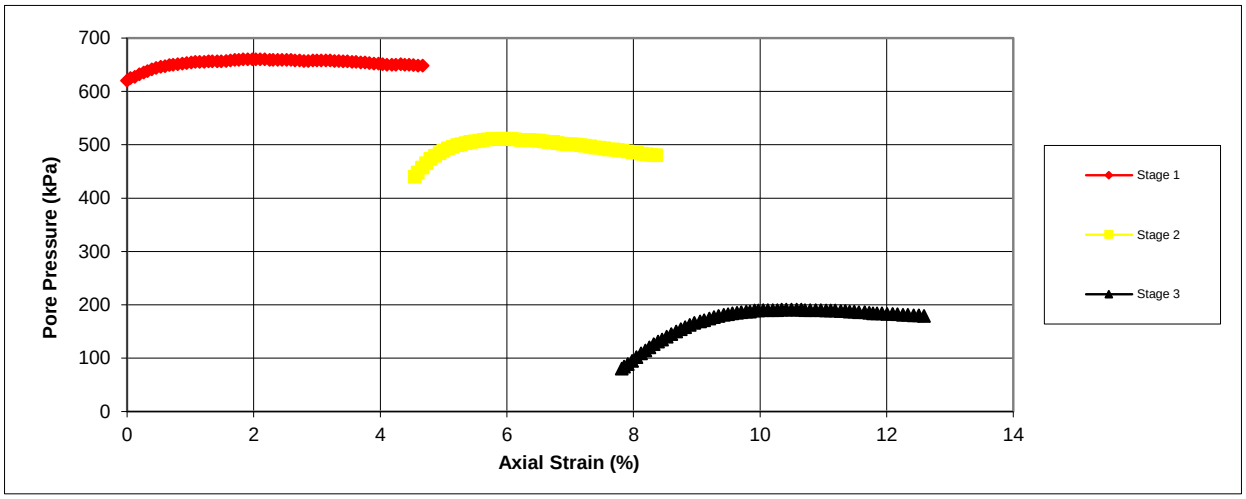
Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95

Shearing Stage





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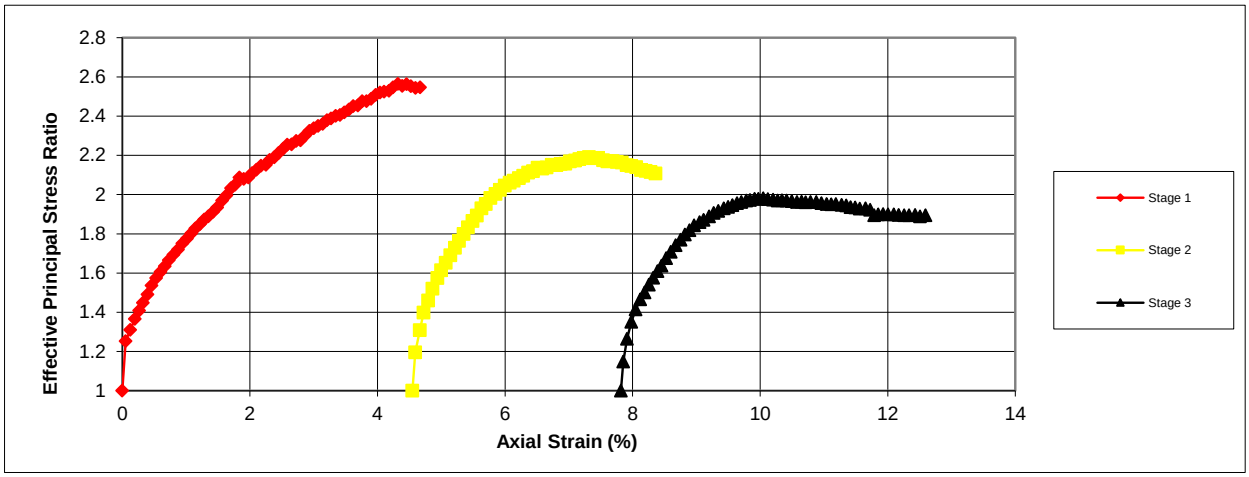
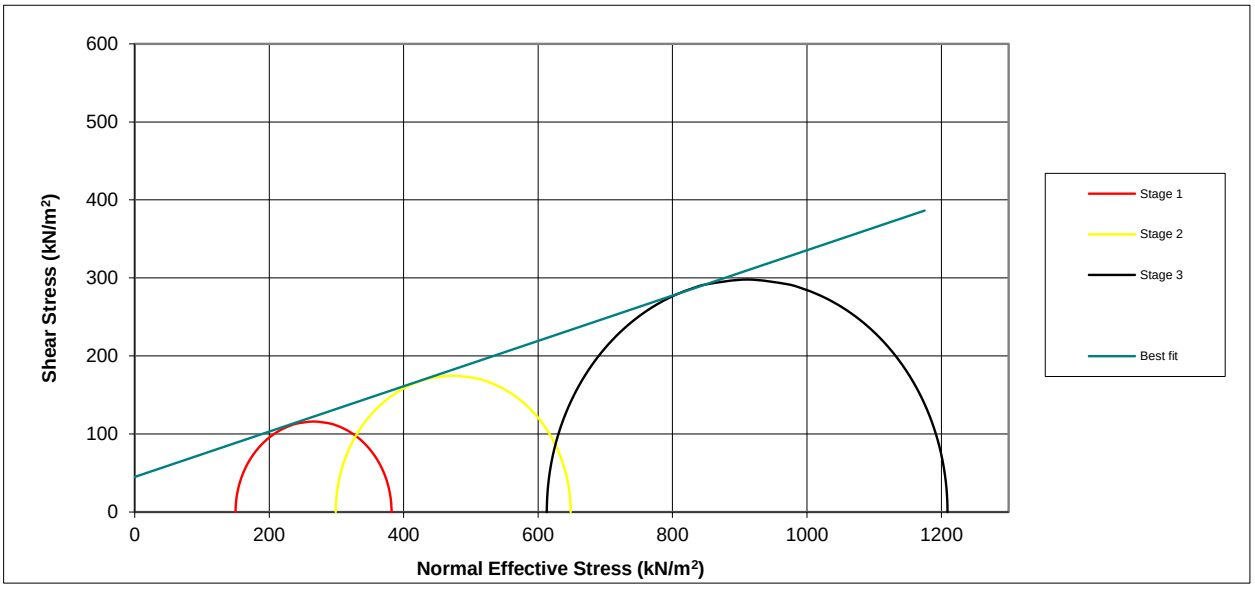
Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95

Shearing Stage





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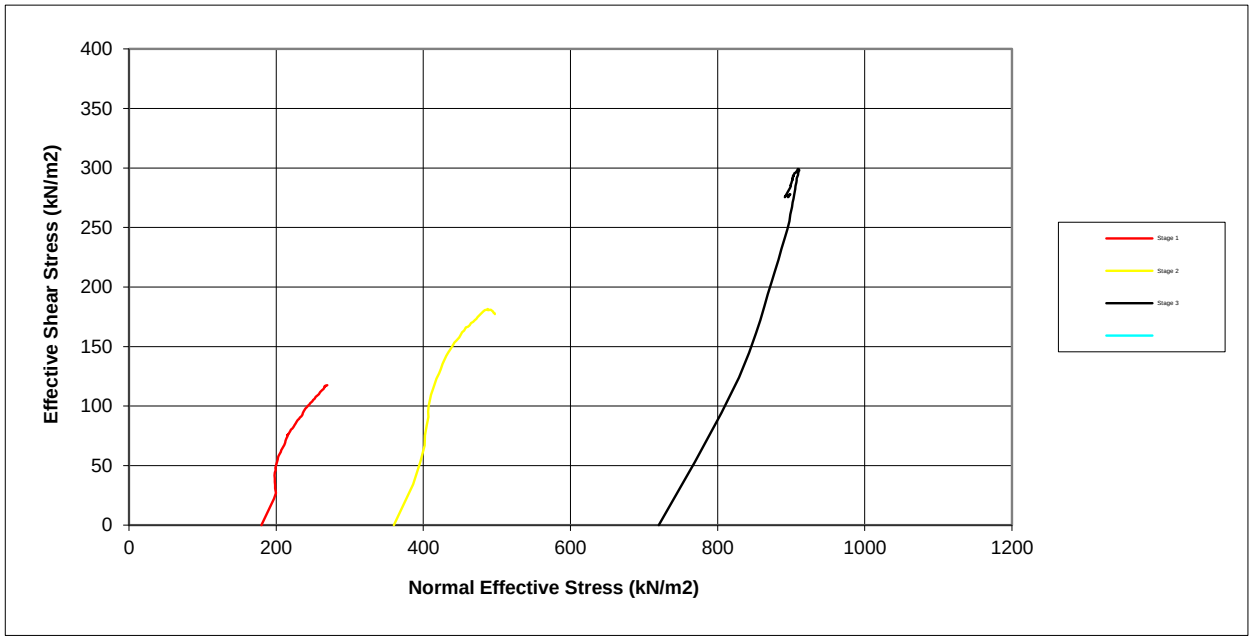
Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95

Shearing Stage



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Specimen Details

Borehole		BH01
Sample No.		
Depth	from(m)	21.50
Depth	to(m)	21.95

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BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019
Disturbed / Undisturbed		U

Description of Specimen

Brown sandy silty CLAY

Initial Specimen Conditions

Height	mm	210.00
Diameter	mm	105.00
Area	mm^2	8659.01
Volume	cm^3	1818.39
Mass	g	3297.50
Dry Mass	g	2587.00
Density	Mg/m^3	1.81
Dry Density	Mg/m^3	1.42
Moisture Content	%	27
Specific Gravity	kN/m^3	2.65
(assumed/measured)		assumed

Final Specimen Conditions

Moisture Content	%	28
Density	Mg/m^3	1.92
Dry Density	Mg/m^3	1.50

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Specimen Details

Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019

Test Setup

Date started	20/05/2019
Date Finished	28/05/2019
Top Drain Used	y
Base Drain Used	y
Side Drains Used	y
Pressure System Number	P4
Cell Number	C4

Saturation

Cell Pressure Incr.	kPa	100.00
Back Pressure Incr.	kPa	95.00
Differential Pressure	kPa	5.00
Final Cell Pressure	kPa	600.00
Final Pore Pressure	kPa	490.00
Final B Value		0.95

Consolidation

Effective Pressure	kPa	140.00	280.00	560.00
Cell Pressure	kPa	700.00	700.00	700.00
Back Pressure	kPa	560.00	420.00	140.00
Excess Pore Pressure	kPa	140.00	140.00	286.00
Pore Pressure at End	kPa	560.00	420.00	140.00
Consolidated Volume	cm^3	1776.89	1753.29	1726.09
Consolidated Height	mm	208.40	202.29	193.50
Consolidated Area	mm^2	8527.27	8667.55	8920.65
Vol. Compressibility	m^2/MN	0.04075	0.03162	0.11081
Consolidation Coef.	$m^2/yr.$	2.94445	0.87057	0.37742

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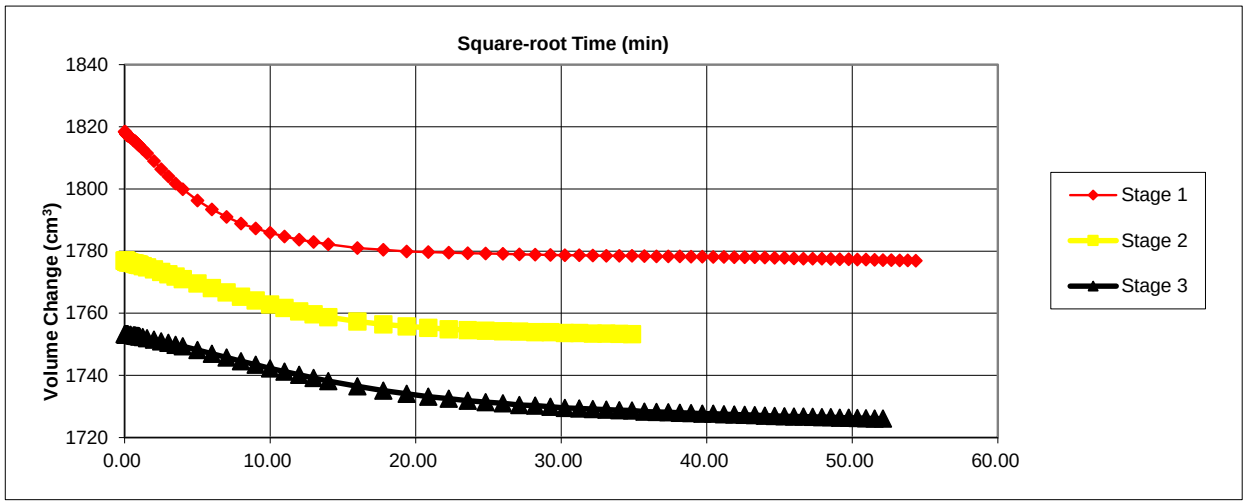
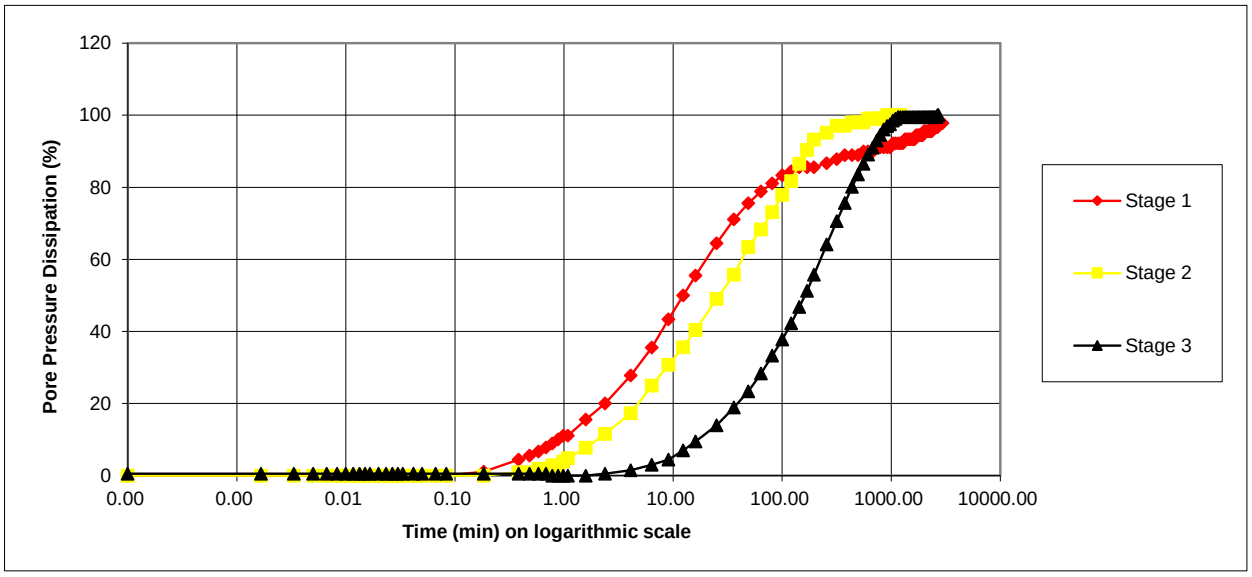
Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019

