25 MAR 2019

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15th March 2019
Our ref. LP1412/CCV/1

Dear David

Connaught Close, Hillingdon, UB8 3DX
Verification of Clean Cover in Garden Plots

1 Introduction

Leap Environmental Ltd (LEAP) was appointed by Aquinna Homes plc to undertake validation testing of soils placed as clean cover at the housing development at Connaught Close, Hillingdon, Uxbridge, UB8 3DX (Figure 1 of Appendix A). It was formerly a garage and MOT station, is irregularly-shaped and covers approximately 0.12 ha.

2 Background

The site is subject to approved planning application 4519/APP/2017/361 for the demolition of the industrial units and the construction of eight dwellings (4 x 3-bed houses and 4 x 1-2 bed apartments) with associated parking, amenity space and access. Landscaping includes private gardens and open communal space (estimated to be approximately 450 sq.m in area) as per the attached layout in Figure 2 of Appendix A.

Previous investigations undertaken by LEAP between August 2017 and January 2018 are reported in the following:

- LEAP: *'Site Investigation Report at Punters Garage, New Road Hillingdon UB8 3DX'*, dated 30th August 2017 (Ref: LP1412/1).
- LEAP: '*Supplementary Site Investigation at Punters Garage, New Road Hillingdon UB8 3DX'*, letter report dated 11th January 2018 (Ref: BCG/vlw/LP1412/Supp.SI).

These reports were submitted by Aquinna Homes plc to successfully discharge parts a). and b). of planning condition 10 relating to land contamination (desk study and site investigation).

3 Scope of Works

The LEAP site investigation report LP1412/1 recommended that the Made Ground should be removed from beneath all areas of soft landscaping and replaced with clean imported topsoil and subsoil. Once imported, the requirements of clean cover in garden areas were specified as follows:

- Back gardens: 600mm of clean cover with a minimum of 150mm topsoil;
- Front gardens: 450mm of clean cover with a minimum of 150mm topsoil.

A geotextile membrane at the base of the clean cover was recommended in all garden areas to prevent excavations deeper than the verified clean materials.

Imported soils were required to comply with the acceptance criteria provided within the LEAP supplementary investigation (Ref: BCG/vlw/LP1412/Supp.SI) and is also provided in Appendix B of this letter report.

The scope of works was to confirm the presence of the geotextile membrane, that a sufficient thickness of cover had been placed and that it was suitable for use from a contamination perspective.

4 Soil Sampling

LEAP attended site on 7th February and 11th March 2019 to inspect the areas of private gardens around Plots 1, 2, 5, 6 and 7. Plots 3 and 4 are apartments with no landscaping, with hardstanding in the open space to the rear of the building. Plot 8 also has no private garden nor other associated landscaped areas.

At least one validation pit was excavated in each of the garden areas through the soil cover to the geotextile membrane. It is understood from documents provided by the client that all the material had been supplied by Springbridge Direct Ltd.

The soil cover was inspected to check that the minimum specified thicknesses had been achieved. During the first visit the soil cover placed in the back gardens of Plots 1, 2 and 5 did not meet the thickness requirements given in Section 3. During the second visit validation pits were repeated in these plots following further placement of soil and further samples were taken of the topsoil and subsoil.

Topsoil samples were taken from every inspection pit by LEAP and subsoil samples were taken from the back gardens of Plots 1, 2 and 5 and the front garden of Plot 7. The samples were sent to The Environmental Laboratory in East Sussex for the following suite of analysis:

- Heavy metals (including hexavalent chromium)
- Polycyclic aromatic hydrocarbons (PAHs)
- Asbestos
- pH
- Total organic carbon (TOC)

The topsoil encountered was a dark brown clayey slightly gravelly sand. Gravel was fine, sub-angular to rounded of flint. Subsoil was encountered as a pale yellow/brown slightly gravelly fine to coarse sand, with gravel of fine sub-angular to sub-rounded flint.

The locations of the inspection pits are included on Figure 2 of Appendix A and a selection of photographs included in Appendix C.

