Desk Study and Ground Investigation Report

122 Drummond Street
London NW1

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GEA Geotechnical & Environmental Associates

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EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA), on the instructions of Michael Alexander Consulting Engineers, on behalf of Julia Pyper, with respect to the deepening of the vaults below the site by about 1.0 m. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground conditions and hydrogeology, to assess the extent of any contamination and to provide information to assist with the design of the basement support and suitable foundations for the proposed development. The report also includes information required to comply with the London Borough of Camden (LBC) Planning Guidance CPG4.

SITE HISTORY

Greenwood's map of London, dated 1827, shows the site to have been developed with a building fronting onto Drummond Street to the south. The earliest Ordnance Survey (OS) map studied, dated 1873, shows the site to have been developed with the existing building and the surrounding area is in a similar layout as existing. Drummond Street is shown to the south of the site and the site appears to have been immediately surrounded by houses or shops. A saw mill is shown about 30 m south of the site, on the opposite side of Drummond Street. A smithy is shown about 20 m northeast of the site on the 1911 map. Sometime between the 1916 and 1953 map, buildings about 50 m northeast of the site were converted into a chemical works and engineering works which were labelled as warehouses from between 1959 to 1970. Fire Insurance Plans dating between 1889 and 1966 show the site to be occupied by a shop. The maps show the site to have remained unchanged from prior to 1873 until the present day.

GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a limited thickness of made ground, Lynch Hill Gravel was encountered over the London Clay Formation, which extended to the maximum depth of the investigation, of 4.00 m. The made ground initially comprised greyish light brown slightly clayey gravelly sand with fragments of brick and extended to depths of between 0.25 m and 0.40 m and was underlain by a layer of paving stones, about 70 mm thick, below which blackish and greyish very dark brown sandy gravelly clay with fragments of coal, ash and bricks was encountered and extended to a depth of 0.70 m in Borehole No 1. The Lynch Hill Gravel comprised orange-brown sand and gravel and extended to a depth of 3.00 m. The London Clay initially comprised soft becoming firm brown silty sandy gravelly clay, which extended to a depth of 3.30 m, whereupon firm grey silty fissured clay with selenite crystals was encountered and extended to the maximum depth of the investigation, of 4.00 m. Groundwater was encountered at a depth of 2.50 m. Two trial pits excavated against the southern and eastern vault walls showed the brick walls to be directly bearing on made ground at depths of 260 mm and 600 mm respectively.

RECOMMENDATIONS

It is understood that the maximum excavation depth will be about 1.0 m, to accommodate a lower floor level in the vaults that will give an increased headroom. The investigation has indicated that groundwater will not be encountered in the 1.0 m deep excavation, and it should therefore be possible to simply underpin the existing foundations to bear in the Lynch Hill Gravel. Foundations bearing at this depth may be designed to apply a net allowable bearing pressure of 100 kN/m^2.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been instructed by Michael Alexander Consulting Engineers, on behalf of Julia Pyper, to carry out a limited desk study, including hydrogeological assessment, and ground investigation at 122 Drummond Street, London, NW1 2HN.

1.1 Proposed Development

It is understood that it is proposed to deepen the existing vaults by a maximum of 1.0 m to provide further habitable space for the lower ground floor flat.

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

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to check the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to investigate the configuration of existing foundations;
- to assess the possible impact of the proposed development on the local hydrogeology;
- to provide advice with respect to the design of suitable foundations and retaining walls; and
- to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a limited desk study was carried out followed by a ground investigation. The desk study comprised:

- a review of historical Ordnance Survey (OS) maps sourced from the Envirocheck database;
- a review of readily available geology maps; and
- a walkover survey of the site carried out in conjunction with the fieldwork.

In the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- a single borehole advanced by window sample techniques to a depth of 4.00 m;
- two hand excavated trial pit advanced to examine existing foundations; and
- provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11[1] and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

1.3.1 Basement Impact Assessment

The work carried out also includes information required for a Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), which form part of the BIA procedure specified in the London Borough of Camden (LBC) Planning Guidance CPG4[2] and their Guidance for Subterranean Development[3] prepared by Arup. The aim of this work is to provide information on the groundwater conditions specific to this site and land stability, in particular to assess whether the development will affect the stability of neighbouring properties and whether any identified impacts can be appropriately mitigated.