Consolidation Stage





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Specimen Details

Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019

Shearing

Initial Cell Pressure	kPa	700	700	700
Initial Pore Pressure	kPa	560	420	140
Rate of Strain	mm/min	0.0587	0.0168	0.0070
Max Deviator Stress				
Axial Strain		4.055	7.598	11.413
Axial Stress	kPa	193.634	437.00	798.02
Cor. Deviator stress	kPa	190.688	432.72	793.55
Effective Major Stress	kPa	327.688	728.72	1328.55
Effective Minor Stress	kPa	138.000	296.00	535.00
Effective Stress Ratio		2.375	2.462	2.48
s'	kPa	232.844	512.36	931.77
t'	kPa	94.844	216.36	396.77
Max Effective Priciple Stress Ratio				
Axial Strain		3.987	6.817	8.948
Axial Stress	kPa	192.351	415.645	708.205
Cor. Deviator stress	kPa	188.410	411.442	703.872
Effective Major Stress	kPa	325.410	697.442	1194.872
Effective Minor Stress	kPa	137.000	286.000	491.000
Effective Stress Ratio		2.375	2.439	2.434
s'	kPa	231.205	491.721	842.936
t'	kPa	94.205	205.721	351.936
Shear Resistance Angle	degs			24.7
Cohesion c'	kPa			0

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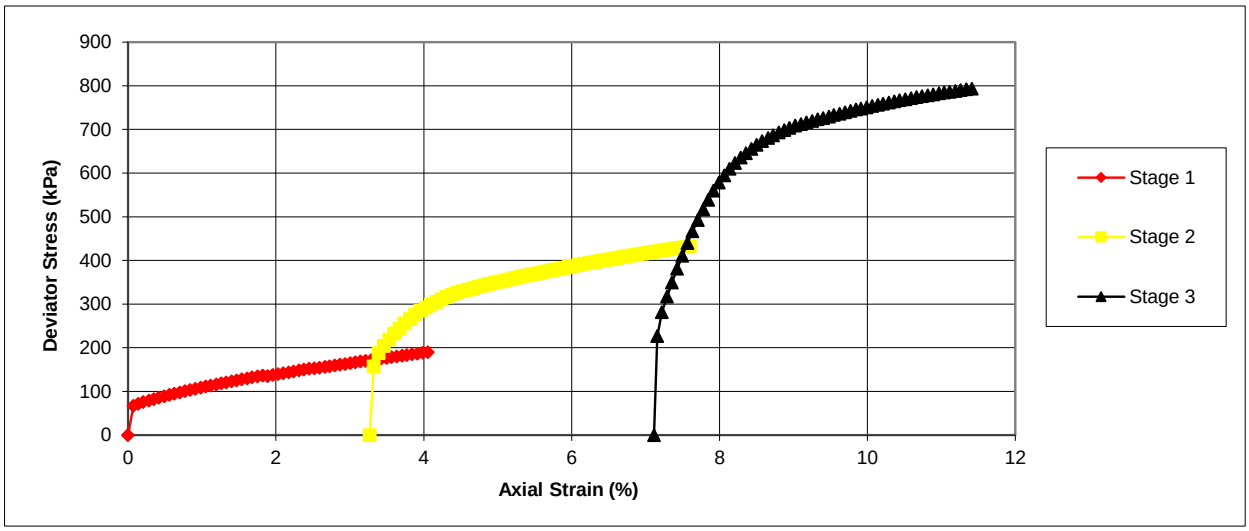
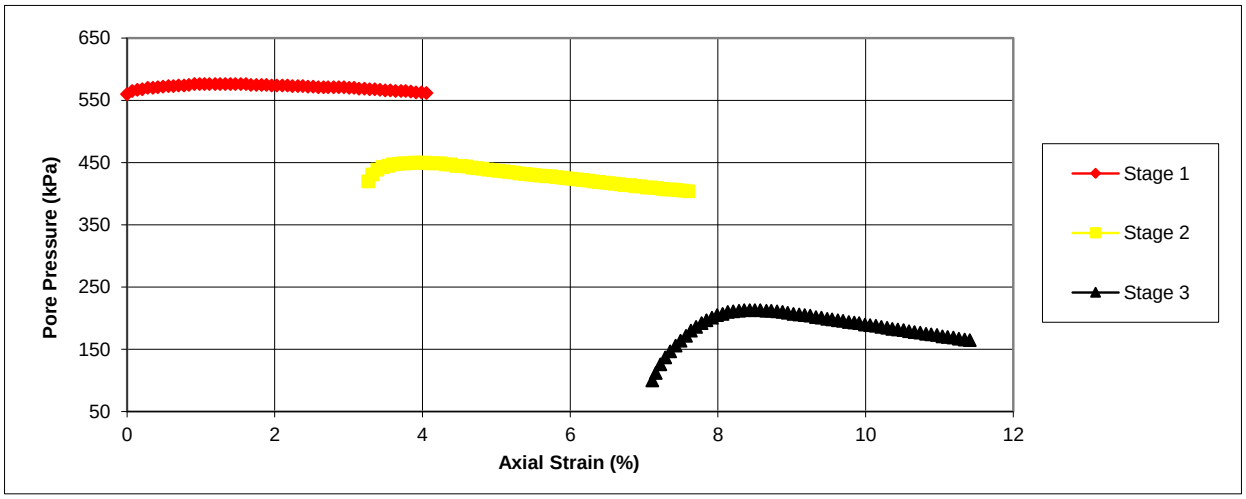
Specimen Details

Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019

Shearing Stage





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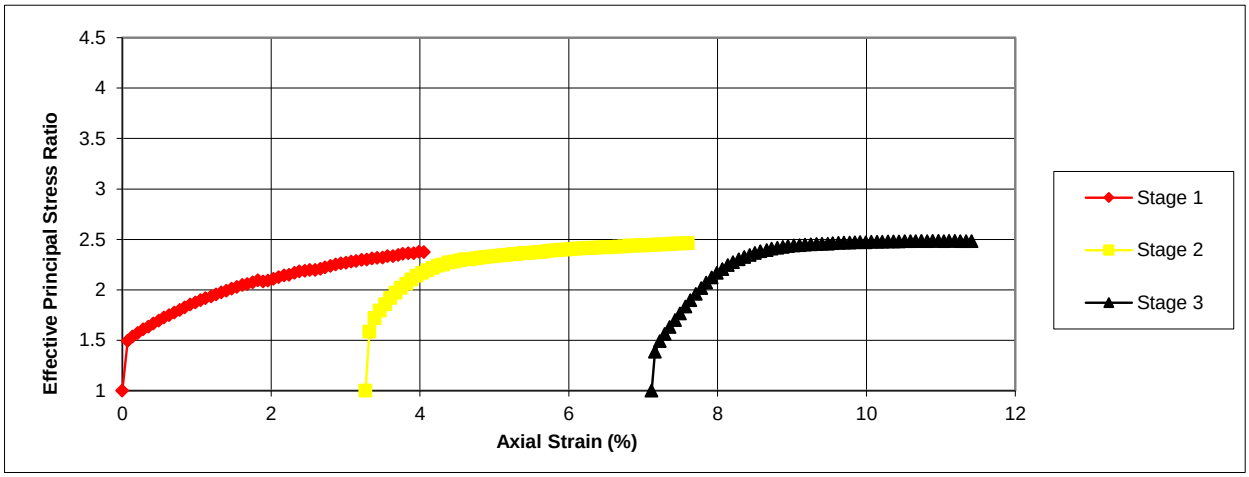
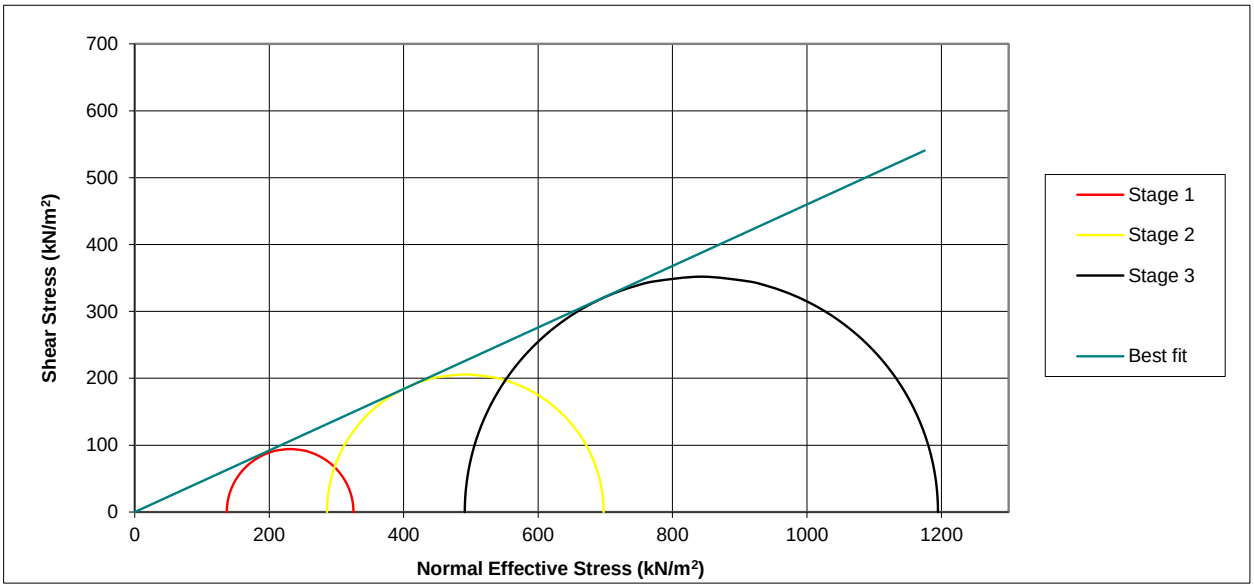
Specimen Details

Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019

Shearing Stage





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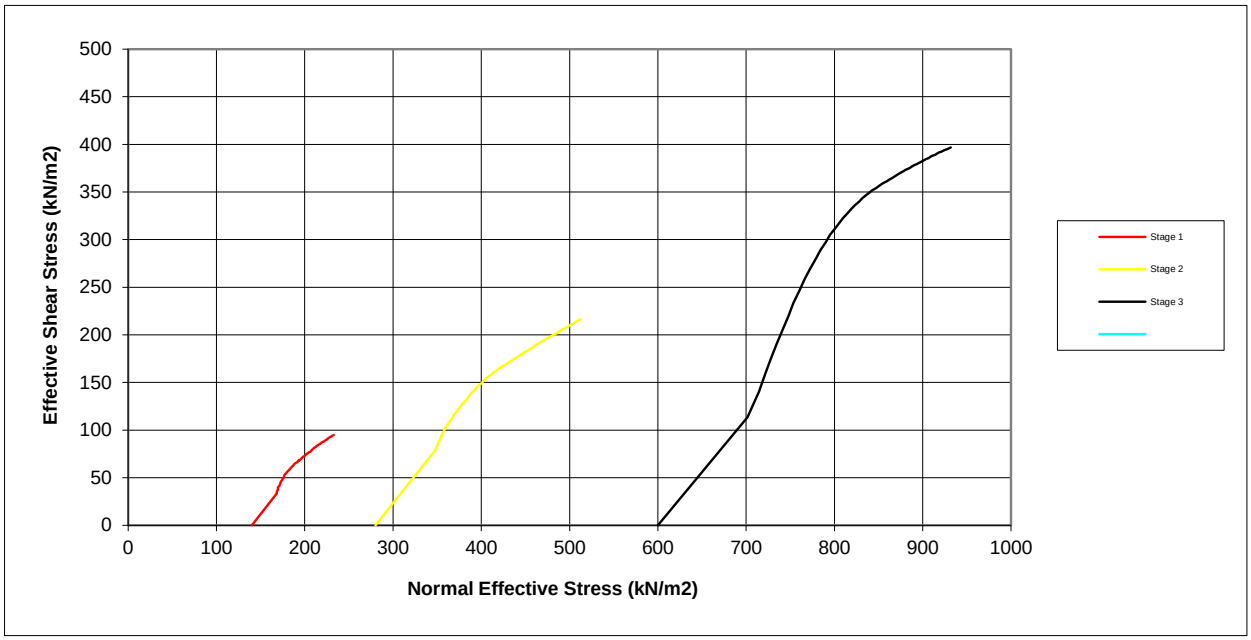
Specimen Details

Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019

Shearing Stage



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Specimen Details

Borehole		BH02
Sample No.		
Depth	m	15.50-15.95
Date		29/05/2019

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BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH02
Sample No.		
Depth	m	20.00-20.45
Date		29/05/2019
Disturbed / Undisturbed		U

Description of Specimen

Brown silty CLAY

Initial Specimen Conditions

Height	mm	210.00
Diameter	mm	104.00
Area	mm^2	8494.87
Volume	cm^3	1783.92
Mass	g	3524.70
Dry Mass	g	2795.00
Density	Mg/m^3	1.98
Dry Density	Mg/m^3	1.57
Moisture Content	%	26
Specific Gravity	kN/m^3	2.65
(assumed/measured)		assumed

Final Specimen Conditions

Moisture Content	%	26
Density	Mg/m^3	2.15
Dry Density	Mg/m^3	1.70

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Specimen Details

Borehole		BH02
Sample No.		
Depth	m	20.00-20.45
Date		29/05/2019

Test Setup

Date started	20/05/2019
Date Finished	28/05/2019
Top Drain Used	y
Base Drain Used	y
Side Drains Used	y
Pressure System Number	P5
Cell Number	C5

Saturation

Cell Pressure Incr.	kPa	100.00
Back Pressure Incr.	kPa	95.00
Differential Pressure	kPa	5.00
Final Cell Pressure	kPa	800.00
Final Pore Pressure	kPa	737.00
Final B Value		0.95

Consolidation

Effective Pressure	kPa	180.00	360.00	720.00
Cell Pressure	kPa	800.00	800.00	800.00
Back Pressure	kPa	620.00	440.00	80.00
Excess Pore Pressure	kPa	180.00	187.00	371.00
Pore Pressure at End	kPa	620.00	440.00	80.00
Consolidated Volume	cm^3	1718.02	1676.22	1645.42
Consolidated Height	mm	207.41	202.00	196.88
Consolidated Area	mm^2	8285.66	8299.31	8358.33
Vol. Compressibility	m^2/MN	0.05958	0.05530	0.22968
Consolidation Coef.	$m^2/yr.$	0.31371	0.09793	0.01597