5 Results

Table 1 below summarises of the findings from the clean cover validation inspections.

Table 1: Summary of Final Cover Thicknesses

Plot Number	Date Inspected	Topsoil Thickness (mm)	Total Pit Thickness (mm)	Geotextile Membrane Present
1 (back)	11/03/2019	170	640	Yes
1 (front)	11/03/2019	210	460	Yes
2 (back)	11/03/2019	220	660	Yes
5 (back)	11/03/2019	220	620	Yes
5 (front)	07/02/2019	240	450	Yes
6 (back)	07/02/2019	150	570	Yes
6 (front)	07/02/2019	190	470	Yes
7 (front)	11/03/2019	250	550	Yes

In the back garden of Plot 6 clean cover was only 570mm which does not meet the required cover of 600mm. However, this thickness will be achieved through subsequent turfing.

The results of the laboratory analysis are summarised in Table 2 and the laboratory analytical test certificates are provided in Appendix D. Table 2 provides a comparison of the results against LEAP's assessment criteria for soils placed in private gardens.

No samples of topsoil that were analysed were found to exceed the assessment criteria.

Two samples of the subsoil that were analysed slightly exceeded the upper limit of the pH range, and one subsoil exceeded benzo(a)pyrene with a concentration of 2.3 mg/kg compared to the assessment criteria of 2.2 mg/kg. Given that the subsoils are covered by a layer of topsoil, the exceedance in benzo(a)pyrene is minimal, and that the acceptance criterion is a S4UL which represents a minimal toxicological risk, the subsoils are not considered to pose and unacceptable risk to human health. Therefore, the soils placed as clean cover are considered suitable for use in terms of their potential risks to human health.

