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Remediation Strategy and Verification Plan

Desk Studies | Risk Assessments | Site Investigations | Geotechnical | Contamination Investigations | Remediation Design and Validation

Site: Phase 1c, Agar Grove, Camden, London, NW1 9SL

Client: Hill Partnerships Ltd.

Report Date: 16th September 2021

Project Reference: V0917

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SUMMARY

The site, which extends to about 0.6 ha, comprises the northeast corner of the wider Agar Grove Estate in Camden, northwest London. It is proposed demolish the existing residential blocks, and construct a series of low-rise residential blocks of apartments.

A Desk Study was previously undertaken by Peter Brett Associates (PBA) in December 2013. This indicates that the site has a history of residential use, with semi-detached and terraced houses occupying the site from the 1870s to the late 1960s when the site was redeveloped as it is today, comprising low to medium rise residential blocks with surrounding areas of soft landscaping, pedestrian access and parking areas.

Two phases of intrusive investigation were carried out. This first phase was undertaken by Peter Brett Associates (PBA), in August 2019, and comprised limited investigation for potential asbestos containing materials (ACMs); following the discovery of pieces of asbestos cement sheet during exploratory excavation works, in relation to the protected trees on the northeast side of the site. The second phase of investigation was undertaken in April 2021 by Southern Testing.

The object of this investigation was to further investigate the shallow soils across the site, with respect to the possible presence of ACM's and general potential contaminants; in order to determine the nature and extent of any remedial works which may be required on the site.

Relevant Pollutant Linkages have been identified in respect of lead, PAH's and asbestos within the Made Ground.

Post redevelopment, the majority of the site is to be covered with hardstanding (buildings, paved areas or raised planters), therefore, the risk to future site residents from the presence of lead, PAH's and asbestos within the Made Ground will be mitigated.

The only soft landscaped areas are around the existing trees on the northeast and southeast of the site. In this area a Remediation Strategy comprising the placement of a minimum of 300mm of certified clean topsoil should be provided above the existing soils, or levels should be reduced to allow the placement of this depth of clean soils. Where there are existing trees which are to be retained, a shallower depth of capping may be required, with the placement of a suitable marker membrane above the residual Made Ground, subject to agreement with the arboricultural consultant. These recommendations are also subject to approval by the regulatory authorities.

A Verification Plan and Discovery Strategy are also included.

The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

The findings and opinions conveyed via this report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd believes are reliable. Nevertheless, Southern Testing Laboratories Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

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For and on behalf of Southern Testing Laboratories Limited

STL: V0917

16th September 2021

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A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in a Consultant 'Small Works' Appointment, which was issued by Sam Faraday on behalf of Hill Partnerships Ltd. on the 25th March 2021.

2 Location

The site comprises the northeast quadrant of the existing Agar Grove Estate in Camden, northwest London. It is known as Phase 1C of the wider site development area. It is situated on the southern side of Agar Grove, approximately 1km north of Kings Cross Railway Station. The approximate National Grid Reference of the site is TQ 29611 84266. The site location is indicated on Figure 1.

3 Proposed Construction

It is proposed to construct two low-rise residential blocks of apartments, with associated access and soft landscaping. Post redevelopment, the majority of the site is to be covered with hardstanding (buildings, paved areas or raised planters), with the retention of the existing area of soft landscaping on the northeast of the site.

For the purposes of the contamination risk assessment, the proposed development land use is classified as Public Open Space (residential) (CLEA model[1]/C4SL report[2]). The gas sensitivity of the site is rated as Moderate (CIRIA C665[3]).

4 Scope

This report presents our Remediation Options Appraisal, Remediation Strategy, and Verification Plan for the proposed remedial works at the site.

As with any site there may be differences in soil conditions between exploratory hole positions.