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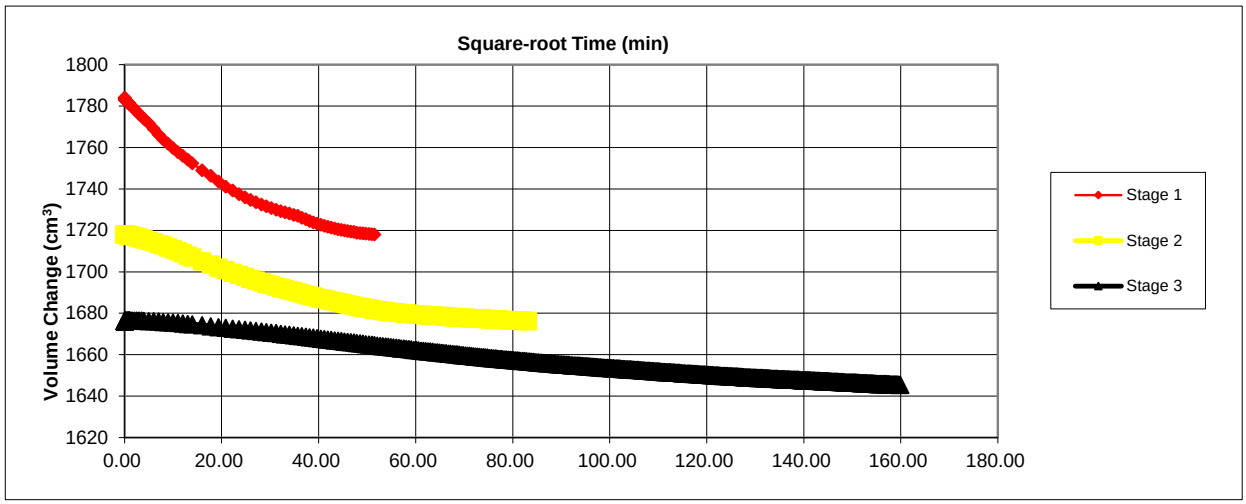
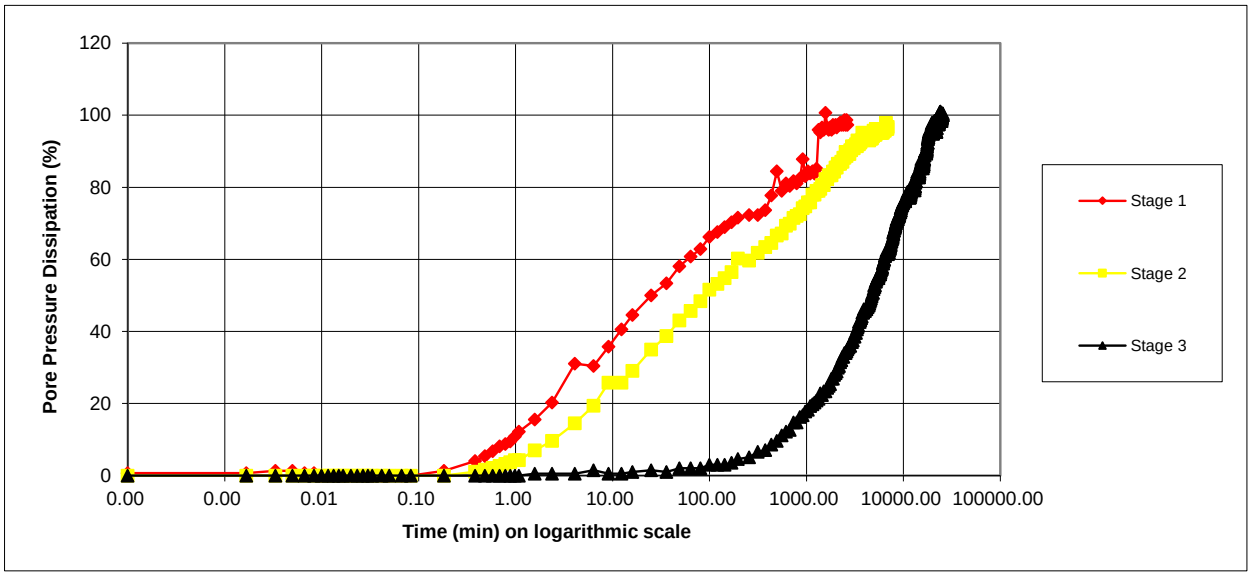
Specimen Details

Borehole		BH02
Sample No.		
Depth	m	20.00-20.45
Date		29/05/2019

Consolidation Stage





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Specimen Details

Borehole		BH02
Sample No.		
Depth	m	20.00-20.45
Date		29/05/2019

Shearing

Initial Cell Pressure	kPa	800	800	800
Initial Pore Pressure	kPa	620	440	80
Rate of Strain	mm/min	0.0063	0.0019	0.0003
Max Deviator Stress				
Axial Strain		0.853	4.413	6.623
Axial Stress	kPa	175.374	318.36	440.78
Cor. Deviator stress	kPa	176.286	314.40	436.58
Effective Major Stress	kPa	302.286	611.40	887.58
Effective Minor Stress	kPa	127.000	297.00	451.00
Effective Stress Ratio		2.380	2.059	1.97
s'	kPa	214.643	454.20	669.29
t'	kPa	87.643	157.20	218.29
Max Effective Priciple Stress Ratio				
Axial Strain		0.853	4.631	6.623
Axial Stress	kPa	175.374	317.851	440.785
Cor. Deviator stress	kPa	175.286	313.868	436.580
Effective Major Stress	kPa	302.286	608.868	887.580
Effective Minor Stress	kPa	127.000	295.000	451.000
Effective Stress Ratio		2.380	2.064	1.968
s'	kPa	214.643	451.934	669.290
t'	kPa	87.643	156.934	218.290
Shear Resistance Angle	degs			17.0
Cohesion c'	kPa			25

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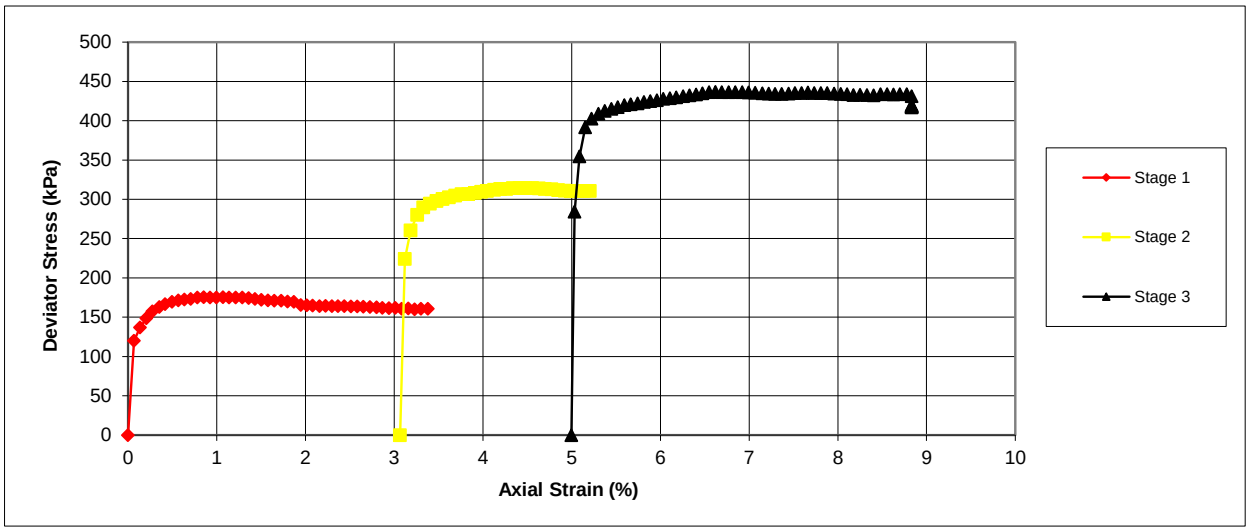
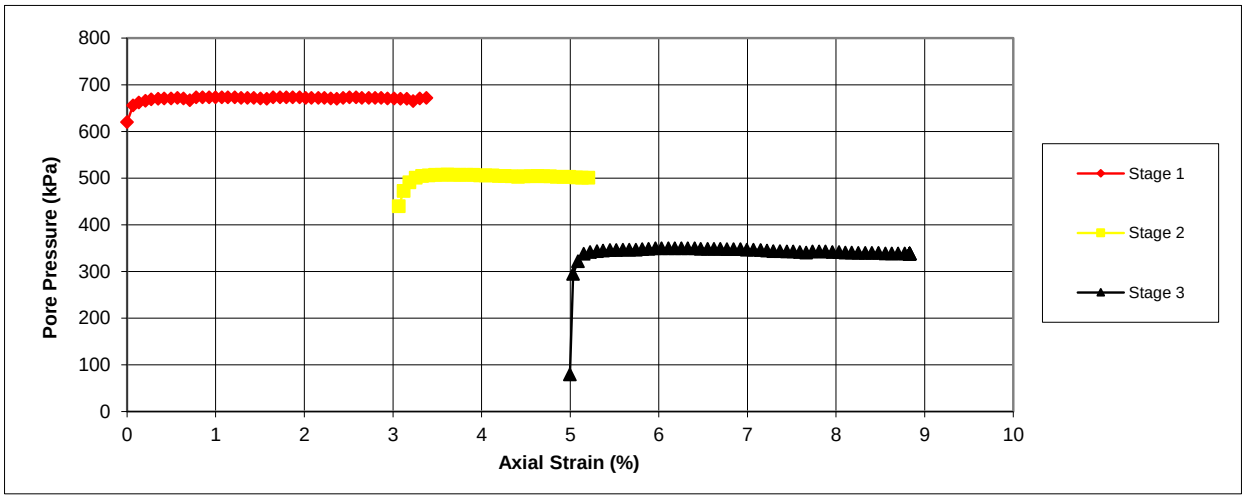
Specimen Details

Borehole		BH02
Sample No.		
Depth	m	20.00-20.45
Date		29/05/2019

Shearing Stage





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43978

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GEO SITE & TESTING SERVICES LTD

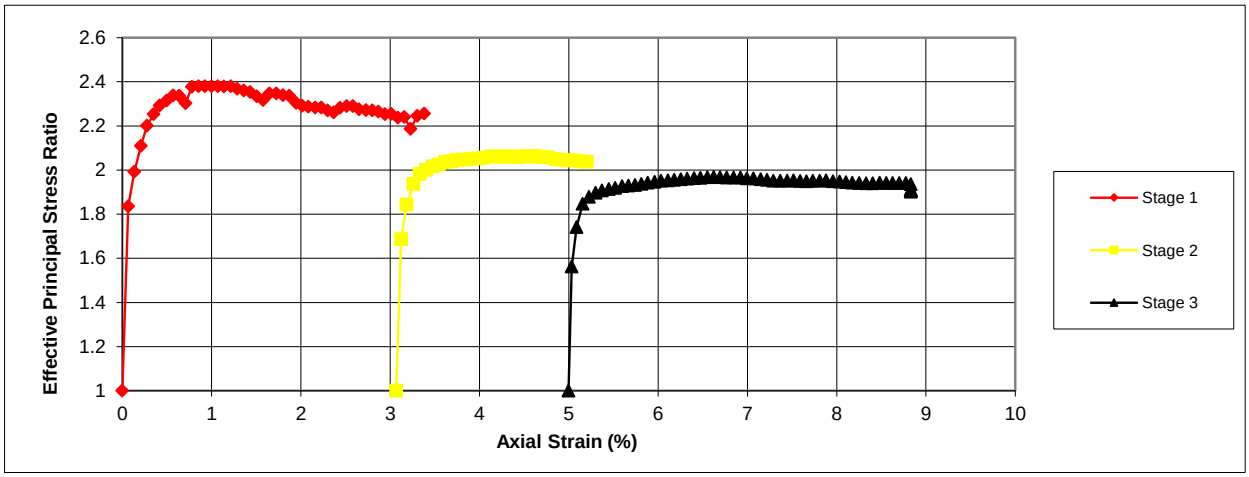
Consolidated Undrained Triaxial Compression Test

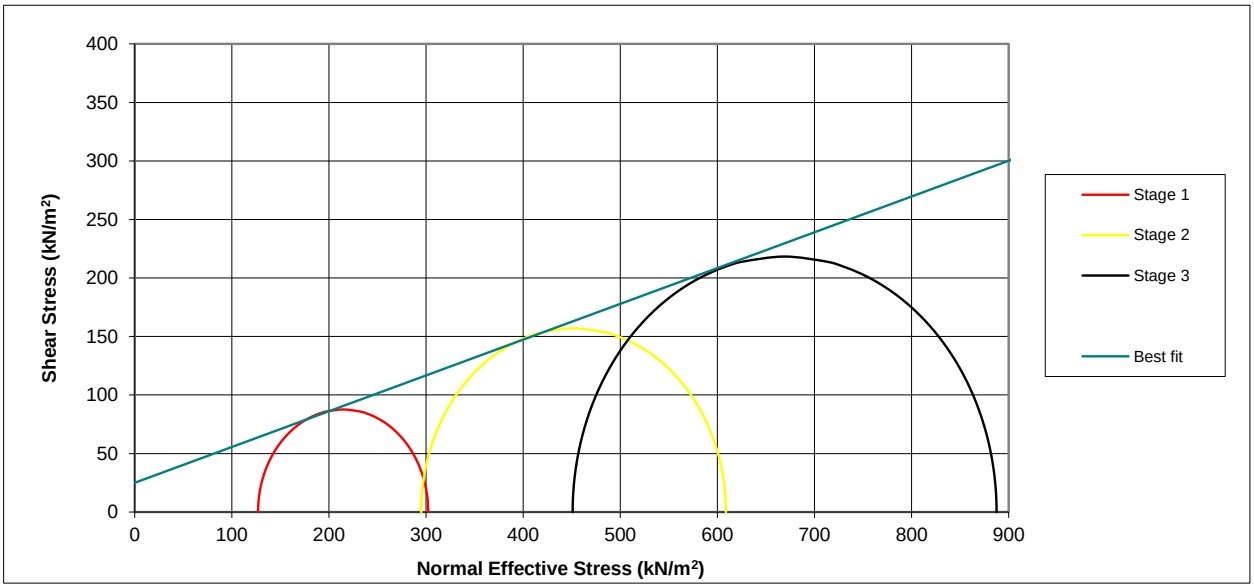
BS 1377 : Part 8 : 1990

Specimen Details

Borehole		BH02
Sample No.		
Depth	m	20.00-20.45
Date		29/05/2019

Shearing Stage





D P Evans

Checked and Approved By

30/05/19
Date

Client Ref

Branch Hill house

Contract No

43978

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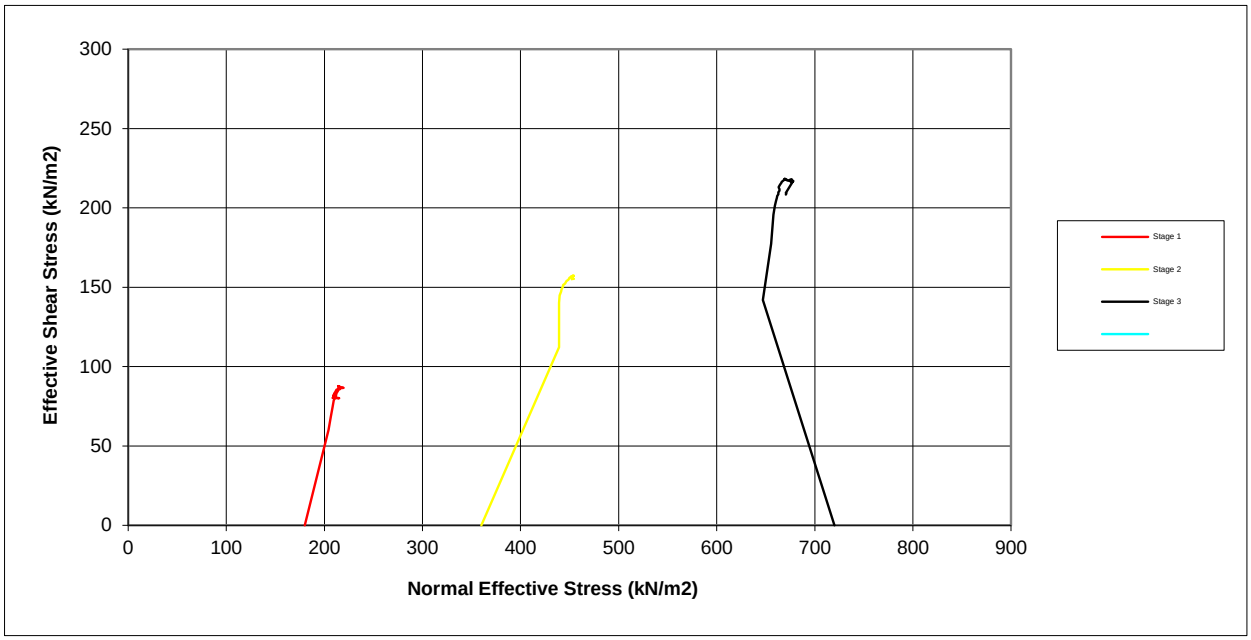