Table 2: Screening Table for Chemical Verification of Soils

			Soil Type:	Topsoil	Topsoil	Subsoil	Topsoil	Topsoil	Subsoil	Topsoil	Topsoil	Subsoil	Subsoil	Topsoil	Topsoil	Topsoil	Subsoil
			Sample ID:	Plot 1 BG	Plot 1 BG	Plot 1 BG	Plot 1 FG	Plot 2 BG	Plot 2 BG	Plot 5 BG	Plot 5 BG	Plot 5 BG	Plot 5 FG	Plot 6 BG	Plot 6 FG	Plot 7 FG	Plot 7 FG
			Sample Depth (m):	0.1	0.1	0.5	0.15	0.15	0.35	0.05	0.15	0.5	0.3	0.1	0.1	0.15	0.5
			Date of Sampling:	07/02/2019	11/03/2019	11/03/2019	11/03/2019	11/03/2019	07/02/2019	07/02/2019	11/03/2019	11/03/2019	07/02/2019	07/02/2019	07/02/2019	11/03/2019	11/03/2019
Determinand	**Units**	**LOD**	**Assesment Criteria**														
Metals																	
Arsenic	mg/kg	1	37	12.9	11.5	9.3	17.2	12.6	12.1	13.7	10.1	11.1	13.8	13.0	15.0	10.0	8.4
Cadmium	mg/kg	0.5	11	< 0.5	< 0.5	0.9	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chromium	mg/kg	5	910	23.5	22.6	15.6	35.2	21.6	22.5	22.5	17.6	19.0	25.0	21.5	24.1	21.4	8.7
Copper	mg/kg	5	2,400	39.4	29.9	16.3	32.0	33.1	32.7	43.3	26.0	26.4	36.3	41.2	44.2	25.6	7.2
Lead	mg/kg	5	200	160	95.2	34.1	106	114	65.0	131	98.0	53.7	53.4	133	159	79.6	14.6
Mercury	mg/kg	0.5	40	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nickel	mg/kg	5	180	15.1	14.1	10.3	19.3	13.8	18.4	15.7	12.1	16	17.3	15.4	17.7	12.4	< 5.0
Selenium	mg/kg	1	250	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc	mg/kg	5	3,700	146	118	62.2	140	113	108	140	103	97.1	143	153	167	115	26.5
Inorganics																	
Hexavalent Chromium	mg/kg	0.8	6	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Miscellaneous																	
pH	pH units	0.1	6.5-9.5	8.4	8.7	9.8	8.2	8.5	9.0	8.3	8.4	8.6	10.1	8.0	8.1	8.5	9.3
Total Organic Carbon	%	0.01	n/a	3.2	2.4	0.4	2.8	3.4	0.82	3.1	3.2	0.66	0.67	2.6	3.2	3.7	0.09
Asbestos	-	-	Not detected	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
Polyaromatic hydrocarbons																	
Naphthalene	mg/kg	0.1	2.3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	0.1	170	< 0.1	< 0.1	< 0.1	< 0.1	0.5	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1
Acenaphthene	mg/kg	0.1	210	< 0.1	< 0.1	< 0.1	< 0.1	0.6	0.2	< 0.1	0.1	0.2	0.3	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	0.1	170	< 0.1	< 0.1	< 0.1	0.1	0.2	0.2	< 0.1	< 0.1	0.2	0.3	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	0.1	95	0.3	0.5	0.5	0.4	0.7	1.7	0.7	0.5	2.3	2.2	0.7	0.9	0.5	< 0.1
Anthracene	mg/kg	0.1	2,400	0.1	0.1	0.2	0.1	0.2	0.6	0.3	0.1	0.7	0.9	0.3	0.3	0.2	< 0.1
Fluoranthene	mg/kg	0.1	280	0.9	1.4	1.0	1.2	2.3	3.9	1.5	1.8	5.2	5.0	1.8	2.3	2.3	0.2
Pyrene	mg/kg	0.1	620	0.6	1.0	0.8	0.9	1.2	3.2	1.1	1.0	4.5	4.2	1.2	1.8	1.2	0.1
Benzo(a)anthracene	mg/kg	0.1	n.v.	0.4	1.8	0.5	0.8	0.7	1.7	0.7	1.2	2.4	2.1	1.5	1.0	2.8	< 0.1
Chrysene	mg/kg	0.1	n.v.	0.4	0.6	0.4	0.6	0.7	1.9	0.8	0.5	2.6	2.4	0.9	1.0	1.2	< 0.1
Benzo(b)fluoranthene	mg/kg	0.1	n.v.	0.5	0.5	0.3	0.6	0.7	1.8	0.7	0.6	2.4	2.4	0.9	1.1	1.7	< 0.1
Benzo(k)fluoranthene	mg/kg	0.1	n.v.	0.5	1.0	0.5	1.0	1.4	1.8	0.8	1.4	2.8	2.1	1.0	1.0	2.5	0.1
Benzo(a)pyrene	mg/kg	0.1	2.2	0.4	0.6	0.3	0.6	0.8	1.7	0.7	0.9	2.3	2.1	1.0	0.9	1.8	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	n.v.	0.3	0.4	0.3	0.5	0.7	1.1	0.4	0.6	1.8	1.5	0.6	0.6	1.5	< 0.1
Dibenzo(a,h)anthracene	mg/kg	0.1	n.v.	0.1	0.2	< 0.1	0.2	0.4	0.3	0.1	0.4	0.4	0.4	0.1	0.2	0.4	< 0.1
Benzo[g,h,i]perylene	mg/kg	0.1	n.v.	0.2	0.7	0.3	0.7	1.1	0.8	0.4	1.2	1.8	1.1	0.5	0.4	1.8	< 0.1
Total PAH(16)	mg/kg	0.4	n.v.	4.7	8.9	5.3	7.6	12.2	21.2	8.5	10.4	29.6	26.9	10.9	11.7	18.4	1.0

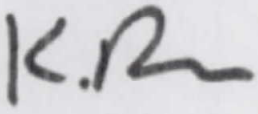
n.v. - no value available
n/a-- not applicable

= Exceedance of soil result relative to the assessment criteria

6 Conclusions

Based on visual inspections and the laboratory evidence gathered during LEAP's site attendance on 7th February and 11th March 2019 it is considered that there is an adequate thickness of clean cover material above the formation level in the front and back gardens of the houses, and that these capping materials meet the acceptability criteria stipulated in the specification.