The findings and opinions conveyed via this report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Limited believes are reliable. Nevertheless, Southern Testing Laboratories Limited cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

This report has been prepared for the sole internal use and reliance of Hill partnership Ltd. and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

[1] Environment Agency Publication SC050021/SR3 'Updated technical background to the CLEA Model' (2009).
[2] SP1010 Development of Category 4 Screening Levels DEFRA (2014)
[3] CIRIA C665 (2006) Assessing risks posed by hazardous ground gases to buildings.

The recommendations contained in this report may not be appropriate to alternative development schemes.

The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

B BACKGROUND INFORMATION

The site has been the subject of a desk study and two intrusive site investigation reports, as listed below

Ref	Date	Author	Ref No.	Subject
1	November 2013	Peter Brett Associates LLP	Project ref. 28732/006 Document: R001Rev1	Phase 1 Ground Condition Assessment
2	August 2019	Peter Brett Associates LLP	28732 Agar grove 1c	Ltr re. Tree root excavation and the presence of asbestos containing materials
3	April 2021	Southern Testing	SKT/JW/V0917	Ltr. re. Verification of Remediation at: Phase 1c, Agar Grove, Camden

These reports provide reasonable coverage and characterisation of the site and information derived from these reports is discussed below. The reader is referred to the original reports for supporting detail if needed. These reports are referred to below by the number given in the left hand column of the above table.

5 Site History

The desk study, detailed in report no. 1 above, indicates that the site has a history of residential use, with semi-detached and terraced houses occupying the site from the 1870s to the late 1960s, when the site was redeveloped as it is today. Redevelopment comprised low to medium rise residential blocks, with surrounding areas of soft landscaping, pedestrian access and parking areas.

6 Intrusive Site Investigation Works

It is understood that following the identification of possible asbestos containing materials (ACMs), during the excavation of a tree root inspection trench on the northeast of the site, further investigation comprising the re-excavation of pits within the area of the original trench were undertaken in August 2019 (ref. 2).

During these works suspected fragments of asbestos cement were identified in a number of the pits. Samples of the suspect material and samples of the soil were sent for laboratory analysis for asbestos. This identified chrysotile (white) asbestos fibres in all six of the samples of suspect material which were submitted for analysis. No ACMs or loose asbestos fibres were detected in the three soil samples submitted for analysis.

Southern Testing undertook further sampling and laboratory analysis of the shallow soils across the site in April 2021 (ref. 3). The object of this investigation was to further investigate the shallow soils across the site, with respect to the possible presence of ACM's and general potential contaminants, in order to determine the nature and extent of any remedial works which may be required on the site.

The soils encountered general comprised a covering of topsoil to 0.1 – 0.3m bgl, over variable Made Ground to 0.4 – 0.8m bgl, underlain by weathered London Clay.

Samples of the Made Ground were submitted for laboratory analysis for a range of potential contaminants, including heavy and phytotoxic metals, non-metals, PAH's and asbestos.

Elevated concentrations of lead were found in all five samples of Made Ground which were subject to analysis. A potential hotspot of polyaromatic hydrocarbon (PAH) contamination was also found one sample (HA01@0.5m) on the northwest of the site.

Chrysotile (white) asbestos was identified in four of the twelve samples analysed for the presence of asbestos. Of these four samples, three samples were identified to contain loose fibres of chrysotile, whilst one was found to contain sheeting/board debris.

Quantification analysis of the samples returned concentrations of asbestos fibres of less than the laboratory limit of detection for the three samples in which loose fibres were identified. One sample in which sheeting/board debris was found, (HA10@0.3m) which was located towards the centre of the site, was found to contain a concentration of 0.026% by weight. This concentration is above the laboratory limit of detection (0.001% by weight), but still well below the hazardous waste threshold of 0.1% by weight.