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Consolidated Undrained Triaxial Compression Test

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Borehole		BH02
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GEO SITE & TESTING SERVICES LTD

APPENDIX 4 – CHEMICAL LABORATORY ANALYSIS

Ryan Gunn
Ridge
Partnership House
Moorside Road
Winchester
SO23 7RX

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 19-05634

Site Reference:	Branch Hill House
Project / Job Ref:	5008338
Order No:	5008338-815
Sample Receipt Date:	23/04/2019
Sample Scheduled Date:	23/04/2019
Report Issue Number:	1
Reporting Date:	29/04/2019

Authorised by:

Dave Ashworth
Deputy Quality Manager

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 19-05634	**Date Sampled**	17/04/19	17/04/19	17/04/19	17/04/19	
Ridge	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Branch Hill House	**TP / BH No**	SA1	SA2	TP2	TP3	
Project / Job Ref: 5008338	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: 5008338-815	**Depth (m)**	0.30	0.50	0.50	0.30	
Reporting Date: 29/04/2019	**DETS Sample No**	403787	403788	403789	403790	

Determinand	Unit	RL	Accreditation					
Asbestos Screen (S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	
pH	pH Units	N/a	MCERTS	4.8	6.8	8.1	6.2	
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	
Organic Matter	%	< 0.1	MCERTS	0.8	0.9	0.6	1.1	
Arsenic (As)	mg/kg	< 2	MCERTS	15	31	21	18	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	0.3	0.3	0.3	
Chromium (Cr)	mg/kg	< 2	MCERTS	34	33	23	23	
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	
Copper (Cu)	mg/kg	< 4	MCERTS	5	12	27	40	
Lead (Pb)	mg/kg	< 3	MCERTS	36	85	506	557	
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	
Nickel (Ni)	mg/kg	< 3	MCERTS	6	9	19	21	
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	
Zinc (Zn)	mg/kg	< 3	MCERTS	31	44	120	291	
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C
Subcontracted analysis (S)

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Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 19-05634	**Date Sampled**	17/04/19	17/04/19	17/04/19	17/04/19	
Ridge	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Branch Hill House	**TP / BH No**	SA1	SA2	TP2	TP3	
Project / Job Ref: 5008338	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: 5008338-815	**Depth (m)**	0.30	0.50	0.50	0.30	
Reporting Date: 29/04/2019	**DETS Sample No**	403787	403788	403789	403790	

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	0.38	< 0.1	< 0.1	
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	1.30	< 0.1	< 0.1	
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	1.20	< 0.1	< 0.1	
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.57	< 0.1	< 0.1	
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	0.47	< 0.1	< 0.1	
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.76	< 0.1	< 0.1	
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.21	< 0.1	< 0.1	
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.51	< 0.1	< 0.1	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.35	< 0.1	< 0.1	
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	0.31	< 0.1	< 0.1	
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	6.1	< 1.6	< 1.6	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{o}C

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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
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Soil Analysis Certificate - TPH CWG Banded						
DETS Report No: 19-05634	**Date Sampled**	17/04/19	17/04/19	17/04/19	17/04/19	
Ridge	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Branch Hill House	**TP / BH No**	SA1	SA2	TP2	TP3	
Project / Job Ref: 5008338	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: 5008338-815	**Depth (m)**	0.30	0.50	0.50	0.30	
Reporting Date: 29/04/2019	**DETS Sample No**	403787	403788	403789	403790	

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21	< 21	< 21	
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	8	< 3	< 3	
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	49	< 10	< 10	
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	57	< 21	< 21	
Total >C5 - C35	mg/kg	< 42	NONE	< 42	57	< 42	< 42	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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Maidstone
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Tel : 01622 850410

Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-05634	**Date Sampled**	17/04/19	17/04/19	17/04/19	17/04/19	
Ridge	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Branch Hill House	**TP / BH No**	SA1	SA2	TP2	TP3	
Project / Job Ref: 5008338	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: 5008338-815	**Depth (m)**	0.30	0.50	0.50	0.30	
Reporting Date: 29/04/2019	**DETS Sample No**	403787	403788	403789	403790	

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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: 1, Rose Lane Industrial Estate
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Maidstone
Kent ME17 2JN
Tel : 01622 850410

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2

DETS Report No: 19-05634		**Date Sampled**	17/04/19			**Landfill Waste Acceptance Criteria Limits**		
Ridge		**Time Sampled**	None Supplied			**Inert Waste Landfill**	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Site Reference: Branch Hill House		**TP / BH No**	SA2					
Project / Job Ref: 5008338		**Additional Refs**	None Supplied					
Order No: 5008338-815		**Depth (m)**	0.50					
Reporting Date: 29/04/2019		**DETS Sample No**	403788					
Determinand	**Unit**	**MDL**						
TOC[MU]	%	< 0.1	0.5			3%	5%	6%
Loss on Ignition	%	< 0.01	1.90			--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05			6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1			1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10			500	--	--
Total PAH[MU]	mg/kg	< 1.7	6.1			100	--	--
pH[MU]	pH Units	N/a	6.8			--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	< 1			--	To be evaluated	To be evaluated
Eluate Analysis			**10:1 mg/l**			**Cumulative 10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**	
Arsenic[U]			< 0.01			< 0.1	0.5	2	25
Barium[U]			< 0.02			< 0.2	20	100	300
Cadmium[U]			< 0.0005			< 0.005	0.04	1	5
Chromium[U]			< 0.005			< 0.05	0.5	10	70
Copper[U]			< 0.01			< 0.1	2	50	100
Mercury[U]			< 0.0005			< 0.01	0.01	0.2	2
Molybdenum[U]			0.005			0.05	0.5	10	30
Nickel[U]			< 0.007			< 0.07	0.4	10	40
Lead[U]			< 0.005			< 0.05	0.5	10	50
Antimony[U]			< 0.0060			< 0.06	0.06	0.7	5
Selenium[U]			< 0.005			< 0.05	0.1	0.5	7
Zinc[U]			0.006			0.06	4	50	200
Chloride[U]			< 1			< 10	800	15000	25000
Fluoride[U]			0.6			6	10	150	500
Sulphate[U]			19			190	1000	20000	50000
TDS			95			950	4000	60000	100000
Phenol Index			< 0.01			< 0.1	1	-	-
DOC			4			40.1	500	800	1000
Leach Test Information									
Sample Mass (kg)			0.11						
Dry Matter (%)			84.7						
Moisture (%)			18.2						
Stage 1									
Volume Eluate L10 (litres)			0.88						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Sample Descriptions
DETS Report No: 19-05634
Ridge
Site Reference: Branch Hill House
Project / Job Ref: 5008338
Order No: 5008338-815
Reporting Date: 29/04/2019

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
403787	SA1	None Supplied	0.30	13.3	Brown clayey sand with stones
403788	SA2	None Supplied	0.50	15.3	Brown clayey sand with stones
403789	TP2	None Supplied	0.50	9	Brown sandy gravel with stones
403790	TP3	None Supplied	0.30	20.5	Brown sandy gravel with stones

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

DETS Ltd
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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 19-05634

Ridge

Site Reference: Branch Hill House

Project / Job Ref: 5008338

Order No: 5008338-815

Reporting Date: 29/04/2019

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

APPENDIX 5 – CAT-WASTE OUTPUT

ATKINS CatWasteSoil

Classification Assessment Tool of Soil Wastes - Hazard Summary Sheet

Site Name	Branch Hill House
Location	Hampstead Heath, NW3 7LS
Site ID	5008338
Job Number	5008338
Date	5/15/2019
User Name	msmeeth@ridge.co.uk
Company Name	Ridge & Partners LLP

Hole ID	Sample Depth	Hazardous Waste Y/N	HP1	HP2	HP3	HP4	HP5	HP6	HP7	HP8	HP9
SA2	0.5	N	No	No	No	No	No	No	No	No	No

This output data has been generated by the CAT-Waste Soil waste classification tool provided by Atkins Consultants Ltd and J.McArdle Contracts and should be read in conjuntion with the standard Terms and Conditions

16:33 15/05/2019

APPENDIX 6 – GAS & GROUNDWATER MONITORING SHEETS

Ground Gas and Soil Vapour Monitoring

Project Name:	Branch Hill House
Project Reference:	5008338

	Date	Personnel	Pressure Trend	Start Pressure (mb)	End Pressure (mb)	Equipment Used	Weather	Max. Flow	Max. CO2	Max. Methane
Round 1	17/04/2019	**RG**	Steady	1006	1007	GA 5000-G505446	Fair / partially cloudy	-0.1	1.8	0
Round 2	21/05/2019	**PB**	Steady	1018	1018	GA 5000-G505446	Clear & Sunny	-0.3	4.8	0

Partnership House, Moorside Road, Winchester, SO23 7RX

ID	Pipe Diameter (mm)	Monitoring Round	Time (elapsed time)	Atmospheric Pressure (mb)	Relative Pressure (mb)	Gas Flow (L/hr)	Methane (%/v)	Carbon Dioxide (%/v)	Oxygen (%/v)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	LEL (%)	PID (ppm)	DTW (mbgl)	DTB (mbgl)	Response Zone (mbgl)	Comments
BH02	50	1	0	1006	-0.1	-0.1	0	0.2	20.4	0	0	0	-	12.3	14.6		
BH02	50	1	30	-	-	-	0	0.2	20.4	0	0	0	-	-	-		
BH02	50	1	60	-	-	-	0	0.3	20.4	0	0	0	-	-	-		
BH02	50	1	90	-	-	-	0	0.3	20.3	0	0	0	-	-	-		
BH02	50	1	120	-	-	-	0	0.4	20.2	0	0	0	-	-	-		
BH02	50	1	150	-	-	-	0	0.5	20.1	0	0	0	-	-	-		
BH02	50	1	180	-	-	-	0	0.7	20	0	0	0	-	-	-		
BH03	50	1	0	1007	-0.05	0	0	1.5	19.1	2	0	0	-	8.2	8.8		
BH03	50	1	30	-	-	-	0	1.5	19.1	2	0	0	-	-	-		
BH03	50	1	60	-	-	-	0	1.5	19	2	0	0	-	-	-		
BH03	50	1	90	-	-	-	0	1.5	18.9	2	0	0	-	-	-		
BH03	50	1	120	-	-	-	0	1.6	18.9	2	0	0	-	-	-		
BH03	50	1	150	-	-	-	0	1.7	18.7	2	0	0	-	-	-		
BH03	50	1	180	-	-	-	0	1.8	18.7	2	0	0	-	-	-		
BH02	50	2	0	1018	-0.1	-0.1	0	0.1	20.1	0	0	0	-	12.56	14.55		
BH02	50	2	30	-	-	-	0	0.7	20.1	0	0	0	-	-	-		
BH02	50	2	60	-	-	-	0	0.7	20.1	0	0	0	-	-	-		
BH02	50	2	90	-	-	-	0	0.7	20.1	0	0	0	-	-	-		
BH02	50	2	120	-	-	-	0	0.7	20.1	0	0	0	-	-	-		
BH02	50	2	150	-	-	-	0	0.7	20.1	0	0	0	-	-	-		
BH02	50	2	180	-	-	-	0	0.7	20.1	0	0	0	-	-	-		
BH03	50	2	0	1018	-0.1	-0.3	0	0.1	19.1	0	0	0	-	N/A	9.65		
BH03	50	2	30	-	-	-	0	4.7	15.4	0	0	0	-	-	-		
BH03	50	2	60	-	-	-	0	4.8	15.2	0	0	0	-	-	-		
BH03	50	2	90	-	-	-	0	4.8	15.2	0	0	0	-	-	-		
BH03	50	2	120	-	-	-	0	4.8	15.2	0	0	0	-	-	-		
BH03	50	2	150	-	-	-	0	4.8	15.2	0	0	0	-	-	-		
BH03	50	2	180	-	-	-	0	4.8	15.2	0	0	0	-	-	-		

APPENDIX 7 – SOAKAWAY TESTING RESULTS

Soakaway Test Results & Soil Infiltration Rate

Branch Hill House

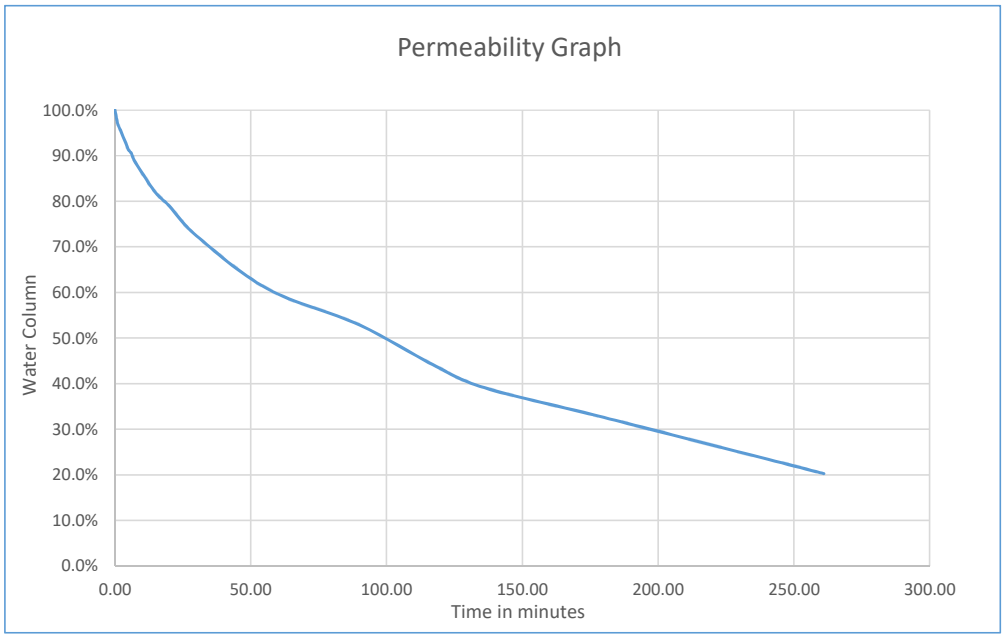
Project: 5008338 Hole ID: SA1 Test 1

Time in minutes	Depth in metres to water surface	Depth in metres of water	Percentage of water depth at start
0.00	1.160	0.69	100.0%
1.00	1.180	0.67	97.1%
2.00	1.190	0.66	95.7%
3.00	1.200	0.65	94.2%
4.00	1.210	0.64	92.8%
5.00	1.220	0.63	91.3%
6.00	1.225	0.63	90.6%
7.00	1.235	0.62	89.1%
10.00	1.255	0.60	86.2%
15.00	1.285	0.57	81.9%
20.00	1.305	0.55	79.0%
30.00	1.350	0.50	72.5%
56.00	1.430	0.42	60.9%
90.00	1.485	0.37	52.9%
117.00	1.545	0.31	44.2%
136.00	1.580	0.27	39.1%
180.00	1.625	0.23	32.6%
261.00	1.710	0.14	20.3%
261.00	**1.710**	**0.14**	**20.3%**

