



Geo-Environmental

REMEDIAL STRATEGY & VERIFICATION PLAN

for the site at

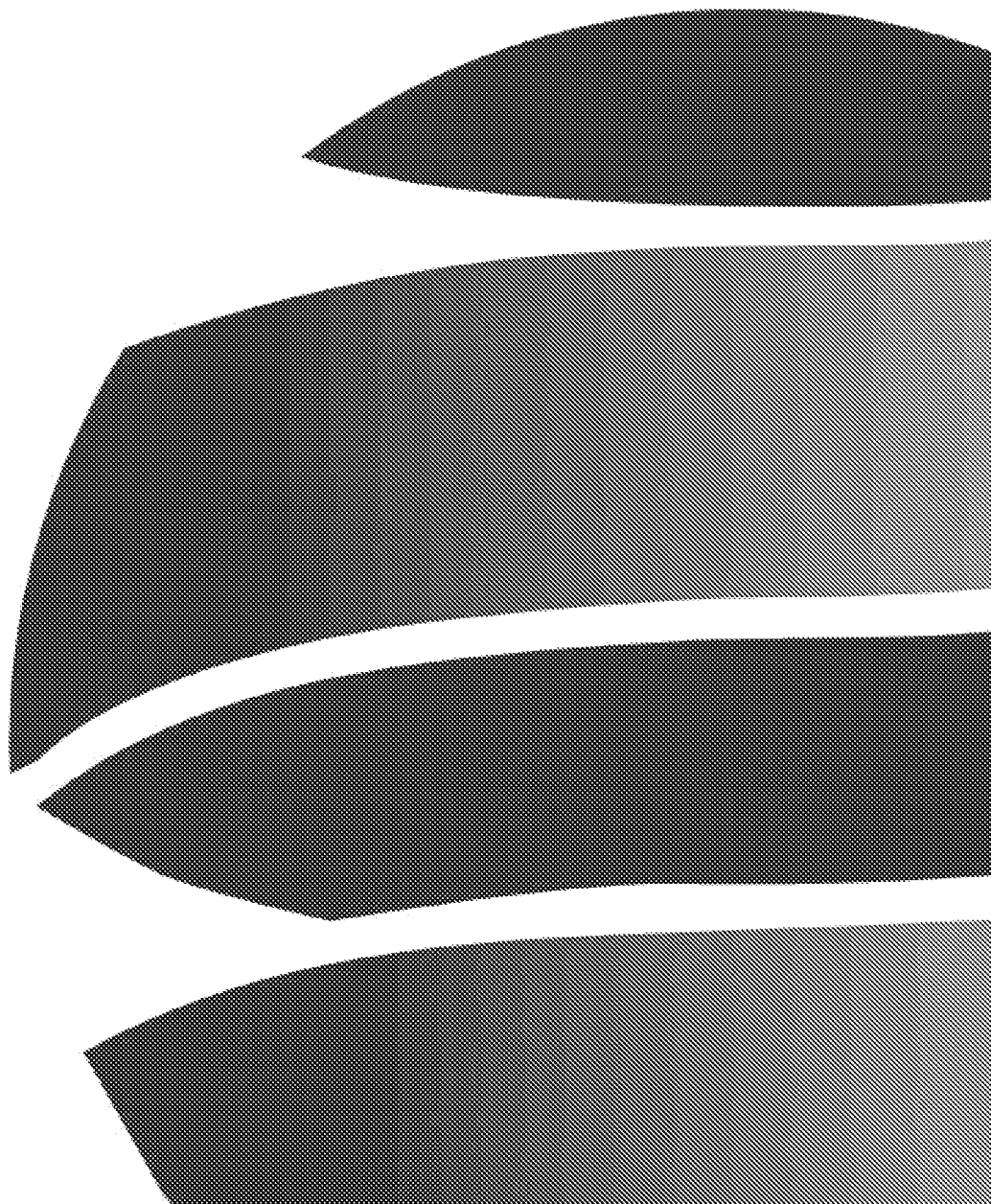
LAND OFF LIDSEY ROAD, WOODGATE

CHICHESTER, WEST SUSSEX

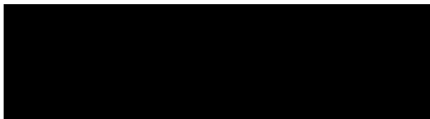
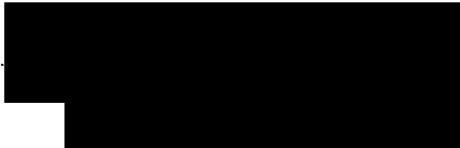
PO20 3SU

on behalf of

THAKEHAM PARTNERSHIPS LIMITED





Report:	REMEDIAL STRATEGY & VERIFICATION PLAN
Site:	LAND OFF LIDSEY ROAD, WOODGATE, CHICHESTER, WEST SUSSEX, PO20 3SU
Client:	THAKEHAM PARTNERSHIPS LIMITED
Date:	SEPT 2021
Reference:	GE19228 – RSVPv2AP210930
Version:	FINAL
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**AMENDMENT RECORD**