Yours sincerely



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Appendix A – Figures

Appendix B – LEAP Specification for Clean Cover

Appendix C – Photographs

Appendix D – Screening Table and Laboratory Certificates

Limitations

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

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

The inspections undertaken were visual only. No specific pressure, integrity or destructive testing nor measurements were undertaken as part of this work.

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APPENDIX A – FIGURES

Figures



Site Boundary

Image from Bing Maps

leap environmental	**Client:**	Aquinna Homes plc	**Title:**	Site Location Plan	**Project:** LP1412
	Project:	Connaught Close, Hillingdon, UB8 3DX	**Date:**	15th March 2019	**Figure No.:** 1

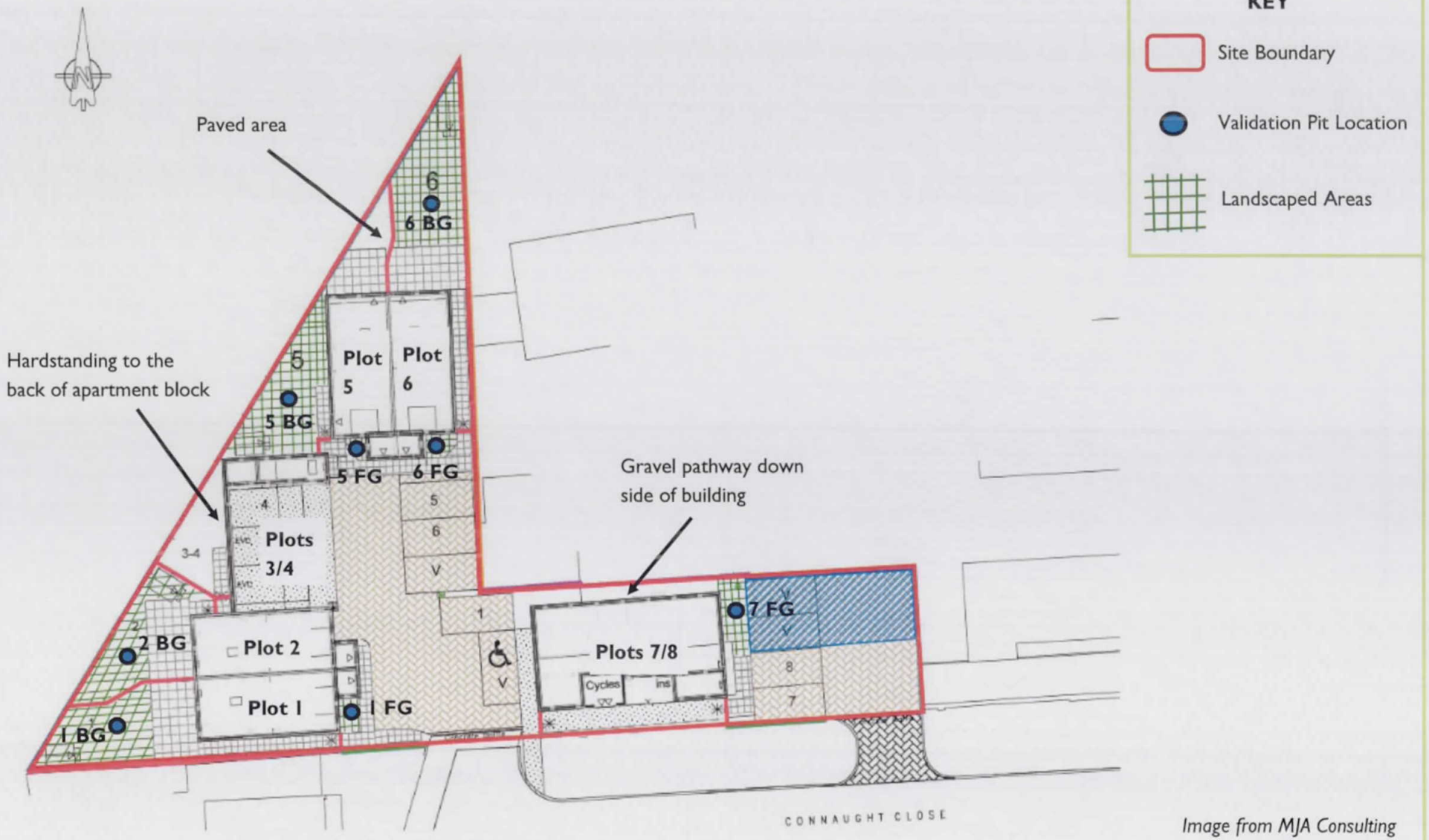

Image from MJA Consulting

Client:	Aquinna Homes plc	**Title:**	Site Layout Plan and Validation Pit Location	**Project:**	LP1412
Project:	Connaught Close, Hillingdon, UB8 3DX	**Date:**	15th March 2019	**Figure No.:**	2

APPENDIX B – LEAP SPECIFICATION FOR IMPORTED SOILS

LEAP Specification for Imported Soils

LEAP SPECIFICATION FOR PLACEMENT OF IMPORTED FILLS AND PROCUREMENT OF IMPORTED TOPSOIL AND SUBSOIL.

1 FILLS

1.1 Filling Generally

Filling shall be carried out in accordance with the recommendations of BS 6031: 1981.

Fill shall be maintained and protected in a satisfactory condition at all times until final completion.

Any material rendered unsuitable or unsatisfactory after being placed in the works shall be repaired or replaced as appropriate so that all the completed filling is in accordance with the specification.

1.2 Dimensions

Fills shall be constructed to backfill the excavations made to remove unacceptable material in order to reinstate the ground to finished levels with an allowance for shrinkage and consolidation of the fill material subsequent to completion, and in order that the minimum clean cover as specified in the remediation method statement is achieved.

The excavated levels shall be recorded before the commencement of filling. The level of the filled areas shall be taken and recorded after filling.

2 Types of Fill

There are potentially two types of fill to be used. These are as follows:

- Topsoil
- Subsoil

The capping of landscaped areas will comprise a minimum of 150 mm of topsoil to finished garden level. Underlying subsoil thicknesses will be as required to achieve the overall finished levels and to provide the required cover layer thicknesses as detailed in the main body of this report.