The BIA elements of the work have been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng) and member of the Institution of Civil Engineers (MICE), who has over 20 years specialist experience in ground engineering. The assessment has been made in conjunction with Steve Branch, a BSc in Engineering Geology and Geotechnics, MSc in Geotechnical Engineering, a chartered geologist (CGeol) and Fellow of the Geological Society (FGS) with 25 years' experience in geotechnical engineering, engineering geology and hydrogeology. Both assessors meet the Geotechnical Advisor criteria of the Site Investigation Steering Group and satisfy the qualification requirements of the Council guidance.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted and the number of locations where the ground was sampled. No liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004
2 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells*
3 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

2.0 THE SITE

2.1 Site Description

The site is located approximately 100 m west of Euston London Underground and railway station and fronts onto Drummond Street to the south and is bordered by a similar three-storey terrace building to the east, a single storey building to the west and another building fronting onto Gower Street to the rear. The site may be additionally located by National Grid Reference 529348, 182570.

A walkover of the site was carried out by a geotechnical engineer from GEA at the time of the fieldwork, at which time access was only possible to the lightwell and vaults. The site is occupied by a four-storey building, including the lower ground floor level. A shop is present at ground floor level and the upper floors are presumably residential, as is the lower ground floor, which was unoccupied at the time of the investigation.

A lightwell is present in the front of the site and a staircase allows access to lower ground floor level. There are two vaults under the pavement, but it was only possible to access the eastern vault. The surrounding area is sensibly flat and the building occupies the entire site, which is devoid of vegetation.

2.2 Site History

The site history has been researched by reference to internet sources and historical Ordnance Survey (OS) maps obtained from the Envirocheck database.

Greenwood's map of London, dated 1827, shows the site to have been developed with a building fronting onto Drummond Street to the south.

The earliest Ordnance Survey (OS) map studied, dated 1873, shows the site to have been developed with the existing building and the surrounding area is in a similar layout as existing. Drummond Street is shown to the south of the site and the site appears to have been immediately surrounded by houses or shops. A saw mill is shown about 30 m south of the site, on the opposite side of Drummond Street. A disused burial ground is labelled about 105 m north of the site and Euston Station is also shown about 200 m to the northeast of the site.

The burial ground is labelled as St. James Gardens from 1895 and a smithy is shown about 20 m northeast of the site on the 1911 map. Sometime between the 1916 and 1953 maps, buildings about 50 m northeast of the site were converted into chemical works and engineering works which were labelled as warehouses from 1970 onward.

Fire Insurance Plans dating between 1889 and 1966 show the site to be occupied by a shop.

The maps show the site to have remained unchanged from prior to 1873 until the present day.

2.3 Other Information

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1% of homes are affected by radon emissions and therefore radon protective measures will not be necessary.

The Slope Angle Map (Fig 16) within the ARUP document indicates that the site and surrounding area does not have slopes greater than 7°.

Online mapping information suggests that London Underground tunnels are in close proximity of the site.

2.4 Geology and Hydrogeology

The British Geological Survey (BGS) map of the area indicates that the site is underlain by the Lynch Hill Gravel, which overlies the London Clay Formation.

The Lynch Hill Gravel is typically described as a sand and gravel but can contain layers of clay, silt and peat. The London Clay Formation is homogenous, slightly calcareous silty clay to very silty clay, with some beds of clayey silt grading to silty fine grained sand.

The Lynch Hill Gravel is classified by the Environment Agency as a Secondary 'A' Aquifer, which refers to 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.

Under the same classification system the London Clay is designated as unproductive strata, which refers to deposits that have low permeability and negligible significance for water supply or river base flow.