Revision ref.	Date	Reasons for amendment	Author's initials
1.0	12/07/21	First issue	VB
2.0	30/09/21	Revised based on clients comments	AP



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1.0 INTRODUCTION

1.1 General

Geo-Environmental Services Limited was instructed by Thakeham Partnerships Ltd to formulate a remedial strategy and verification plan for the proposed development works at land off Lidsey Road, Woodgate, Chichester, West Sussex, PO20 3SU (Figure 1).

1.2 Development Proposals

It was understood that the redevelopment would comprise residential properties, private gardens, access roads and associated infrastructure.

1.3 Objectives

Investigation of the site by Geo-Environmental Services Limited identified the presence of potential hazards and through a risk assessment process a series of pollutant linkages were identified which require action to mitigate or otherwise reduce the risk. This Remedial Strategy and Verification Plan sets out the proposed remedial works to be undertaken on the subject site to support its development for a residential end use.

1.4 Planning Permission

It is understood that a planning application has been submitted for the site to Arun District Council under Planning Reference AL/20/21/PL. The following pre-commencement planning conditions have been attached to the application which relate to the remediation and validation of land contamination on the site.

Contaminated Land

Prior to commencement of the development hereby approved (or such other date or stage in development as may be agreed in writing with the Local Planning Authority), the following components of a scheme to deal with the risks associated with contamination of the site shall each be submitted to and approved in writing by the Local Planning Authority:

- 1. A Preliminary Risk Assessment which has identified: all previous (historical) uses; potential contaminants associated with those uses; a conceptual model of the site indicating sources, pathways and receptors; potentially unacceptable risks arising from contamination at the site.*
- 2. A Site Investigation Scheme, based on (1) above to provide information for a detailed assessment of the risk to all receptors that may be affected, including those off site.*
- 3. Based on the Site Investigation Scheme and the detailed risk assessment (2), an options appraisal and remediation strategy giving full details of the remediation measures required and how they are to be undertaken.*
- 4. A Verification Report providing details of the data that will be collected in order to demonstrate that the works set out in (3) are complete and identifying any requirements for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action.*



Note: Any changes to these components, (1) to (4) require the express written consent of the Local Planning Authority

The scheme shall be implemented as approved above and, prior to commencement of any construction work (or such other date or stage in development as may be agreed in writing with the Local Planning Authority), a Verification Report demonstrating completion of the works set out in the approved remediation strategy and the effectiveness of that remediation shall be submitted to and approved in writing by the Local Planning Authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met. The report shall also include a long-term monitoring and maintenance plan for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action, as identified in the verification report, and for the reporting of this in writing to the Local Planning Authority.

Reason: To protect the amenity of local residents in accordance with Policy QE DM4 of the Adopted Arun Local Plan 2011 - 2031

Unexpected contamination

If during development, any visible contaminated or odorous material, (for example, asbestos containing material, stained soil, petrol / diesel / solvent odour, underground tanks or associated pipework) not previously identified, is found to be present at the site, no further development (unless otherwise expressly agreed in writing with the Local Planning Authority) shall be carried out until it has been fully investigated using suitably qualified independent consultant(s). The Local Planning Authority must be informed immediately of the nature and degree of the contamination present and a method statement detailing how the unsuspected contamination shall be dealt with must be prepared and submitted to the Local Planning Authority for approval in writing before being implemented.

If no such contaminated material is identified during the development, a statement to this effect must be submitted in writing to the Local Planning Authority.

Reason: To protect the amenity of local residents in accordance with Policy QE DM4 of the Adopted Arun Local Plan 2011 - 2031



2.0 BACKGROUND

A desk study (ref. GE18390/DSR/AUG19) ground investigation report (ref. GE18390/GAR/OCT19), additional site investigation (ref. GE18679/AP02/200626) and addendum ground gas and groundwater letter report (ref. GE18390 – LRv1AP200528) were undertaken in August 2019, October 2019, May 2020 and June 2020 respectively by Geo-Environmental Services Limited.