INFILTRATION CALCULATED FROM 75%-25% WATER DEPTH RANGE

Pit Size		Time in mins	
Length	1.30	26	75%
Width	0.50	230	25%
Depth	1.85		

Infiltration Rate from75%-25% **9.68345E-06**



Soakaway Test Results & Soil Infiltration Rate

Branch Hill House

Project: 5008338 Hole ID: SA2 Test 1

Time in minutes	Depth in metres to water surface	Depth in metres of water	Percentage of water depth at start
0.00	0.880	0.77	100.0%
1.00	0.900	0.75	97.4%
2.00	0.910	0.74	96.1%
3.00	0.930	0.72	93.5%
4.00	0.940	0.71	92.2%
5.00	0.955	0.70	90.3%
6.00	0.960	0.69	89.6%
7.00	0.970	0.68	88.3%
10.00	0.990	0.66	85.7%
15.00	1.010	0.64	83.1%
20.00	1.025	0.63	81.2%
30.00	1.060	0.59	76.6%
40.00	1.080	0.57	74.0%
68.00	1.130	0.52	67.5%
96.00	1.160	0.49	63.6%
114.00	1.180	0.47	61.0%
155.00	1.200	0.45	58.4%
177.00	1.220	0.43	55.8%
177.00	**1.220**	**0.43**	**55.8%**

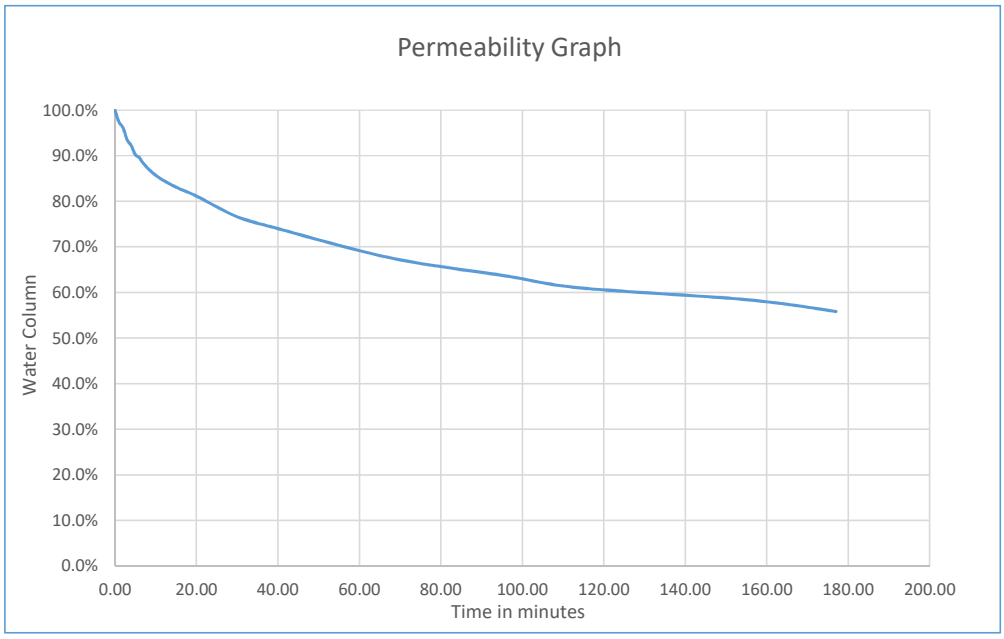
WARNING DOES NOT FALL TO 25% OF START DEPTH-Refer to graph sheet for calculation

Pit Size	
Length	1.30
Width	0.50
Depth	1.65

Time in mins	
36	75%
	25%

invalid 25% and/or 75% times

Infiltration Rate from75%-25% not valid



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LEVEL 2 FLOOD RISK ASSESSMENT
BRANCH HILL HOUSE

ALMAX GROUP
October 2019

LEVEL 2 FLOOD RISK ASSESSMENT
BRANCH HILL HOUSE, LONDON
ALMAX GROUP

October 2019

Prepared for

Almax Group
4 Old Park Lane
London
W1K 1QW

Prepared by

Ridge and Partners LLP
Partnership House
Moorside Road
Winchester
Hampshire
SO23 7RX

Tel: 01962 834400

Contact

Rob Leland
Senior Structural Engineer
rleland@ridge.co.uk
07500 097333

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REV	DATE	DESCRIPTION	AUTHOR	CSE	ICSE
-	29/10/2019	Issued for Information	Rob Leland BEng MSc CEng MICE	Rob Leland BEng MSc CEng MICE	Mathew Newman BSc CEng MIStructE
A	18/12/2019	Final Issue	Julian Rush BEng (Hons)	Julian Rush BEng (Hons)	Rob Leland BEng MSc CEng MICE

CONTENTS

1. INTRODUCTION

1.1. Background

Ridge and Partners have been commissioned by Almax Group to undertake a Flood Risk Assessment (FRA) to support a planning application for development of a 5-storey residential building with a single storey of basement, adjacent to the existing Branch Hill House. The existing site is currently occupied by a large area of hardstanding, numerous unoccupied outbuildings as well as grassed and wooded areas.

Appendix A provides an illustration of the scheme layout.

1.2. Level of Study

The National Planning Policy Framework (2018) states that where a site-specific Flood Risk Assessment is required, the level of detail of the study should be proportionate to the scale and nature of the development in conjunction with its vulnerability classification.

The levels of study are outlined as follows, in accordance with CIRIA. Publication C624. Development and Flood Risk – Guidance for the Construction Industry. (2004):

Level 1 Screening Study

The purpose of the study is to identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information and will be used to ascertain whether an FRA level 2 or 3 is required.

The above information is typically obtained via ‘open source’ Government and Environment Agency records and in conjunction with liaison with the appropriate bodies.

Level 2 Scoping Study

The study is typically progressed to Level 2 if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk off-site due to increased run-off. At this stage, the purpose of the study is to confirm the sources of flooding which may affect the site and should include:

- An appraisal of the availability and adequacy of existing information;
- A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; and
- An appraisal of the scope of possible measures to reduce flood risk to acceptable levels.

Typically, information to complete this study can be obtained via record searches in conjunction with liaison with appropriate Government and Statutory bodies in addition to undertaking site-based investigations and research.

Level 3 Detailed Study

If there is insufficient qualitative information to conclude an appropriate FRA for the scale and nature of the proposed development, then the study must progress to Level 3. As part of this, full qualitative analysis is undertaken to assess flood risk issues related to the development estate and should include:

- Quantitative appraisal of the potential flood risk to the development;
- Quantitative appraisal of the potential impact of the development site on flood risk elsewhere; and

- Quantitative demonstration of the effectiveness of any proposed mitigation measures.

As part of this study, it is likely that site specific hydrological and hydraulic modelling analyses would be required to demonstrate the full magnitude of flood risk on the development and that any proposed development mitigates flood risk both on and off-site.

1.3. Objectives of the Flood Risk Assessment

Ridge have been commissioned to undertake a Level 2 Scoping Study to evaluate the impact of flooding on the site, with consideration for plans for future development.

This FRA has been undertaken for the Branch hill House project. In accordance with the requirements of the National Planning Policy Framework (NPPF, see Section 2.1.1) this FRA:

- Includes an assessment of the flood risk to the proposed development, demonstrating that the intended use is appropriate in terms of flood risk;
- Includes an assessment of the predicted impact of the development upon flood risk;
- Demonstrates that the development will not have a deleterious impact upon flood risk to other parties; and
- Summarises any mitigation measures required to achieve this outcome.

1.4. Flood Risk Assessment Methodology

This Flood Risk Assessment (FRA) assesses the risk of all forms of flooding to and from the development and sets out how they can be managed. Conventionally the identification of flood mechanisms and mitigation options is based upon the Source-Pathway-Receptor model.

This model is used to identify the causes (or sources) of flooding to and from a development with identification based upon a review of available information, local conditions and consideration of the effects of climate change.

The nature and likely extent of flooding arising from any source is will be reviewed, considering, for example, whether such flooding is likely to be fast or slow to occur, localised to a specific area of the site, or widespread.

It should be noted that the presence of a flood source does not always imply a flood risk as it is the pathway or ‘flooding mechanism’ which determines the risk to the receptor and the consequences as a result of exposure. As an example, sewer flooding will not necessarily increase the risk of flooding unless the sewer is local to the site and the current topography allows this water to pond.

The varying effect of flooding on receptors depends largely on the sensitivity of the proposed development and for this purpose the vulnerability classification referred to in the National Planning Policy Framework (2018) should be used.

Receptors typically will include occupants, people and buildings within the range of the flood source, which can be demonstrated as being connected to the source of flooding via a pathway.

In order for there to be a flood risk, all elements of the conceptual model (i.e. a flood source, a pathway and a receptor) must be present. Furthermore, effective mitigation can be provided by the elimination of one element of this model, such as the removal of the pathway or the receptor.

Once flood risk has been established, mitigation measures can be proposed where necessary and potential options for managing residual risks can be determined.

1.5. Assessment of Flood Risk to Receptors

If a source and pathway of flooding is identified, the assessment of flood risk to the receptor is determined by combining the probability of the flood event occurring versus the consequences or severity of the flood event, were it to occur.

The probability of a flood event occurring is usually determined from historical records of flood events, available hydrological or hydraulic modelling information and the standard and condition of any infrastructure associated with the source of flooding.

For more rigorous assessments, hydrological or hydraulic simulation modelling may be used to determine the frequency of flood events occurring, or for a more detailed appraisal of flooding from a specific flood source.

The severity of the impact of the flood event is determined by analysing a combination of the type of flood source, the flood mechanism and the layout, design and vulnerability of the receptor.

The approach used within this FRA involves a desk-based review of available information to establish:
The likely flooding sources;

- The potential flooding pathways, or mechanisms of flooding;
- The probability of a flood event occurring; and
- The severity and impact of a flood event to the site.

In summary, for a flood risk to be identified all elements of the Source-Pathway-Receptor model must be present. Additionally, removal of a single element of this model will constitute mitigation of the risk and reduce the flood risk accordingly.

For example, flood risk can be significantly reduced by;

- Removing the pathway;
- Defending against the flood source;
- Incorporating flood management or flood resilient measures into the building receptors; or
- Providing safe flood refuge and safe access / egress with flood evacuation plans for human receptors.

It can therefore be demonstrated that several mitigation measures are available, with those which are considered most appropriate for the site location likely given within the Strategic Flood Risk Assessment, Surface Water Management Plans and Local Planning Policies for the governing authorities.

1.6. Limitations

The purpose of this report as outlined in Section 1.3, together with those related matters specifically referred to therein and it is not intended to be used for any other purposes. The report is for the sole benefit and may only be relied upon by the addressee, to whom we will owe a duty of care. The report and any part of it is confidential to the addressee and should not be disclosed to any third party for any purpose, without the prior written consent of Ridge and Partners LLP as to the form and context of such disclosure. The granting of such consent shall not entitle the third party to place reliance on the report, nor shall it confer any third-party rights pursuant to the Contracts (Rights of Third Parties) Act. The report may not be assigned to any third party.

2. FLOOD RISK POLICY

2.1. National Planning Policy

Revised National Planning Policy Framework (2019)

The Revised National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how they are expected to be applied. The policy aims to avoid inappropriate development by directing it away from the areas that are at highest risk. Where development is necessary within an area designated as floodplain, it must be demonstrated to be safe without increasing the risk of flood elsewhere.

Planning policy states that a site-specific FRA is required for development proposals:

- That are located within Flood Zones 2 or 3;
- That are located within Flood Zone 1 but are greater than 1 hectare (ha) in area;
- Are located within Flood Zone 1, but are less than 1 ha in area but include a change of use in development type to a more vulnerable class (i.e. changing from commercial to residential);
- Are located within 20 m of a watercourse; and/or
- Where requested by the Local Planning Authority.

A site-specific FRA should identify and assess the risks of all sources of flooding to and from the development and demonstrate how these flood risks will be managed so that the development remains safe for its lifetime, taking into account climate change.

Flood Zone Definition

The Technical Guidance to the NPPF defines the flood risk zones that are published by the EA, which are as follows:

- **Flood Zone 1** – The low probability zone which is defined as having less than 0.1 % (or a 1 in 1000 year) probability of flooding each year;
- **Flood Zone 2** – The medium probability zone which is defined as having between 0.1 % - 1.0 % (or between 1 in 1000 and 1 in 100 year) probability of fluvial flooding or between 0.1 % and 0.5 % (or between 1 in 1000 and 1 in 200 year) probability of flooding from the sea each year;
- **Flood Zone 3a** – The high probability zone which is defined as having a 1 % or greater (or a 1 in 100 or greater) probability of fluvial flooding, or a 0.5 % or greater (1 in 200 or greater) probability of flooding from the sea each year;
- **Flood Zone 3b** – Functional Floodplain which is defined as land where water must flow or be stored in times of flood.

Sequential Test

In accordance with the NPPF, London Borough of Camden (LBC) use the Strategic Flood Risk Assessment to complete their Sequential Test process to inform their spatial strategies and development proposals for each of their strategic locations. The process identifies the flood risks and development vulnerability in order to assess the suitability of each development location and where possible, steers more vulnerable developments to areas of lowest flood risk, matching vulnerability of land use to flood risk.

The sequential test is undertaken in accordance with the following matrix:

FLOOD RISK VULNERABILITY CLASSIFICATION	ESSENTIAL INFRASTRUCTURE	WATER COMPATIBLE	HIGHLY VULNERABLE	MORE VULNERABLE	LESS VULNERABLE
FLOOD ZONE ZONE 1	Permitted	Permitted	Permitted	Permitted	Permitted
FLOOD ZONE ZONE 2	Permitted	Permitted	Exception Test Required	Permitted	Permitted
FLOOD ZONE ZONE 3A	Exception Test Required	Permitted	Not Permitted	Exception Test Required	Permitted
FLOOD ZONE ZONE 3B	Exception Test Required	Permitted	Not Permitted	Not Permitted	Not Permitted

Table 1 - Sequential Test Example

Examples of the various Flood Risk Vulnerability Classifications in accordance with the NPPF are as follows:

Essential Infrastructure

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons including electricity generating power stations and grid and primary substations; and water treatment works that needs to remain operation in times of flood.
- Wind turbines.