7 Relevant Pollutant Linkages

The various site investigations and risk assessments carried out identified the following Relevant Pollutant Linkages for the site:

Contaminant/Source	Pathways	Receptors
Lead and PAH's in Made Ground	Soil/dust Dermal exposure Soil/dust Ingestion/inhalation	Site workers
	Soil/dust Dermal exposure Soil/dust Ingestion/inhalation Plant uptake	Future residents
	Direct contact (PAH's only)	Services
ACM's and loose asbestos fibres in the Made Ground	Dust Inhalation	Site workers Future residents

C REMEDIAL OBJECTIVES AND OPTIONS

8 Remedial Objectives

The site is to be developed for a residential end-use. In the absence of significant off-site risk, the principal objective of the remediation is to remove or reduce to an acceptable level the identified potential risks to end-users of the site. Additional objectives are to achieve the remediation goal in a cost effective and timely manner, whilst minimising impact from associated traffic movements, landfill and resource consumption.

9 Options Appraisal

Lead & Polyaromatic Hydrocarbons (PAH's) in the Made Ground

The risks to human health receptors from lead and PAH compounds in the Made Ground could be dealt with by several methods.

In respect of construction and maintenance workers, the use of PPE and safe working practices (minimising disturbance of the soil, creation of dust and the extent and duration of contact with soils) can reduce risk by helping to break the exposure pathways. However, while use of these measures should be considered as part of good practice in construction and maintenance, they typically are looked upon as a measure of last resort and need to be used in combination with other measures. Neither are such measures appropriate for future site users (residents).

Breaking the exposure pathway prior to construction by emplacement of imported clean material and/or impermeable cover over the made ground could reduce risks to human health receptors including future site users. Buildings, access roads, car parking spaces and raised planters constitute impermeable cover and therefore imported soils would only be needed for areas of the site proposed as soft landscaping.

Removing the source by careful selective excavation of affected soils and subsequent off-site disposal to an appropriately licensed facility is also capable of reducing/eliminating the risk to human health receptors and the underlying aquifers.

With respect to the laying of new services, advice should be sought from the appropriate services providers at an early stage with regard to the suitability of materials. Clean corridors through the Made Ground may also be an option.

Off-site disposal of contaminated soils and importation of clean materials place additional demands on aggregate resources and waste disposal capacity, and both require significant road haulage. Use of these remediation methods therefore requires that the quantities involved be minimised to ensure the approach remains sustainable in respect of resources, energy and traffic impacts.

An approach combining source removal and replacement with clean material to limited areas of the site, with carefully considered safe working methods for construction is considered most likely to be effective and sustainable in respect of lead and PAH Compounds in the Made Ground.

Asbestos in the Made Ground

Loose fibres of chrysotile (white) asbestos were identified in three samples analysed for the presence of asbestos, whilst a fourth sample was found to contain pieces of sheeting/board debris.

There is a potential risk to construction workers and future site residents from the presence of asbestos containing materials (ACMs) within the Made Ground.

In respect of ground workers, construction and maintenance workers, the use of PPE and safe working practices (minimising disturbance of the soil, creation of dust and the extent and duration of contact with soils) can reduce risk by helping to break the exposure pathways. However, while use of these measures should be considered as part of good practice. Such measures are not appropriate for future site users (residents).

With respect to the low concentrations of loose asbestos fibres found across the site, the removal or capping of the Made Ground within soft landscaped areas, will remove the risk to future site users from asbestos fibres within the Made Ground.

D REMEDIATION STRATEGY

11 Remediation Methods

The Remediation Strategy will comprise the following:

Location	Details
Soft landscaped areas	Excavation and removal of 300mm of Made Ground. Where the Made Ground is thinner, only the Made Ground will be removed. Placement of 300mm of clean soil including a minimum of 150mm topsoil.* *Advice should be sought from the arboricultural consultant as to the depth to which the reduced level dig can be taken within the tree root protection zones. In these areas an alternative approach may be to provide a membrane above the existing Made Ground in order to reduce the depth of clean capping required.*
Raised Planters	Placement of certified clean imported soils (subsoil and/or topsoil).
Buried Services	Consultation with the utilities companies will be required, and consideration of material types used for drainage, in affected areas.

*Where larger trees and shrubs are proposed a greater depth of imported soil may be required.