Desk Study:

The desk study identified the site had previously been occupied an area within the greater site with a glasshouse, a potentially contaminative use. As such intrusive investigation was recommended.

Furthermore, the site is situated within an area where radon protection measures are not considered necessary for new dwellings or extensions.

Ground Investigation:

The investigation broadly comprised seven window sample boreholes and six machine excavated trial pits located across the site.

Made Ground was encountered within three of the intrusive positions to depths ranging between 0.25m and 0.45m. Laboratory analysis of selected soil samples indicated elevated concentrations exceeding screening values of benzo(a)pyrene, Barium and Beryllium within the Made Ground located within the grounds of the nursery and immediate grounds of the existing residential property 'Wings'. As such, remedial measures were considered necessary to protect future end users of the development from soils in these areas. Further investigation was recommended to further investigate these areas.

The results of the relevant chemical analyses indicated exceedances of the UKWIR thresholds for SVOCs and TPH within samples from the area of the former nursery and immediate grounds around Wings, as such it was considered that barrier pipe may be required in these areas.

Additional Investigation:

The investigation broadly comprised sixteen hand excavated trial pits located across the site of the former nursery and immediate grounds of 'Wings'.

Made Ground was encountered within all of the intrusive positions to depths ranging between 0.18m and 0.30m. In addition, in the area of the former glasshouse a wooden electrical box, with a concrete base shuttered with potentially asbestos containing material. Laboratory analysis of selected soil samples indicated elevated concentrations exceeding screening values for Benzo(a)pyrene and Beryllium within the Made Ground. As such, remedial measures were considered necessary to protect future end users of the development located in the areas of the former nursery and the hotspot located in the immediate grounds of Wings from soils on site (Plots 1-9 and 63-64). A zonal excavation to c.0.30m to remove Made Ground soils with natural soils sampled and submitted for laboratory analysis to confirm their chemical suitability in terms of risk to human health prior to the placement of chemically and physically suitable subsoil and topsoil. Should any deeper areas of Made Ground be encountered these should be chased out and if they exceed 600mm in depth we would recommend terminating the excavation at 750mm and installing a 150mm 'deter to dig' layer topped with a geotextile and chemically and physically suitable subsoil and topsoil is installed within rear private gardens. A cover system of 600mm is applicable to front private gardens and 300mm for soft landscaping/private open space.



In addition, an appropriately qualified contractor should remove the electrical box and surrounding soils, with all material disposed of as hazard waste.

Ground Gas and Groundwater Addendum:

During the monitoring undertaken, methane was recorded at concentrations ranging between 0.0% v/v and 0.40% v/v. Carbon dioxide was recorded at concentrations ranging between 0.0% v/v and 7.40% v/v whilst oxygen was present in the range of 1.80% v/v and 21.1% v/v. VOC was recorded as ranging between 0.0ppm and 0.3ppm. A maximum positive borehole flow of 1.2l/hr was recorded. Atmospheric pressures were recorded as ranging between 996mb and 1042mb. The high Carbon Dioxide result was attributed to the high-water table acting on ground gases. The HGF for carbon dioxide and methane were both calculated to be representative of CS1/Green. No further action was deemed necessary.

For full details, reference should be made to the separate reports.

3.0 REMEDIAL WORKS

3.1 Protection of End Users

Due to the physical and chemical quality of the near surface soils encountered in the intrusive positions within the nursery and hotspot within the grounds of 'Wings', it was recommended that a zonal excavation be undertaken with the placement of chemically and physically suitable subsoil and topsoil.