Groundwater flow in the region of the site is likely to be controlled by contours, and thus generally toward the south.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2 as far as possible in view of the limited available access, a single window sample borehole was drilled in the lightwell to a depth of 4.00 m and two trial pits were excavated in the vaults to investigate the shallow foundations. The work was carried out under the supervision of a geotechnical engineer from GEA.

Disturbed samples were obtained from the borehole, but have not been tested to date.

The borehole and trial pit records are appended, together with a site plan indicating the exploratory positions.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a limited thickness of made ground, the Lynch Hill Gravel was encountered over the London Clay, which extended to the maximum depth of the investigation.

4.1 Made Ground

The made ground initially comprised greyish light brown slightly clayey gravelly sand with fragments of bricks and extended to depths of between 0.25 m and 0.40 m which was underlain by a layer of paving slabs typically noted to be about 70 mm thick. Below the slabs blackish and greyish very dark brown sandy gravelly clay with fragments of coal, ash and bricks was encountered and extended to a depth of 0.70 m in Borehole No 1.

Apart from the presence of fragments of extraneous material noted above, no visual or olfactory evidence of contamination was observed during the fieldwork.

4.2 Lynch Hill Gravel Member

The Lynch Hill Gravel was only encountered in the borehole and comprised orange-brown fine to coarse sand and fine to coarse gravel and extended to a depth of 3.00 m.

These soils were observed to be free from obvious contamination.

4.3 London Clay Formation

The London Clay initially comprised a weathered zone of soft becoming firm brown silty sandy gravelly clay which extended to a depth of 3.30 m, whereupon firm grey silty fissured clay with selenite crystals was encountered and extended to the maximum depth of the investigation, of 4.00 m.

These soils were observed to be free from obvious contamination.

4.4 Groundwater

Groundwater was not encountered in the trial pits, but was indicated at a depth of 2.50 m in the sampling tubes.

The borehole was dipped upon completion and had collapsed to a depth of 3.60; water was measured at a depth of 3.48 m.

4.5 Existing Foundations

Trial Pit No 1, excavated on the southern vault elevation showed the brick wall to be directly bearing on made ground at a depth of 260 mm.

Trial Pit No 2, excavated adjacent to the eastern vault wall similarly showed the brick to be directly bearing on made ground, but at a greater depth of 600 mm.

The trial pit records are included in the Appendix.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations.

5.0 INTRODUCTION

The existing lower ground floor flat will be extended by increasing the head height in the vaults by lowering the floor level by a maximum of 1.0 m.

6.0 GROUND MODEL

The historical maps indicate that the site has been occupied by a shop since at least 1873. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- below a limited thickness of made ground, the Lynch Hill Gravel was found to overlie the London Clay Formation;
- London Underground tunnels are likely to be present near the site;
- the made ground generally comprises light brown clayey gravelly sand with brick fragments or blackish dark brown sandy gravelly clay with fragments of ash, coal and brick and extends to a depth of 0.70 m;
- there is an old suspected floor slab below the vaults;
- the underlying Lynch Hill Gravel comprises orange-brown sand and gravel and extends to a depth of 3.00 m;
- the London Clay initially comprises soft to firm brown silty sandy gravelly clay which extends to a depth of 3.30 m whereupon firm grey silty fissured clay was encountered and extended to the maximum depth of the investigation, of 4.0 m; and
- groundwater is present within the Lynch Hill Gravel, possibly at a depth of about 2.50 m.

7.0 ADVICE AND RECOMMENDATIONS

In order to accommodate a lowered floor in the vaults, it is understood that the maximum excavation depth will be about 1.0 m, to allow the formation of underpins and new floor slab. The formation level will therefore be within the Lynch Hill Gravel and the investigation has indicated that groundwater will not be encountered in the excavation.

A check should be made with London Underground that the proposed works will not interfere with their tunnels and apparatus.

7.1 Basement Construction

At this stage it is assumed that the excavation will be about 1 m deep and the limited investigation has indicated that groundwater should not generally be encountered in the excavation. There is however a potential for perched groundwater to be encountered in the vicinity of existing foundations although this should be controllable with sump pumping.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions.