12 Assessment Criteria

The following assessment criteria values will be used in the verification process:

Imported soils shall be free from deleterious materials, weeds and contamination. The material to be used will be tested in accordance with the appropriate BS Specifications for Topsoil (BS 3882:2015) and Subsoil (BS 8601:2013) and the analysis shall also comply with the values given for Public Open Space (residential) in the table in Appendix B. These values are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based on them. Their validity should be confirmed at the time of site development.

E VERIFICATION PLAN

13 Data Collection

Location	Data	Responsible party
Soft landscaped areas	Post placement check of thickness, including check on the placement of a membrane within the tree root protection zones (if required). Suppliers certificates & consignment notes for the imported subsoil and/or topsoil	Southern Testing Groundworker
Raised Planters	Suppliers certificates & consignment notes for the imported subsoil and/or topsoil	Groundworker
Buried Services	Consultation with the utilities companies will be required, and consideration of material types used for drainage, in affected areas.	Main Contractor/Hill Partnership Ltd.

14 Reporting

At the end of the remediation, a verification report will be produced by Southern Testing.

15 Discovery Strategy

As with any site, areas of contamination not identified during site investigation works may come to light in the course of redevelopment. Accordingly, a discovery strategy will be adopted to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner, as follows:

- A close watch will be maintained during all demolition and excavation works.
- In the event that unexpected or malodorous soils or liquids are encountered, excavation work shall cease in the affected area.

- The affected area shall be made safe and fenced off to prevent unauthorised access.
- The Site Manager shall notify Southern Testing Laboratories of the discovery, who will attend site to inspect the suspect materials, provide advice and take samples as necessary. Within Southern Testing Laboratories, Sarah Toms shall be the first point of contact.
- The Site Manager shall notify Camden Council of the discovery. Within Camden Council, the Contaminated Land Officer shall be the first point of contact.

Any suspect excavated soil will be stockpiled separately on polythene sheeting, covered, and tested before being removed

16 General Guidance

In general terms, the workforce and general public should be protected from contact with contaminated material. There is a range of relevant documents published by the Health and Safety Executive, and organisations such as CIRIA, and the BRE.

Some soils will require removal from site and disposal to suitably licensed landfills. Different guidelines and charges will apply to different waste classifications. As waste producers, the Developer holds responsibilities under the various governing regulations, including:-

- Ensuring that waste is characterised in accordance with current Technical Guidance.
- Ensuring that waste is disposed of at a facility appropriately licensed to receive the waste as classified.
- Keeping accurate records of all waste classification, transfer and a disposal log including information such as:
    - Date, Waste Classification, Carrier's Registration Number, Transfer Note Number, Ultimate Destination.
- Submitting full copies of those records for inclusion in validation/closure reports.

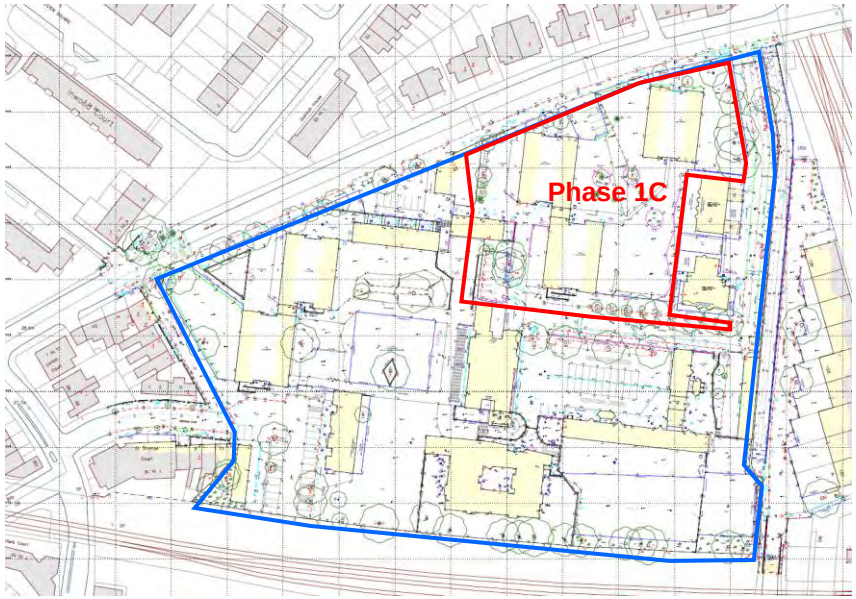
Maintaining those records for potential future regulatory inspection.