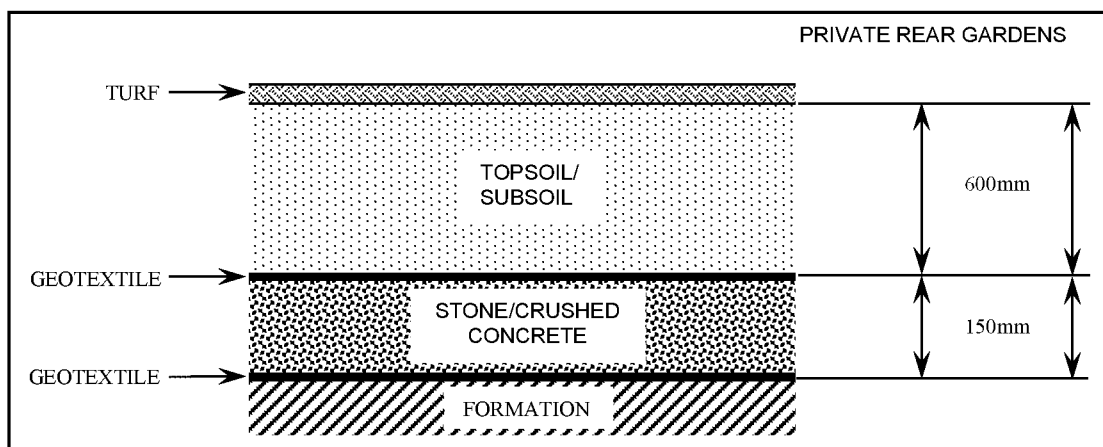
The results of the relevant chemical analyses indicated that barrier pipe was likely to be required in the area of the nursery and grounds of 'Wings'. Given the non-mandatory status of the guidance, it was recommended that the results of the investigation be presented to the water utility company as soon as reasonably practicable to confirm their requirement for the potable water supply pipe material.

3.1.1 Zonal Excavation / Cover system

It is recommended that within proposed private garden areas for Plots 1-9 and Plots 63 and 64 and soft landscaping adjacent to the plots, the Made Ground should be zonally excavated down to the natural soils. Based on the findings of the investigations the likely average zonal excavation depth is c.300mm. The underlying natural soils should be sampled and submitted for laboratory analysis to confirm their chemical suitability in terms of risk to human health prior to the placement of chemically and physically suitable subsoil and topsoil.

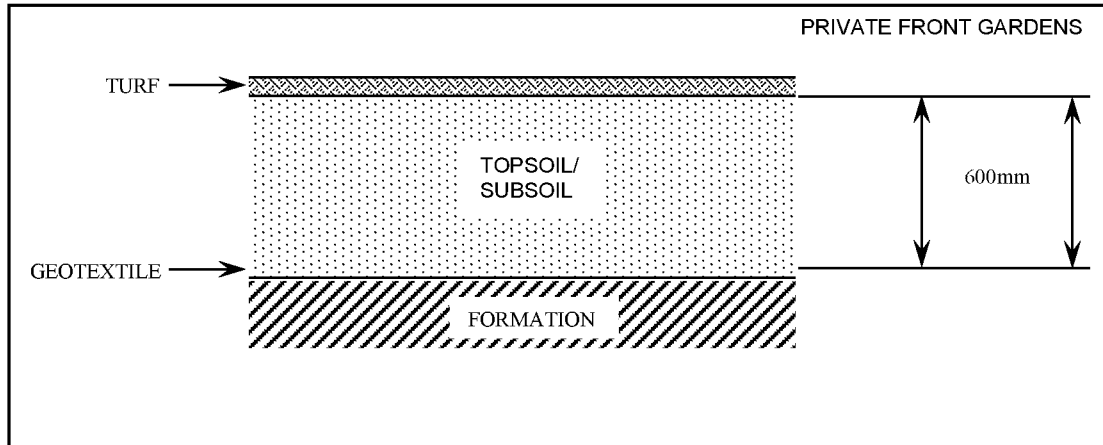
Cover System – Private Rear Gardens

Should any deeper areas of Made Ground be encountered these should be chased out and if they exceed 600mm in depth we would recommend terminating the excavation at 750mm and installing a 150mm 'deter to dig' layer, topped with a geotextile and chemically and physically suitable subsoil and topsoil is installed within the area of proposed private rear gardens within the area of the former nursery (plots 1-9) and location of WS7 (plot 63 and 64). A diagrammatic representation of the proposed remedial cover system for private rear gardens is presented below:



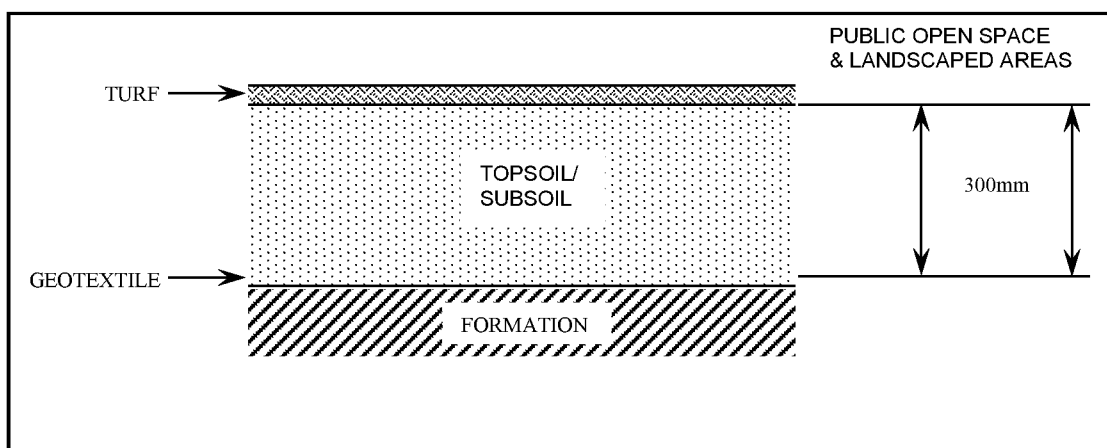
Cover System – Private Front Gardens

Should any deeper areas of Made Ground be encountered these should be chased out to 600mm in depth and underlain with a geotextile and chemically and physically suitable subsoil and topsoil is installed within the area of proposed private front gardens within the area of the former nursery (plots 1-9) and location of WS7 (plot 63 and 64). A diagrammatic representation of the proposed remedial cover system for private front gardens is presented below:



Cover System – Soft Landscaping/Public Open Space

For soft landscaped areas, the depth should be 300mm of Topsoil and subsoil, and underlain with a geotextile membrane. A diagrammatic representation of the proposed remedial cover system for public open space and areas of soft landscaping is presented below:



Based on the laboratory results from the first phase of investigation, Topsoil and subsoil from other parts of the site, namely the field may be re-used as part of any cover system. However, some of the Topsoil's physical properties will require improvement to fully comply with the requirements of Multipurpose Topsoil as defined

in BS3882:2015. Furthermore, with careful management and segregation it may be possible to utilise site won natural soils from foundation and drainage excavations for use as subsoil.

3.1.2 Water Supply Pipes

Buried plastics laid in contact with contaminated soils may be susceptible to attack by aggressive chemicals; therefore, potable water supplies may potentially become contaminated or tainted.

The results of the chemical analysis indicated that there were exceedances of SVOCs and TPH within the Made Ground soils when compared against the thresholds stated within Table 3.1 of UK Water Industry Research's (UKWIR) report reference 10/WM/03/21 (re-issued 2010). Given these exceedances it is considered that barrier pipe is likely to be required in the area of the former nursery and hotspot in the gardens of 'Wings'.

However, it is recommended that the results of this investigation be presented to the water utility company as soon as reasonably practicable to confirm their requirement for the potable water supply pipe material.

As a matter of good practice, and to maximise the protection to utilities, it is recommended that clean, gap-graded granular backfill is used in service runs and that marker tapes are used for all buried services.

3.2 Imported Materials

If imported materials are required chemical certification of the imported Topsoil and subsoil should be submitted prior to importing materials onto site to confirm their suitability for use.

Samples of the imported Topsoil/subsoil should also be collected from in situ locations and submitted for laboratory analysis by the Environmental Consultant. Laboratory testing would include analysis of determinands known to pose a risk to human health (see Appendix A).

In addition to the above, the physical quality of imported soils should be verified by visual inspection. The presence of brick, concrete, timber, metal, glass, etc. would render the materials sub-standard (regardless of the results of chemical analysis) and would not be considered fit for the proposed end use.

In addition, all Topsoil materials should generally conform to Multipurpose grade as specified under BS3882:2015 or will otherwise be rejected.

3.3 Inspection

Zonal Excavation

Regular site inspections should be made by the Environmental Consultant to ensure that appropriate management of near surface soils is carried out during excavation works. Upon completion of this phase of the remediation, the Environmental Consultant shall be instructed to sample the formation and sample the sides and base of the excavation. Once clean materials are placed the Environmental Consultant should again visit the site and inspect the materials placed to verify their installation and sample to ensure their suitability.

Potable Water Supply Pipes



The Environmental Consultant should be contacted to make regular inspections of the barrier pipe in-situ to verify its installation, should it be specified. Should it not be specified, evidence that the water utility does not require such pipework will be required as verification.