Given the small size of the area to be lowered and the restricted access, formation of retaining walls by underpinning techniques is likely to be the most practical option at this site. It should be possible to form the retaining walls by concrete underpinning of the existing foundations using a traditional 'hit and miss' approach in limited widths. The groundworks contractor should have a contingency plan in place to deal with instability of the underpin excavations and groundwater inflows. It may be prudent to conduct a 'test pin' to determine the stability of the soils and assess if groundwater inflows will be problematic.

The design of basement support in the temporary and permanent conditions needs to take account of the need to maintain the stability of the excavation and the neighbouring properties.

7.1.1 Basement Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls. The parameters are based upon knowledge of the soils.

Stratum	Bulk Density (kg/m^3)	Effective Cohesion (c' – kN/m^2)	Effective Friction Angle (φ' – degrees)
Made Ground	1700	Zero	27
Lynch Hill Gravel	1900	Zero	30
London Clay	2000	Zero	25

The design water level should be determined by reference to advice in BS8102:2009[4] should be followed.

7.1.2 Basement Heave

The excavation of the proposed 1 m deep basement will result in an unloading of about 20 kN/m^2. This unloading will result in heave of the underlying London Clay Formation, which will comprise short term elastic movement and longer term swelling that will continue over a number of years. These movements may be relatively small and will be mitigated to some extent by the loads applied by the proposed structure, although it is considered that a more detailed analysis of the possible heave should be carried out once the basement design has been finalised.

7.2 Spread Foundations

The proposed formation level will be within the Lynch Hill Gravel and it should be possible to adopt moderate width pad or strip foundations in the gravel, designed to apply a net allowable bearing pressure of 100 kN/m^2 below the level of the proposed lower floor. This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits.

4 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

7.3 Shallow Excavations

On the basis of the borehole and trial pit findings it is considered likely that it will be generally feasible to form relatively shallow excavations terminating within the made ground without the requirement for lateral support, although localised instabilities may occur where more granular material or groundwater is encountered.

Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

7.4 Basement Floor Slab

Following the excavation of the basement, at a depth of approximately 1.0 m, it should be possible to adopt a ground bearing floor slab directly on to the Lynch Hill Gravel, following a proof rolling exercise and the infilling of any soft spots with suitably compacted granular material. This assumes that the slab will be designed to accommodate any potential heave forces.

7.5 Hydrogeological Assessment

The site is currently entirely occupied by a four-storey building with a lower ground level and front lightwell and vault that extends out under the pavement. Given the age of the building it is likely to be founded upon spread foundations, similar to those encountered in the vaults.

It is understood that it is proposed to deepen the vault areas by a maximum of 1.00 m to provide additional headroom. Formation level will therefore be within the Lynch Hill Gravel. Groundwater was encountered at a depth of 2.50 m and upon completion of drilling was subsequently measured at a depth of 3.48 m, groundwater flow is likely to be toward the south.

On the basis of the investigation, groundwater will not be encountered and the basement is not likely to extend below the groundwater table.

The Flood Map (Fig 15) within the ARUP document indicates that the site is not at risk of flooding, therefore a flood risk assessment will not be required.

7.6 Contamination Risk Assessment

The historical maps and Goad plans indicate that the site has been occupied by a single building for its entire developed history, which was in use as a shop. A shop is not considered to represent a source of contamination and given that the proposals will see the entire site covered by the building or hardstanding, there is not considered to be a pathway to end users from contamination in the soil, or on adjacent sites. Therefore there is considered to be a very low risk to end users of the site.

8.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work may be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

Due to time constraints contamination and geotechnical testing did not form part of the project brief and it would be prudent to carry out this work, possibly during the formation of the test pin recommended in the report above, to help classify soil for disposal to landfill and to determine the concrete design for the site.

The test pin, if excavated to the full depth of the proposed basement, should determine likely groundwater inflows into the basement excavation and assess the stability of the made ground and Lynch Hill Gravel.

It would be prudent to check the amount of heave that is likely to occur once the designs have been finalised.

London Underground should be consulted with regard to the proposed works to check that the basement will not interfere with their tunnels or apparatus.