APPENDIX A

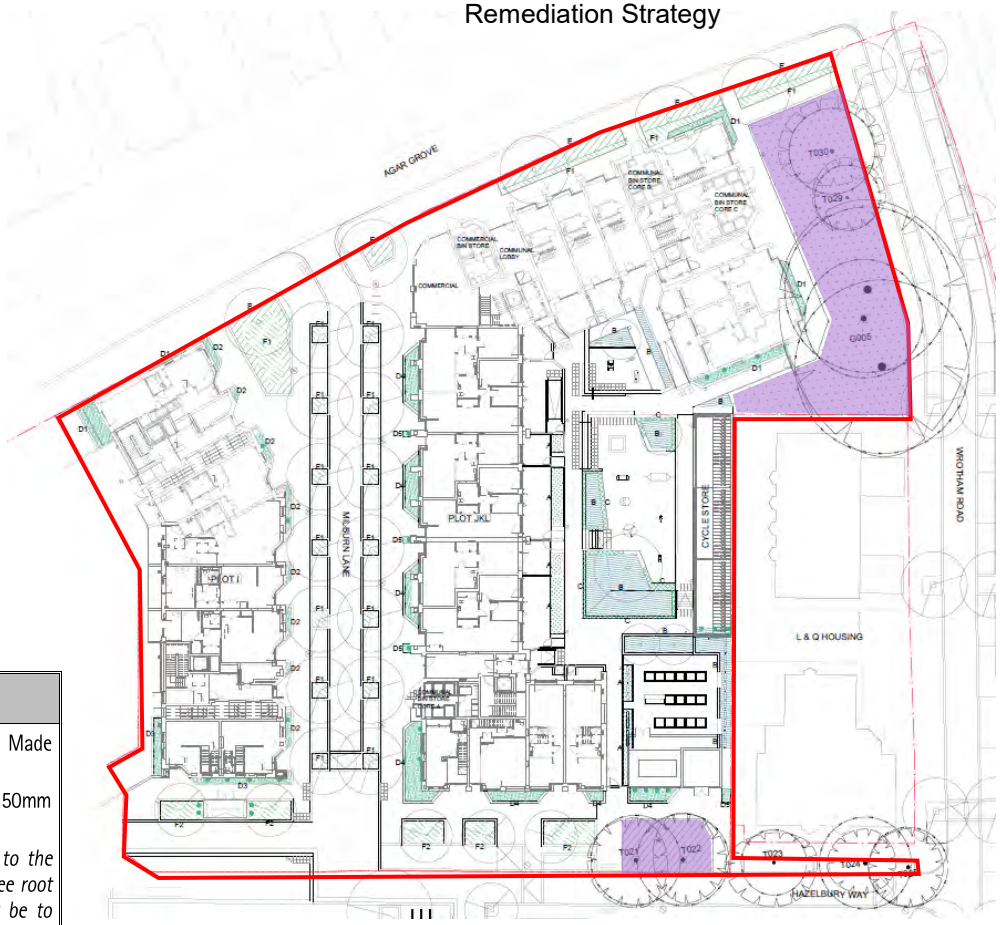
Site Plans

Site:	Agar Grove, Phase 1C, Camden, London, NW1 9SL	Project ID	V0917
Figure 1	Site Location Plan	Date:	16/09/2021

Agar Grove Estate Regeneration Area



Remediation Strategy



Location	Details
Soft landscaped areas	Excavation and removal of 300mm of Made Ground. Where the Made Ground is thinner, only the Made Ground will be removed. Placement of 300mm of clean soil including a minimum of 150mm topsoil.* *Advice should be sought from the arboricultural consultant as to the depth to which the reduced level dig can be taken within the tree root protection zones. In these areas an alternative approach may be to provide a membrane above the existing Made Ground in order to reduce the depth of clean capping required.*
Raised Planters	Placement of certified clean imported soils (subsoil and/or topsoil).