3.5 Timetable of Remedial Works

Once this document has been approved by the Local Authority (LA), the remedial works should be undertaken in accordance with Thakeham Partnerships Ltd construction timetable for the site. A copy of the timetable should be forwarded to the LA. In addition, the Environmental Consultant should be given suitable notice of the dates of the individual remedial works so they can be appropriately inspected and validated.



4.0 WASTE

In accordance with CL:AIRE Code of Practice (2011) materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded by the holder'.

The Code of Practice therefore allows soils to be reused on site where the following criteria are met:

- Pollution of the environment and harm to human health is prevented in reusing the excavated materials;
- The material are suitable for use (without any further processing);
- There is certainty of use; and
- The quantity that is absolutely necessary (and no more) is used.

In order to comply with the Code of Practice, a material management plan that confirms the above criteria are met has to be prepared. The material management plan must be reviewed by a 'Qualified Person' who then issues a declaration to the Environment Agency. Geo-Environmental can provide this service should it be required.

Where materials do not meet the required criteria, it may be possible to treat them under an environmental permit so that they may be re-used on site.

4.0.1 Reuse of Waste

Where material is discarded as waste, it may still be possible to re-use the waste on site under a standard rules environmental permit or a U1 waste exemption. However, strict limits on the volumes that can be reused apply in these cases.

4.0.2 Disposal to Landfill

Under current legislation, where wastes are to be disposed of to landfill they may, depending on their classification, require pre-treatment. Pre-treatment shall comprise a chemical, physical (including sorting), thermal or biological process. The pre-treatment is required to change the characteristics of the waste, reduce its volume, reduce its hazardous nature, and facilitate its handling and enhance its recovery.

4.1 Waste Classification

In the first instance the laboratory results for all samples of near surface soils were uploaded to Atkins' waste soils characterisation assessment tool, 'CatWasteSoil' which determines whether a generated waste has any hazardous chemical properties based on standard laboratory analysis. The results identified no hazardous samples.

The results of the waste acceptance criteria (WAC) analysis undertaken on samples of samples from across the site, indicated that the majority of material to be 'inert' for waste disposal purposes. Made Ground soils from the former nursery had hazardous markers for hydrocarbon/ oil with benzo(a)pyrene marker. It was recommended further testing was carried out for excavated soils in this area.

Soils associated with the removal of the electrical box would only be suitable for disposal at a landfill licensed to accept hazardous waste due to the asbestos content (>0.1%).

Natural soils free of contamination (River Terrace Deposits) are likely be classified as Inert Waste (under the respective EWC codes for naturally occurring soils), suitable for disposal at an inert landfill facility.

It is recommended that confirmation of the above preliminary classifications be sought from the appropriate landfill facility to confirm the waste classification.

Evidence of appropriate disposal will be required for verification.

4.2 Storage and/or Removal of Waste Materials

Materials excavated as part of the remedial works (zonal excavation) should be removed immediately from site to an appropriate facility. Where immediate removal is not possible, these materials may be stockpiled on site prior to removal at the earliest possible time. Stockpiled soils should be placed on plastic sheeting (1200 gauge damp proof membrane) and covered with plastic sheeting, weighed down at regular locations. Waste Transfer tickets should be retained and forwarded to the Environmental Consultant to form part of the verification report for the site.

In the event of dry spells, or where the exposed surface becomes dry, it is recommended that the surface of the site is regularly dampened down to prevent the release of soil dust which could migrate off-site and thereby mitigate both off-site exposure and nuisance for neighbours.

Excess natural arisings may be placed beneath roadways etc. subject to geotechnical constraints to reduce the volume of materials disposed of to landfill. Where re-use of soils is proposed on site, validation samples will be required to confirm suitability.

5.0 DISCOVERY STRATEGY

Whilst an intrusive investigation has been undertaken on the site, it remains possible that unexpected ground and/or groundwater conditions may be encountered during the process of construction.

Should previously undiscovered contamination or unforeseen ground conditions be encountered during construction by the ground workers, this must be reported to the Site Manager immediately in order that the Consultant is notified. Where deemed necessary, the Consultant shall attend the site to inspect the discovery and provide recommendations on the further actions required, if any. Where necessary the regulatory authority shall be informed. Post any additional investigation or laboratory testing the results and any proposed remedial measures shall be reported to the regulatory authority or other appropriate organisation for consent, before proceeding or implementing the remedial measures.

A copy of the discovery strategy must be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious, abnormal, unforeseen or contaminated ground and/or groundwater conditions they may encounter.