Highly Vulnerable

- Police stations, ambulance stations and fire stations, and command centres and telecommunications installations required to be operational during flooding.
- Emergency dispersal points.
- Basement dwellings.
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent (where there is a demonstrable need to locate such installations for bulk storage of materials with port or similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure").

More Vulnerable

- Hospitals.
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non-residential uses for health services, nurseries and educational establishments.
- Landfill and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Less Vulnerable

- Police, ambulance and fire stations which are not required to be operational during flooding.

- Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable", and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill and hazardous waste facilities).
- Mineral working and processing (except for sand and gravel working).
- Sewage treatment works (if adequate measures are taken to control pollution and manage sewage during flooding events are in place).

Water Compatible Development

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel workings.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to implementation of a specific warning and evacuation plan.

Exception Test

Where new development is necessary in such areas, policy aims to make it safe, without increasing flood risk elsewhere, and where possible, reducing flood risk overall through the application of the NPPF's Exception Test. The Exception Test allows consideration of the wider sustainability benefits of a development to be considered to justify development in a higher risk flood zone.

To ensure that the proposed development meets the requirements of the Exception test (NPPF):

- It must be demonstrated that the development provides wider sustainability benefits for the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared;
- A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking into account the vulnerability of its users, without decreasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

2.2. Climate Change

The attenuation storage of runoff from the development should be sized for the 1% (1 in 100) year) AEP event plus an allowance for climate change of +40% for rainfall intensity.

2.3. Local Flood Risk Policy

2.3.1. Local Plan – Managing Flood Risk in Camden: Sites in Zone 1

The entirety of the LBC is located within Flood Zone 1, which comprises land outside the extent of fluvial flooding in a 0.1% annual exceedance probability (AEP) event. As set out in the NPPF all types of development are considered appropriate within Flood Zone 1. Proposals for new development greater than 1 hectare in Flood Zone 1 will require a site-specific FRA to ensure that surface water generated by the site is managed in a sustainable manner and does not increase the burden on existing infrastructure and/or flood risk to neighbouring property. Due to the majority of the borough being located within a Critical Drainage Area as defined by the LBC SWMP, all opportunities should be taken during development to reduce existing runoff rates post-development. Policy 5.13 of the London Plan 55 states that all development should aim to achieve greenfield runoff rates, and where this is not possible, runoff rates post-development should not exceed those pre-development, as per the NPPF. The SWMP Critical Drainage Areas and Local Flood Risk Zones, and the Environment Agency's uFMfSW (updated flood map for surface water) dataset should be used as a starting point to indicate broad areas with a potential for surface water flood risk in the borough. In the absence of fluvial flood risk within the borough, a clear focus for new development should be a reduction in surface water runoff rates post-development, wherever practicable.

2.3.2. Strategic Flood Risk Assessment (SFRA)

In July 2014, URS, on behalf of the London Borough of Camden, produced revision 2 Level 2 Strategic Flood Risk Assessment (SFRA) for all populated areas at risk of flooding and locations being considered for future development (identified by a Level 1 SFRA). The SFRA flood maps indicate flood zones (including functional floodplain and effect of climate change on flood zones), flood incident records and localised flooding areas. The maps also illustrate watercourses.

These maps have been consulted to inform this FRA and are referred to in this document. Our development is not within any of the highlighted areas for proposed development listed within the SFRA document.

3. PROPOSED DEVELOPMENT

3.1. Location

The proposed development site is located off Spedan Close in Hampstead in North West London, NW3 7LS, Grid reference: E526124, N186047.

Figure 1 - Aerial View of the Existing Site

3.2. Proposed Works

The proposed project principally comprises the demolition of the existing 1960's extension whilst retaining the existing Branch Hill House. The retained Branch Hill House is to undergo a change in use from the current care home to residential with associated external alterations. A new 3-5 storey residential development with a single storey basement will be constructed in place of the demolished 1960's extension. The new replacement development will comprise residential accommodation on the upper floors with ancillary plant, access and servicing and car parking in the basement.

The site area is approximately 0.8 hectares. For the purposes of the assessment of the impact of climate change the design life for the development has been assumed to be 60 years. The criteria set by the NPPF.

3.3. Existing Site Characteristics

The current site arrangement comprises a 3-storey (+1 storey basement) masonry residential manor house constructed circa 1870s, with an abutting 2-storey concrete frame residential block constructed circa 1960s. The site has formerly been used as a residential facility for senior-citizens but is currently occupied by building guardians. The site is set back from the main Branch Hill road, with access via a driveway (Spedan Close).

Neighbouring along the south-west of the property is the Branch Hill Estate (approx. 15m away), a multiplex of council-owned houses built upon a complex stepped-section of hill circa 1970s. The estate is likely founded

on strip foundations and is in reasonable condition. To the north of the property is West Heath Lodge (approx. 55m away), a 5-storey apartment block, constructed circa 1980s. The block is likely founded on piled foundations given its height, anticipated loadings and condition. At the entrance to the Spedan Close driveway is a small gate house (approx. 70m away). Directly south is a residential property (approx. 70m away)

Figure 2 – Existing Site Plan

3.3.1. Topography

The site is within a wider hillside setting. Slope angles are approximately 6º which correlates to a 10m fall across the site. The site is on level ground at approximately 125m above sea level.

The site slopes from east to west and north to south. A selection of approximate site levels is outlined below:

- NW corner: 115.3m AOD
- SW corner: 115.3m AOD
- NE corner: 124.5m AOD
- SE corner: 122.7m AOD

Figure 3 - Existing buildings showing site slopes and overland flow routes

3.3.2. Geology

Ridge have undertaken a Phase II intrusive site investigation (5008338-RDG-XX-ST-DOC-C-00-GCA-01, May 2019). The following soil conditions were encountered during the investigation works.

Topsoil

Encountered in BH02 to a depth of 0.3mbgl, the Topsoil was described as brown sandy silt with abundant rootlets, on;

Macadam & Made Ground

Macadam and/or Made Ground were identified within all exploratory holes except BH02 from a depth of 0.10mbgl to a depth of 1.65mbgl. The Made Ground soils were largely described as brown occasionally orangish brown mottled dark blackish brown, speckled red, silty sand gravelly clay with coarse brick, concrete, flint and clinker, over;

Bagshot Formation

The Bagshot formation was identified within all exploratory holes except SA02 from a depth of 0.3mbgl (BH02) to a maximum depth of 15mbgl (BH02). The Bagshot Formation was largely described as loose to medium dense orangish brown and brownish orange mottled clayey silty fine and medium SAND interbedded with thinly bedded sandy CLAY, over;

Claygate Member

The Claygate Member was identified within BH01 & BH02 from a depth of 14.5mbgl (BH01) to the maximum drill depth of 30mbgl (BH02). The Claygate Member was largely described as medium dense dark grey very silty fine SAND to firm to stiff grey silty sandy CLAY.

According to BGS aquifer maps, the site is situated near a 'Secondary A Aquifer' (superficial) which, in most cases, describes permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers. The bedrock is classified as a 'Secondary A' aquifer which describes permeable layers of rock which are able to support water supplies at a local rather than strategic scale. The site is not located within a groundwater source protection zone.

3.3.3. Existing Site Drainage

The existing site is assumed to be connected to the existing combined public sewerage network operated by Thames Water. However, at the time of writing this report this is yet to be confirmed. A CCTV survey of the drainage system will be undertaken to confirm.

4. EXISTING FLOOD RISK

4.1. Basis of the Assessment

In accordance with the NPPG an assessment of the flood risk to the development site has been completed based on the following sources of information:

- Flood risk information available of the Environment Agency's website;
- London Borough of Camden – Flood Risk Management Strategy;
- London Borough of Camden – Strategic Flood Risk Assessment.

The impact of the development on all sources of flood risk has been considered, including:

- Fluvial (River);
- Tidal;
- Pluvial (Surface water);
- Sewer flooding;
- Groundwater flooding;
- Artificial Sources;

4.2. Assessment of Existing Flood Risk

4.2.1. Fluvial Flood Risk

The development is located within Flood Zone 1 and is classified as 'very low' fluvial risk. As such, floodplain compensation will not be required. Please refer to an extract of the Environment Agency's Risk of Flooding from Rivers and Sea Map in Figure 4.

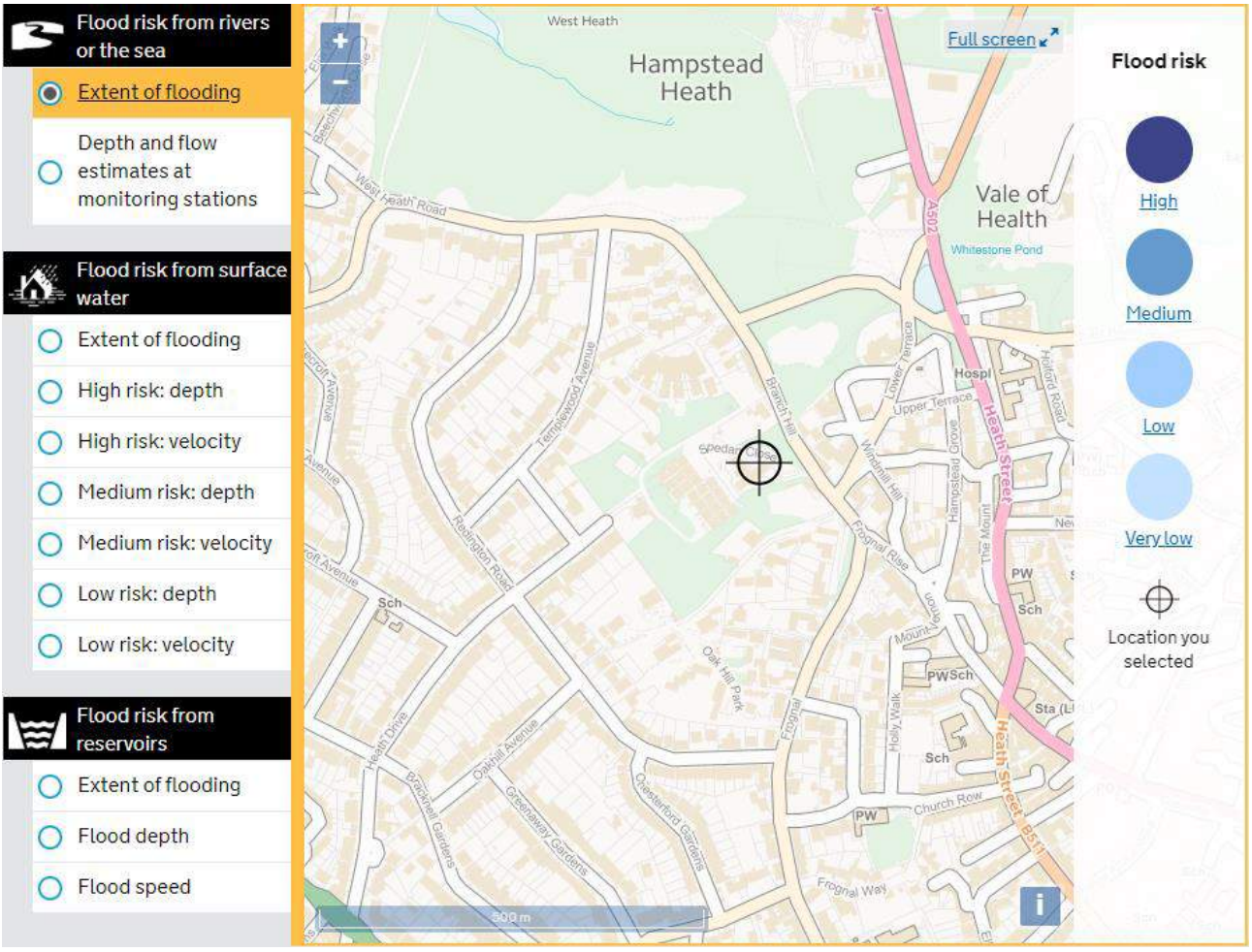


Figure 4 - Flood Zone Mapping

Given the distance of the site from the nearest area of Flood Zone 2 (approximately 3km) and with reference to point C3 of CBC SFRA guidance, it is anticipated that the site will remain within Flood Zone 1 when climate change is taken into consideration. However, further clarification has been sought from the Environment Agency. No response has been received at the time of writing this report.
The SFRA and strategic documents have not identified any historic fluvial flood events at the site.

4.2.2. Tidal Flood Risk

The site is located within EA Flood Zone 1 and 8km from the sea, therefore a very low risk from tidal flooding (see Figure 4).

4.2.3. Pluvial (Surface Water) Flood Risk

Figure 5 highlights the risk of surface water flooding at the development. The map shows a small patches of low risk flooding in the in adjacent sites.

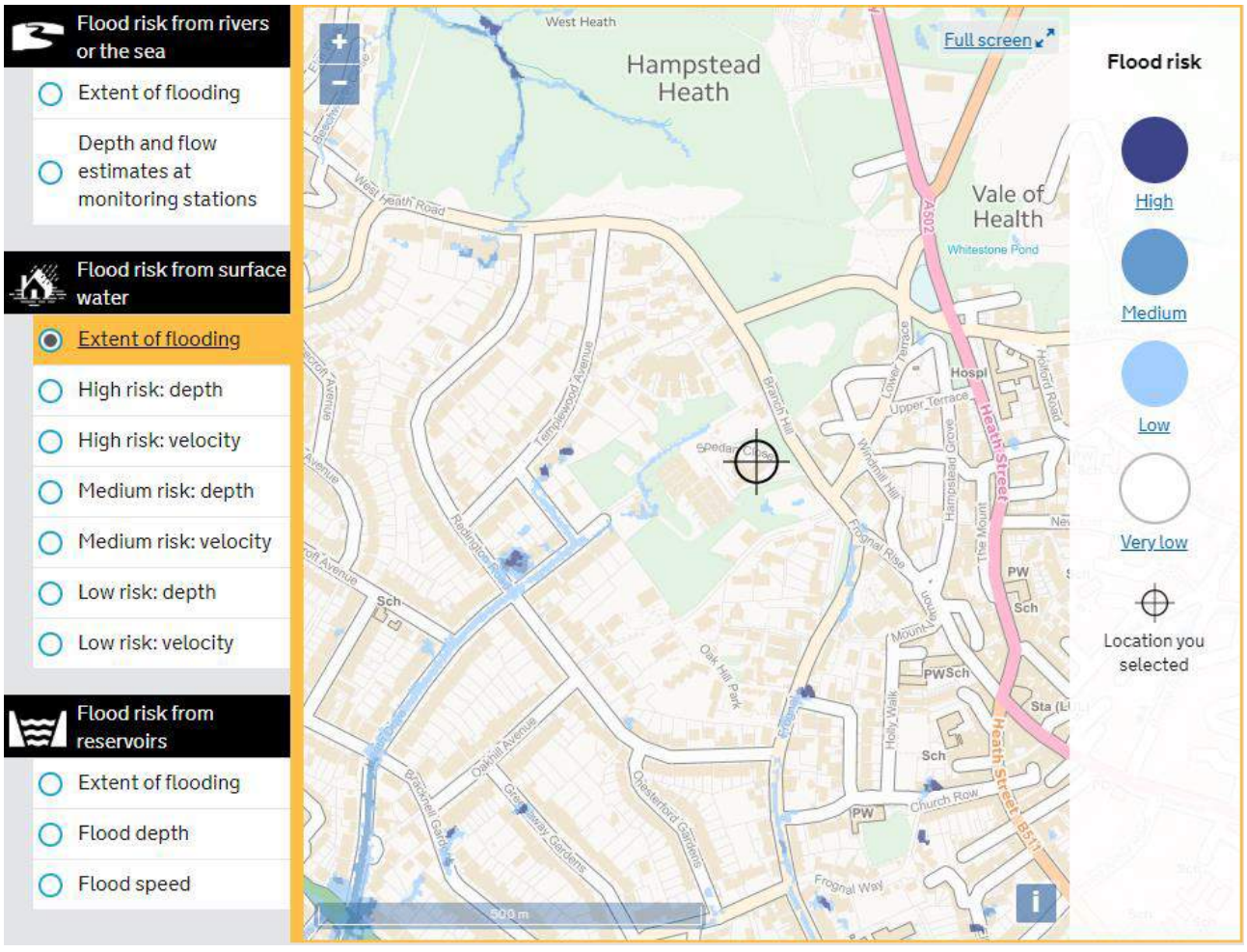


Figure 5 - Surface Water Flood Risk

Historic Pluvial (Surface Water) Flooding Events

Figure 6 highlights the historic record of surface water flooding in the Hampstead region of London. The mapping shows flooding in nearby streets back in 2002 but nothing within the redline boundary of the site and is therefore considered a very low risk.