2.1 Topsoil

It is recommended that imported topsoil complies with the requirements of BS 3882: 2015 for a Premium or General Purpose Grade material.

The topsoil shall be free from fragments of glass, bricks, concrete, wire or other potentially hazardous matter.

The topsoil will be subject to the additional limitations set out below.

2.2 Subsoil

Imported manufactured or modified subsoil shall comprise certified clean material which satisfies the conditions set out in BS8601:2013. Subsoil arising from site or from a certified direct transfer (e.g. under CL:AiRE Code of Practice) shall comprise clean natural arisings from construction activities which have been confirmed acceptable by the Engineer.

2.3 Sources of Materials

Imported materials may be obtained from any source unless otherwise stated in the Drawings or in the Specification.

It shall remain the responsibility of the Contractor to obtain only fill material complying with the Specification and Method Statement, not withstanding any tests which may be accepted by the Engineer.

The Contractor shall demonstrate to the Validation Engineer's satisfaction that his fill materials from each source are uncontaminated by submitting to the Validation Engineer a chemical analysis of material or evidence of such other tests as the Validation Engineer may require for all proposed sources of fill, and if necessary sampling and analysing materials as they are delivered to stockpiles or the fill location on site.

Sampling rates shall be a minimum of one sample per 150 cubic metres of imported soil, unless otherwise agreed with the Engineer. Such tests for chemical composition as may be agreed by the Engineer shall be carried out on each sample and the results of tests shall be forwarded to the Engineer. Testing for contamination on samples taken shall be carried out at a testing laboratory approved by the Engineer and shall be to appropriate MCERTS standards. The Contractor shall maintain records of the location in the Works of fill from each source and the date of delivery to the site, and shall submit these records to the Engineer as requested. Chemical analysis on the imported fill material shall include testing for the contaminants listed in Tables B1 as a minimum. Contaminant concentrations shall be below those listed in Tables B1 and B2, which are attached, unless agreed otherwise by the Engineer. Additional analyses may be requested depending on the source and nature of the material.