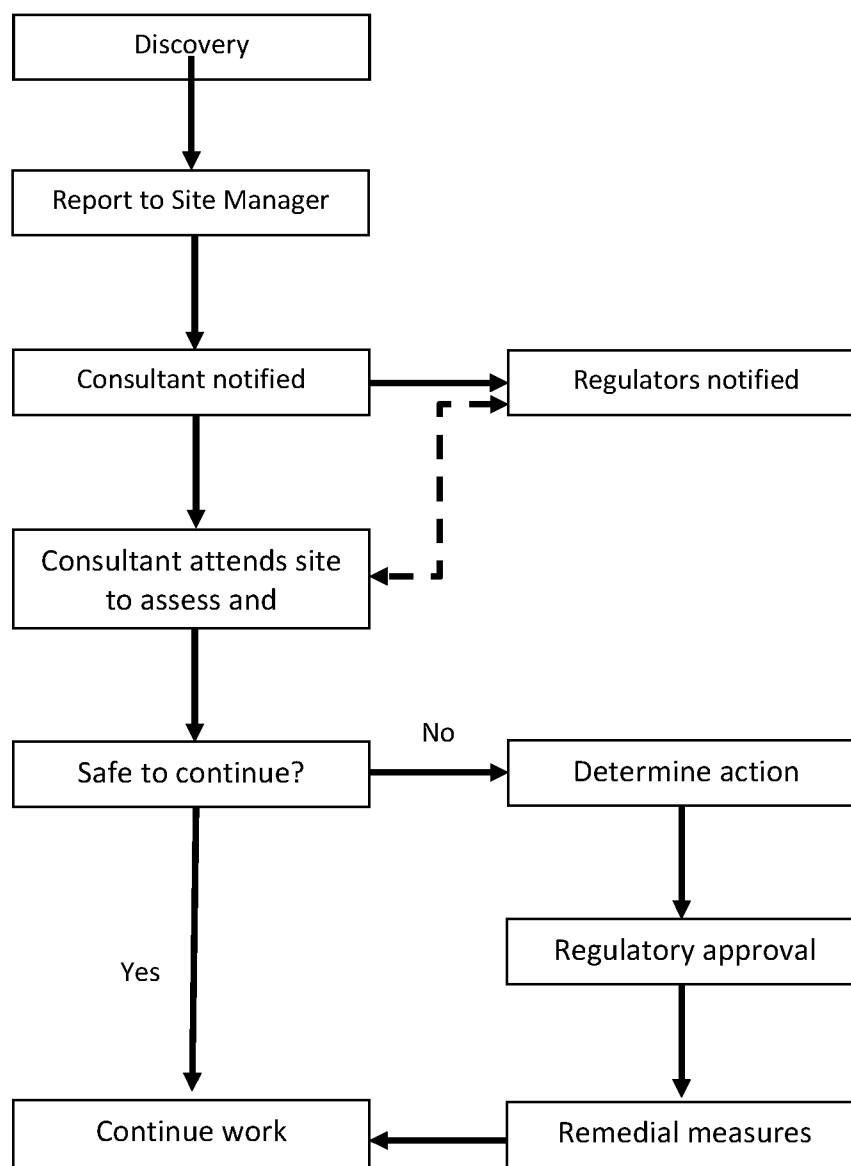
Depending on the type, nature and extent of any such 'discovery', it may be necessary to halt works in that location until such time as the assessment has been completed. This shall be reviewed on a 'discovery' specific basis and in conjunction with consultation with the client, other technical personnel and/or regulatory/approval organisations.

As a general guide, where such unexpected conditions are encountered the following approach is required as a minimum:

- All discoveries are to be reported to the Site Manager immediately and works at that location are to halt until further notice;
- The Site Manager is to report any such discoveries to the Client and the Consultant;
- Following notification from the Site Manager, the Consultant shall discuss the discovery with the Local Authority and/or other relevant parties and if considered necessary, arrange to meet on site to view the discovery;
- The Consultant shall attend the site to record the location, extent and nature of the discovery and implement an appropriate sampling and analysis regime, taking due account of the type and nature of the discovery, known and probable land uses in that area of the site;
- Where remedial action is required, regulatory consultation and approval will be sought;
- A record will be produced by the Consultant and held on site (with copies held by the Consultant, Client and Local Authority/other relevant organisation), detailing the discovery, assessment works undertaken, findings thereof, confirmation either of no action required or detailing the remedial action taken and validation thereof.



The process is shown below.