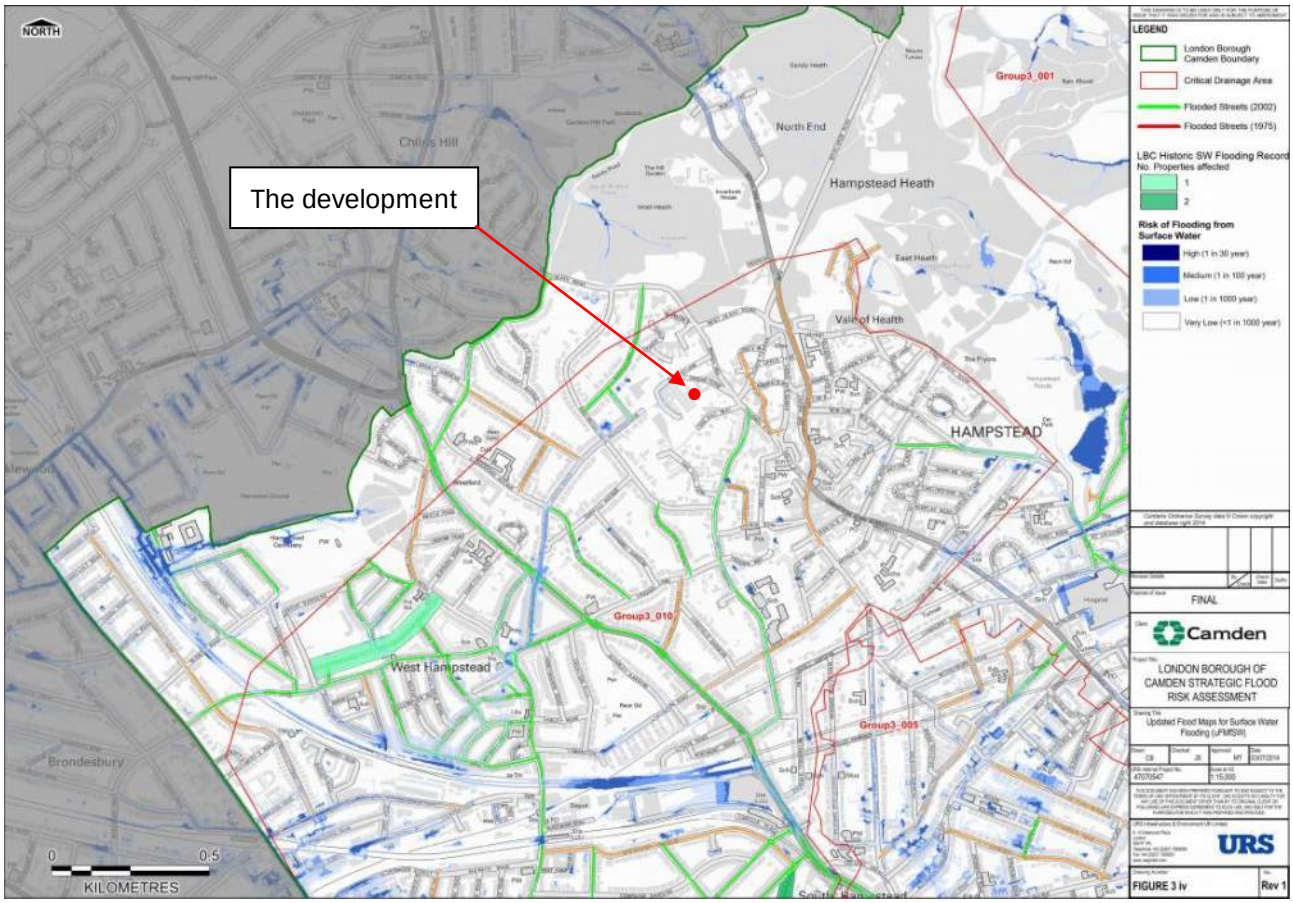


Figure 6 - Historical Surface Water Flooding

4.2.4. Sewer Flooding

The majority of LBC is served by a combined surface and foul water sewer system. Modern (post 1970) Thames Water Utilities Limited (TWUL) sewer systems are typically designed and constructed to accommodate rainfall events with a 3.3% AEP or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. However, the North London SFRA27 identified the sewer network within Camden as being particularly old, with some sections of sewer potentially designed to only convey storms up to the 10% AEP event, as stated in the LBC SFRA. The last recorded incident of sewer flooding was in 2012 on Kilburn High Road, approximately 1.5 miles from the site.

The risk of sewer flooding on the site is therefore considered to be moderate. Current data has been requested from Thames Water to confirm this risk to the development, this not been received at the time of writing the report.

4.2.5. Groundwater Flood Risk

Based on the information available, the susceptibility of the site to groundwater flooding is considered low. The SFRA includes historic flood records, see Figure 7, some of which have been attributed/partly attributed to groundwater flooding. The nearest incident which refers to groundwater flooding as a potential cause is several hundred meters from the development. As there is no history of flooding to the site, the likelihood of groundwater flooding is considered low. Updated groundwater levels have been requested from the Environment Agency but have not been received at the time of writing this report.

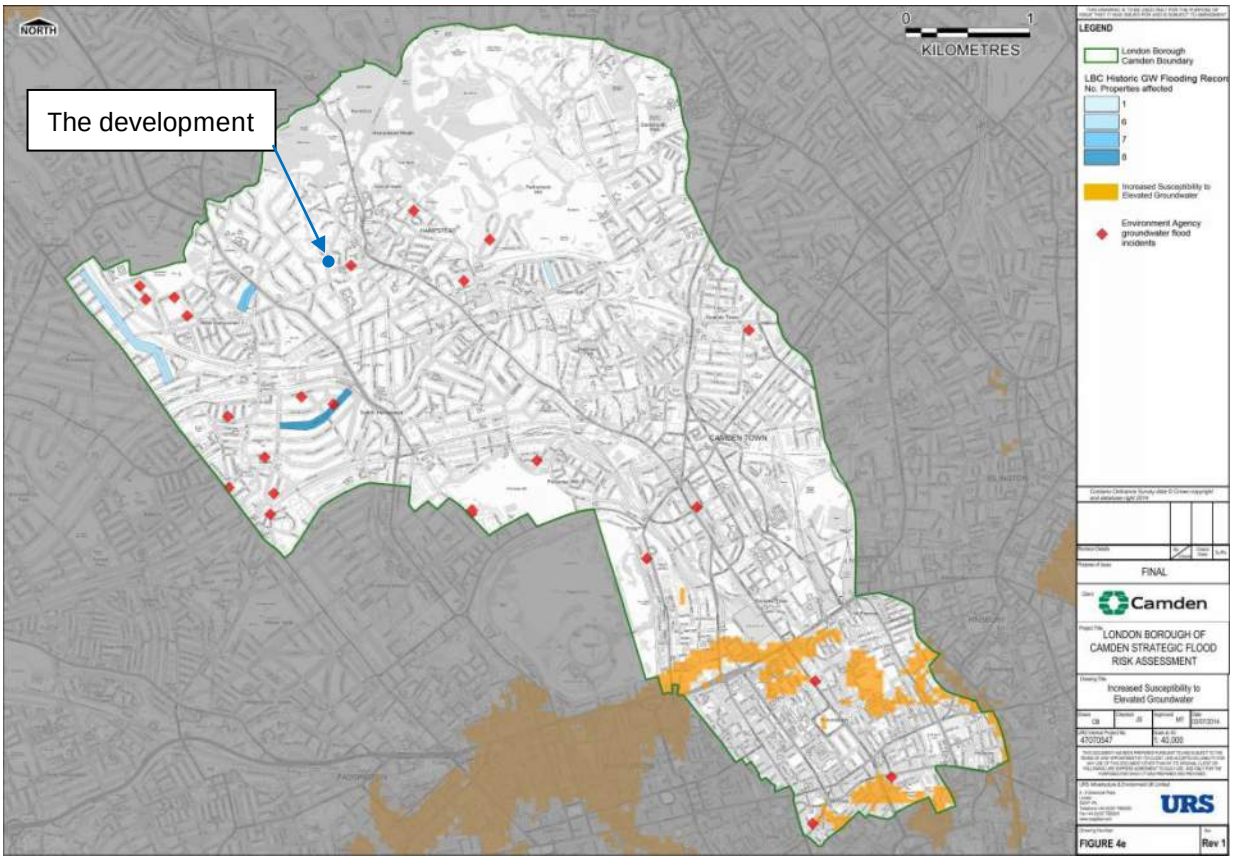


Figure 7 - Historical Groundwater Flooding

4.2.6. Artificial Sources

The Environment Agency's Risk of Flooding from Reservoirs map was reviewed online and according to this the development is not located within an area at risk of reservoir flooding.

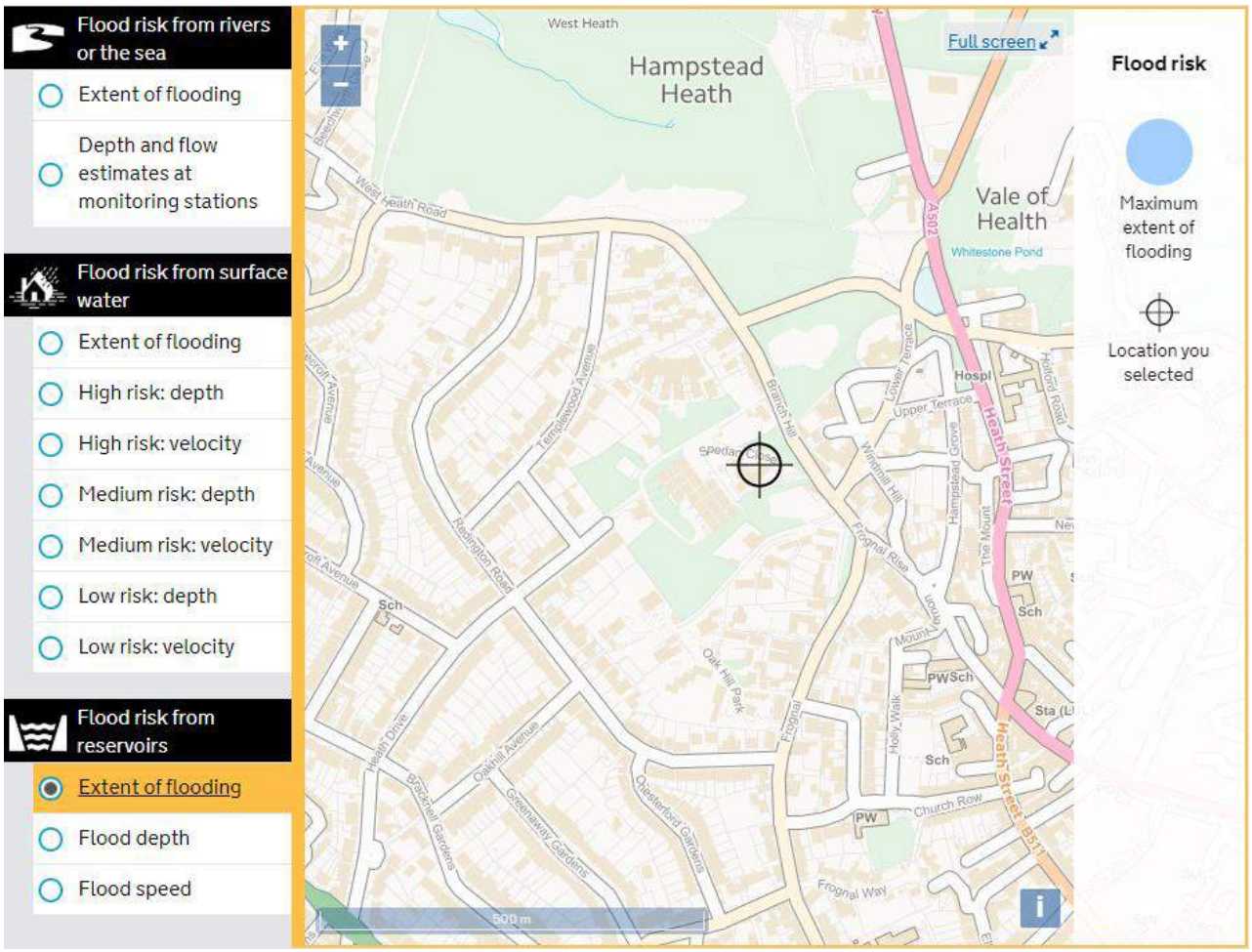


Figure 8 - Flood Risk from reservoirs

4.3. Summary

- The risk of fluvial flooding is considered to be **very low**;
- The risk of tidal flooding is considered to be **very low**;
- The risk of pluvial (surface water) flooding is considered to be **very low**;
- The risk of sewer flooding to be **moderate**;
- The risk of groundwater flooding is considered to be **low**;

5. NATIONAL PLANNING POLICY FRAMEWORK CLASSIFICATION

5.1. Vulnerability Classification

Table 2 of the Flood Zone and Flood Risk Tables section of the NPPF classifies the flood risk vulnerability of all land uses. The development has been classified as 'highly vulnerable' in accordance with Paragraph 066, Table 2 of the NPPG. The NPPG also classifies "basement dwellings" as 'highly vulnerable'.