In addition, the following shall be deemed as unacceptable for replacement fills:

- Peat, materials from swamps, marshes and bogs.
- Logs, stumps and perishable material.
- Materials in a frozen condition.

- Clay having a liquid limit determined in accordance with BS1377; Part 2, exceeding 90% or plasticity index determined in accordance with BS1377; Part 2, exceeding 65%.
- Material susceptible to spontaneous combustion.

2.4 Practical Considerations

2.4.1 Formation Level / Subgrade Testing

Where made ground from previous site usage remains present at formation level then subgrade / formation level testing will be required to confirm the necessary thickness of sub soil and / or topsoil to be placed. This is assessed in accordance with BRE 2004: Cover systems for land regeneration. Sufficient time should be allowed in the programme for this testing to be completed prior to the requirement for clean cover to be laid. The standard turnaround for laboratory testing is 5 working days from the date of receipt at the laboratory.

2.4.2 Preparation of Subgrade

All pile mat, scaffold base and/or waste materials must be removed in their entirety from the surface of areas to become gardens or public open space / soft landscaping prior to the application of clean cover soils. This aspect of the works will be inspected and validated by the Engineer.

2.4.3 Out of Specification Materials

Should the Contractor proceed with stockpiling or spreading and fill prior to receiving approval from the Engineer of results of the above tests, and the results of such tests show that the fill is contaminated above acceptable levels, the Contractor shall remove all contaminated material and replace it with acceptable material at his own cost as part of the main contract.

2.4.4 Suitability of Materials in Gardens

Materials laid as clean cover in private gardens must not only meet the requirements to be protective against land contamination but they must also be suitable to garden in. Hence, topsoil should not contain more than the British Standard-specified percentage of clay as exceeding this value may result in poor drainage and the failure of turf to establish. Subsoil should contain sufficient nutrition and be of sufficient depth to allow for the establishment of larger shrubs and trees and hence, a subsoil exceeding the British Standard-specified percentage of sand (i.e. an as-dug sand) would be unsuitable.

TABLE B1: CHEMICAL ACCEPTABILITY CRITERIA FOR MATERIALS TO BE IMPORTED FOR USE AS TOPSOIL OR SUBSOIL IN PRIVATE GARDENS

Determinant	Assessment Criteria mg/kg
pH	6.5-9.5
Arsenic	37
Cadmium	11
Trivalent Chromium	910
Hexavalent Chromium	6.0
Copper	2400
Lead	200
Mercury	40[1]
Nickel	180
Zinc	3700[2]
Selenium	250
Naphthalene	2.3
Acenaphthylene	170
Acenaphthene	210
Fluorene	170
Phenanthrene	95
Anthracene	2400
Fluoranthene	280
Pyrene	620
Benzo(a)Pyrene	2.2
Asbestos	Not detected

Notes to table

1. *Assessment criterion based on inorganic mercury.*

2. *Assessment criterion based on oral pathway only.*

TABLE B2: CHEMICAL ACCEPTABILITY CRITERIA FOR MATERIALS TO BE IMPORTED FOR USE AS TOPSOIL OR SUBSOIL IN PUBLIC OPEN SPACE (NEAR HOUSING)

Determinant	Assessment Criteria mg/kg
pH	6.5-9.5
Arsenic	79
Cadmium	120
Trivalent Chromium	1500
Hexavalent Chromium	7.7
Copper	12000
Lead	630
Mercury	120[1]
Nickel	230
Zinc	81000[2]
Selenium	1100
Naphthalene	4900
Acenaphthylene	15000
Acenaphthene	15000
Fluorene	9900
Phenanthrene	3100
Anthracene	74000
Fluoranthene	3100
Pyrene	7400
Benzo(a)Pyrene	5.7

Asbestos	<0.001 wt%

Notes to table

1. *Assessment criterion based on inorganic mercury.*
2. *Assessment criterion based on oral pathway only.*