*Where larger trees and shrubs are proposed a greater depth of imported soil may be required.

Site:	Agar Grove, Phase 1C, Camden, London, NW1 9SL	Project Id:	V0917
Figure 2	Remediation Strategy	Date:	15/09/2021

APPENDIX B

Verification Criteria

Contaminant Screening Values for Imported Soils

Contaminant	Units	Proposed Land Use					
		Residential with homegrown produce consumption	Residential without homegrown produce consumption	Open Space* (Residential)	Open Space* (Park)	Allotments	Commercial / Industrial
Arsenic (As) [2]	mg/kg	37	40	79	170	43	640
Cadmium (Cd) [2]	mg/kg	11	85	120	555	1.9	190
Trivalent Chromium (CrIII) [2]	mg/kg	910	910	1,500	33,000	18,000	8600
Hexavalent Chromium (CrVI) [2]	mg/kg	6	6	7.7	220	1.8	33
Lead (Pb) [3]	mg/kg	200	310	630	1300	80	2330
Mercury (Hg) [1,2,7]	mg/kg	7.6-11	9.2-15	40	68-71	6.0	29-320
Selenium (Se) [2]	mg/kg	250	430	1,100	1,800	88	12,000
Nickel (Ni) [1,4]	mg/kg	pH<6.0 60 pH 6.0-7.0 75 pH>7.0 110					
Copper (Cu) [1,4]	mg/kg	pH<6.0 100 pH 6.0-7.0 135 pH>7.0 200					
Zinc (Zn) [1,4]	mg/kg	pH<6.0 200 pH 6.0-7.0 200 pH>7.0 300					
Phenol [1,2]	mg/kg	120-380	440-1200	440-1300	440-1300	23-83	440-1300
Benzo[a]pyrene [1,5]	mg/kg	1.7-2.4	2.6	4.9	10	0.67-2.7	36
Naphthalene [1,2]	mg/kg	2.3-13	2.3-13	77-430+	77-430+	4.1-24	77-430+
Total Cyanide (CN) [6]	mg/kg	/	/			/	/
Free Cyanide [6]	mg/kg	/	/			/	/
Complex Cyanides [6]	mg/kg	/	/			/	/
Thiocyanate [6]	mg/kg	/	/			/	/

Notes:

***** Open Space levels calculated on the basis of the exposure modelling developed in the C4SL research.

+ Screening values constrained to saturation limit. Higher values may be acceptable on a site specific basis.

[1] Where ranges of values are given for organic contaminants, the screening value is dependent on the Soil Organic Matter. Where ranges are given for inorganic contaminants, the screening value is dependent on the pH.

[2] LQM/CIEH S4UL (2014). Copyright Land Quality Management Ltd reproduced with permission; Publication Number S4UL 3116. All rights reserved.

[3] C4SL (DEFRA 2014).

[4] Copper Zinc and Nickel may have phototoxic effects at the GAC or SGV concentrations and alternative criteria are given for importation of Topsoil or other soils for cultivation, based on BS3882:2015 (Topsoil) and BS8601:2013 (Subsoil).

[5] Based on the Surrogate Marker approach and modelled using the modified exposure parameters of C4SL but retaining 'minimal risk' HCV.

[6] Usually Non-Detect concentrations. Screening criteria to be derived on a site specific basis if test results indicate.

[7] SGV/GAC for Methyl Mercury, higher concentrations may be tolerable if inorganic mercury is the only species present. Lower concentrations apply for elemental mercury.

These screening values are valid at the time of writing but may be subject to change. Their validity should be confirmed at the time of site development.