5.1.1. The Sequential Test

Table 3 of the NPPG (substantially reproduced here as Table 2 defines appropriate land uses for each flood zone. This development is considered appropriate within Flood Zones 1 and 2 but has to pass the Exception Test if it is located within Flood Zones 3a. It should not be permitted within Flood Zone 3b.

FLOOD RISK VULNERABILITY CLASSIFICATION		ESSENTIAL INFRASTRUCTURE	HIGHLY VULNERABLE	MORE VULNERABLE	LESS VULNERABLE	WATER COMPATIBLE
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	Exception test required	✓	✓	✓
	3a	Exception test required	[3]	Exception test required	✓	✓
	3b	Exception test required	[3]	[3]	[3]	✓

✓ = development is appropriate, [3] = Development should not be permitted

Table 2 - Sequential Test

5.1.2. The Exception Test

The development is not required to comply with the Exception Test as it is located within Flood Zone 1.

6. FLOOD RISK FROM THE DEVELOPMENT

The risk of flooding from fluvial, tidal and groundwater has been shown to be low and as such mitigation methods are not required.

6.1. Development Considerations

In accordance with NPPF guidance, the development will need to demonstrate that it will:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage; and
- Not impede water flows and not increase flood risk elsewhere

The following sections indicate how these requirements have been met.

6.1.1. Safe Access

NPPF paragraph 103, states that the development must provide safe access and egress during times of flood. The entirety of the development is located within fluvial Flood Zone 1 which will ensure safe access and egress for flood events up to the 0.1% (1 in 1000) AEP event.

6.1.2. Temporary Works

There will be a facility constructed on the existing car park/ hard standing to the west of the site which will function as a temporary school whilst the permanent structure is completed. This is not anticipated to affect any watercourses and would not impact upon existing levels of flood risk.

6.1.3. Loss of Floodplain Storage

The development is located outside of Flood Zone 3 and there is no loss of floodplain storage. As such, floodplain compensation is not required.

7. DRAINAGE STRATEGY

A drainage strategy has been prepared by Ridge for the proposed development and is presented in a separate report titled 'Drainage Strategy', dated December 2019. A summary of the proposed drainage strategy is provided below.

It should be noted that this strategy presents one possible solution to demonstrate that the proposed development can be sustainably drained and should not be interpreted as the definitive solution.

- Both surface and foul water currently generated by the site are presumed to discharge to the public combined sewer network on Heysham Lane.
- Due to low infiltration rates recorded during the Ground Investigation of the underlying soils at the site, the disposal of surface water within the site using soakaways are not considered to be practicable.
- No watercourses or other appropriate surface water bodies are present within close proximity to the site and it is therefore proposed that the development will connect to the existing public sewer for the disposal of surface water from impermeable areas.
- The discharge from the site post-development will be limited to a maximum rate of 2 l/s during all events up to and including the 1:100 AEP event, including a 40% allowance for climate change. This would demonstrate a significant betterment) to the existing condition without introducing an additional source of flood risk.
- To achieve the above limitations, 191.0 m^3 of below ground attenuation storage tanks will be provided at the proposed development. This volume is expected to be split proportionally between the front and rear portions of the proposed development due to site topography and availability of suitable areas to store the storm events.
- The development proposals will contribute to a reduction in flood risk associated with the exceedance of the public surface water sewer network in the vicinity of the site by providing a significant reduction in peak runoff rates and by avoiding an increase in the total runoff volume.
- The proposed drainage strategy has been prepared to be robust and demonstrate that it is possible to drain the site in a sustainable manner in keeping with local policy requirements, without increasing flood risk to or from the Proposed Development.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. Development Suitability

The new development has been classified as 'highly vulnerable' development in accordance with the NPPG. The proposed site is located within Flood Zone 1 and therefore is considered appropriate in accordance with Table 2 of the NPPG.

8.2. Flood Risk to the Site

- The risk of fluvial flooding is considered to be **very low**;
- The risk of tidal flooding is considered to be **very low**;
- The risk of pluvial (surface water) flooding is considered to be **very low**;
- The risk of sewer flooding to be **moderate**;
- The risk of groundwater flooding is considered to be **low**;

8.3. Planning Requirements

In accordance with the NPPF this FRA demonstrates that the development will:

- not affect existing levels of flood risk from all sources;
- not increase flood risk elsewhere through the provision of mitigation measures such as attenuation of additional runoff to greenfield rates prior to discharge to the receiving watercourse/sewer; and
- be safe for users for its lifetime (100 years).

8.4. Recommendations

Following the assessment of flood risk as a consequence of the proposed scheme, it can be concluded that the site is appropriate for the intended use from a flood risk perspective.

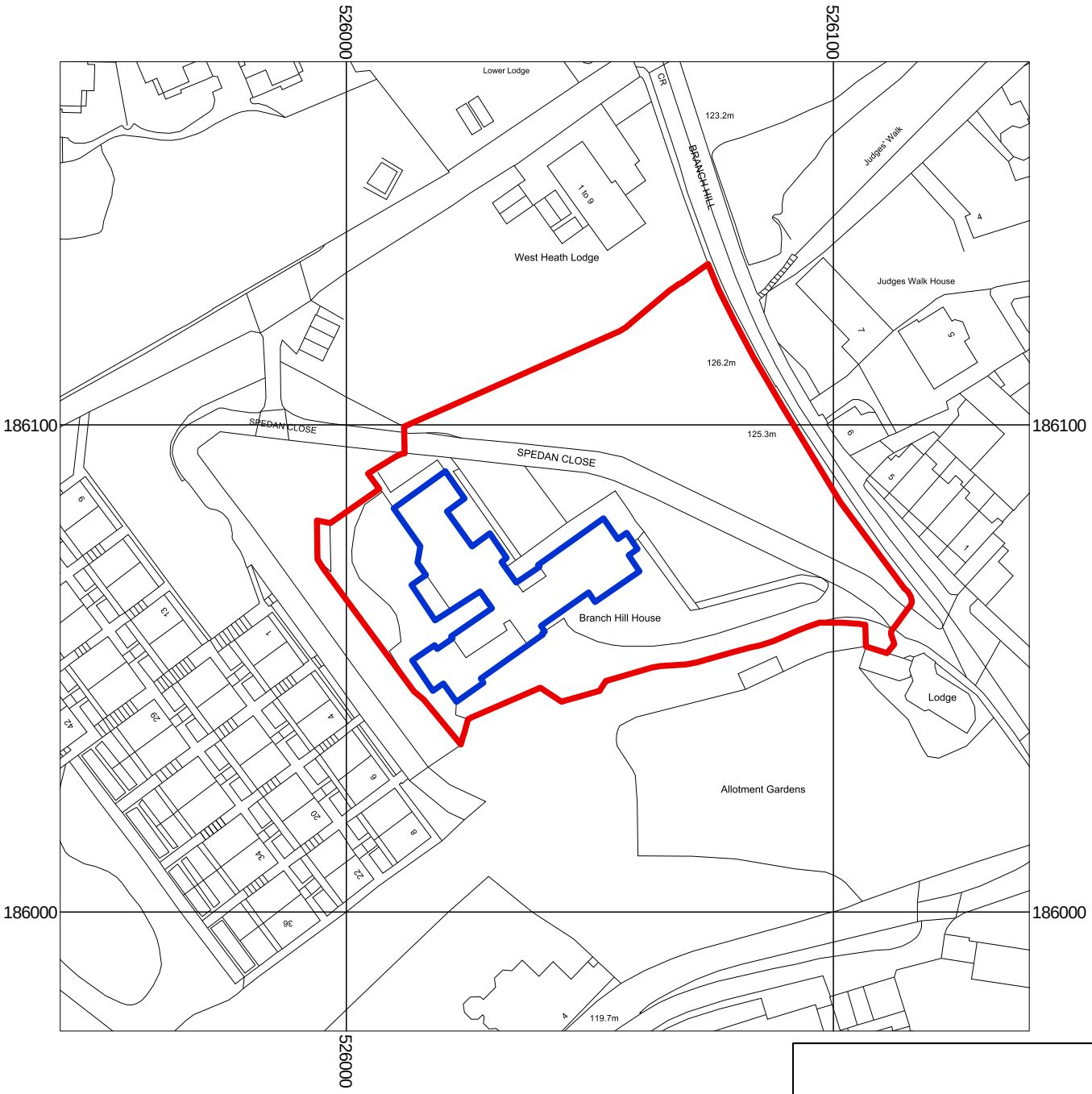
To mitigate, as much as reasonably practicable, the risk of sewer flooding, the proposed discharge from the site will be less than that of the existing. A 50% betterment of surface water (to be confirmed by Thames Water) will be achieved, reducing the discharge into the existing combined sewer network.

The low risk of surface water flooding can be incorporated into the surface water drainage design to mitigate the risk.

For any adverse impacts on flood risk to the surrounding area, mitigation measures to address the increase in surface water runoff from the development will be included within the drainage design.

APPENDIX A

Proposed Site Plan



SITE BOUNDARY

EXISTING BUILDING

BRANCH HILL HOUSE

LONDON

SITE LOCATION PLAN

DRNG No	SCALE	DATE
PL-01	1:1250 @ A4	SEPT-19

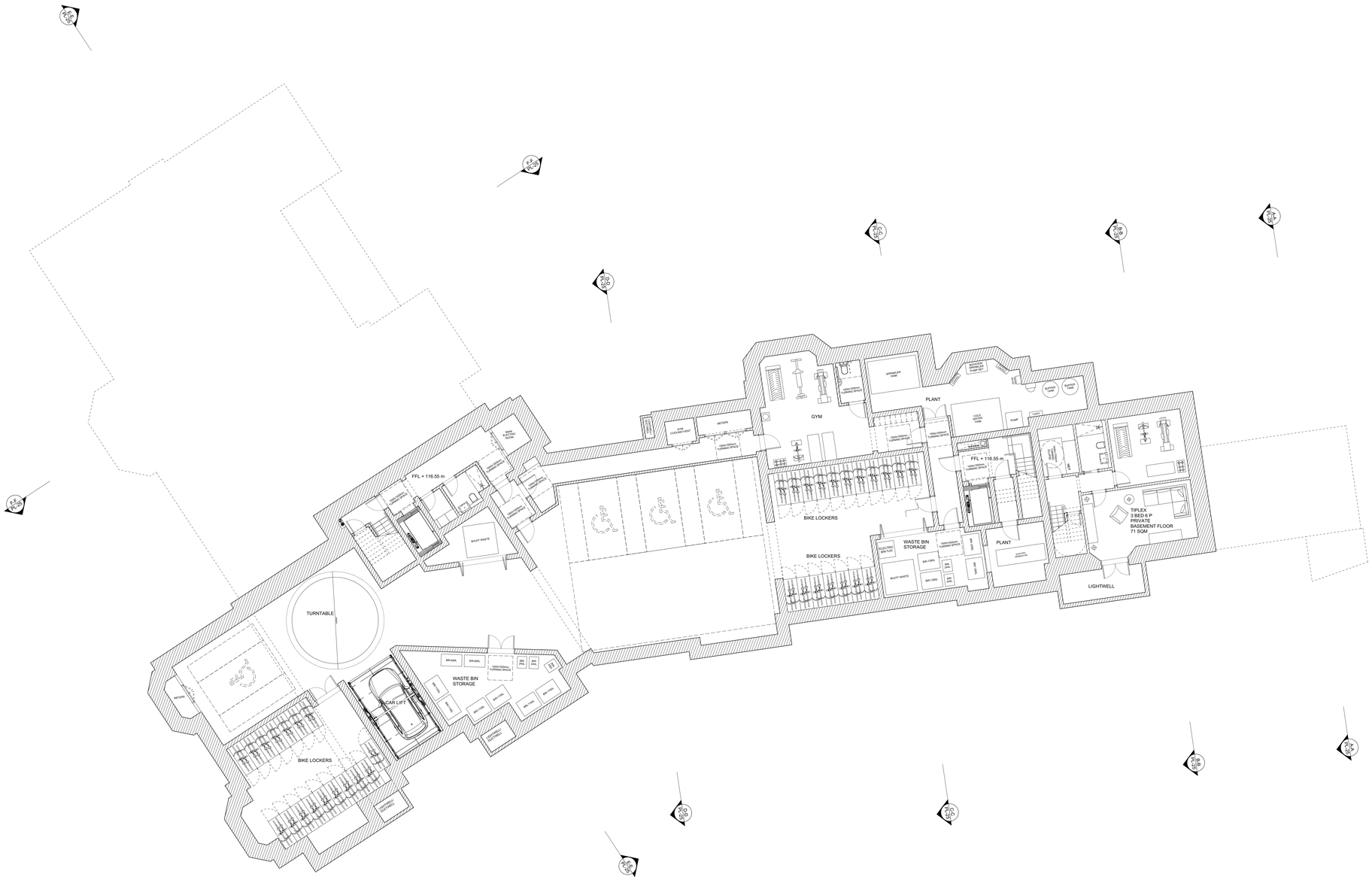
0 25m 50m 75m 100m

N

S

Stanhope Gate Architecture

5 ST. JAMES'S SQUARE
LONDON SW1Y 4JU
T 020 7451 0955 mail@stanhopegate.co.uk
www.stanhopegatearchitecture.com



REV.	DATE	DESCRIPTION

BRANCH HILL HOUSE
LONDON

PROPOSED BASEMENT PLAN

DRNG No	SCALE	DATE
PL-17	1:100 @ A0 1:200 @ A2	MONTH 2017

Stanhope Gate Architecture

5 ST JAMES'S SQUARE
LONDON SW1Y 4JU
T 020 7451 0955 mail@stanhopegate.co.uk
www.stanhopegatearchitecture.com

1.5m high retaining wall

1.2m high retaining wall

Sub Station

FLAT 1
2 BED 4 P + STUDY
PRIVATE
178 SQM

FFL + 119.75 m

FLAT 2
3 BED 6 P + STUDY
PRIVATE
221 SQM

FFL + 119.75 m

FFL + 119.750 m

FLAT 3
2 BED 4 P + STUDY
PRIVATE
138 SQM

FLAT 4
2 BED 3 P
INTERMEDIATE
89 SQM

FLAT 5
3 BED 6 P + STUDY
PRIVATE
180 SQM

FFL + 119.750 m

FLAT 8
3 BED 6 P + STUDY
PRIVATE
263 SQM

FFL + 119.750 m

UNIT 6 - TRIPLEX
3 BED 6 P + STUDY
PRIVATE
GROUND FLOOR
77 SQM

FFL + 119.30 m

GATE HOUSE
PRIVATE
GROUND FLOOR 36SQM

LIGHTWELL

N

S

0 1 2 3 4 5 10m

REV.	DATE	DESCRIPTION

BRANCH HILL HOUSE

LONDON

PROPOSED GROUND FLOOR PLAN

DRNG No	SCALE	DATE
PL-18	1:100 @ A0 1:200 @ A2	DEC 2019

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LONDON SW1Y 4JU
T 020 7451 0955 mail@stanhopegate.co.uk
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REV.	DATE	DESCRIPTION

BRANCH HILL HOUSE
LONDON

PROPOSED FIRST FLOOR PLAN

DRNG No	SCALE	DATE
PL-19	1:100 @ A0 1:200 @ A2	DEC 2019

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