A copy of this strategy should be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious or contaminated materials they may encounter.



6.0 VERIFICATION

On completion of the development a verification report(s) will be prepared for the remedial works undertaken. The report(s) will be submitted to the Client (who should then submit them to the Local Authority for formal approval).

The Verification Report(s) will refer to the works as set out within this Remedial Strategy and include relevant site-based information such as records from site inspections, photographs of specific remedial or waste handling measures, material datasheets, QA certification (where relevant) and an audit trail for imported sub-soil and Topsoil, including source, provenance, analytical results, placement location and thickness.

The remedial works will be inspected and validated by the Environmental Consultant (Geo-Environmental).



Remedial Strategy & Verification Plan

Reference	Principal requirements	Design or construction related	Site visit required by qualified geo-environmental engineer?	Supporting documentation
1.0 General principles	The redevelopment proposals were to comprise the construction of a residential estate consisting of housing with associated private gardens, soft landscaping, parking and utilities. The site remediation requirements are as follows: - Implementation of a zonal excavation within private front and rear gardens and areas of soft landscaping/public open space associated with plots 1-9 and 63-64. Subject to confirmation from the water utility company - Protection of underground potable water supply pipes from contact with residual contaminants in the near surface soils on site. Amendments will be made to accord with any differing conditions encountered during the progress of the construction works.	Design & Construction	YES As detailed below.	Details of construction programme to be provided by client/contractor.
2.0 Compliance with legislation	The construction and remediation activities on the site will be undertaken in accordance with all current health and safety and environmental legislation.	Construction	-	-
3.0 Health and Safety requirements	This verification plan does not specifically cover health and safety requirements. This will be addressed in the Contractor's Health and Safety Plan.	Design & Construction	-	-



Remedial Strategy & Verification Plan

Reference	Principal requirements	Design or construction related	Site visit required by qualified geo-environmental engineer?	Supporting documentation
4.0 Zonal Excavation / Cover System	All Made Ground soils should be removed from the area of the former nursery and hotspot in the gardens of 'Wings'. Clean material should then be used to replace this. If excavation exceeds 600mm a cover system is recommended. Samples of the base and sides of the excavation should be collected from in-situ locations and submitted for laboratory analysis by the Environmental Consultant. This should take place before clean materials are placed. The cover system in <u>private rear gardens</u> should comprise 600mm of Topsoil and subsoil overlying a geo-textile membrane sandwiching a stone/ crushed concrete layer of 150mm thickness. The cover system in <u>private front gardens</u> should comprise 600mm of Topsoil and subsoil overlying a geo-textile membrane.			



Remedial Strategy & Verification Plan

The cover system in all <u>public open space and areas</u> of <u>soft landscaping</u> should comprise 300mm of Topsoil and subsoil overlying a geo-textile membrane. Chemical certification of the imported Topsoil and subsoil should be submitted prior to importing materials onto site to confirm their suitability for use. Samples of the imported Topsoil/subsoil should also be collected from in situ locations and	Design & Construction	YES - To validate contaminated materials have been removed from the areas around the former nursery and hotspot in Wings. - To visually inspect the physical quality of the imported in situ Topsoil. - Take samples of imported soils from in situ locations for chemical analysis.	Laboratory certificates to be supplied by Client prior to importation. Site visit reports including photographs and laboratory reports.
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Remedial Strategy & Verification Plan

5.0 New Services	<i>Subject to confirmation from the water utility company</i> Barrier pipe (such as Protect-Line) should be used for all proposed potable water supplies in areas of the former nursery and gardens of the former residential property 'Wings'. Clean, gap graded granular backfill is to be used in service runs and that marker tapes are used for all buried services.	Design & Construction	YES <i>Subject to confirmation from the water utility company</i> To validate that the recommended pipework has	Barrier pipe specification sheet to be supplied by Client prior to installation. Site visit reports including photographs.
7.0 Unexpected Contamination	A discovery strategy is to be put in place on site. Should unexpected areas of contamination be encountered during construction works a qualified geo-environmental engineer is to be informed to conduct a site visit, take additional samples and assess the risk. The Local Authority should also be notified. For full details, reference should be made to the Section 5 (Discovery Strategy) of the Remedial Strategy.	Construction	YES <i>Only in the event of unexpected contamination.</i> To assess the extent of any unexpected contamination.	<i>In the event of unexpected contamination.</i> Site visit reports including photographs. Chemical test results.

FIGURE 1

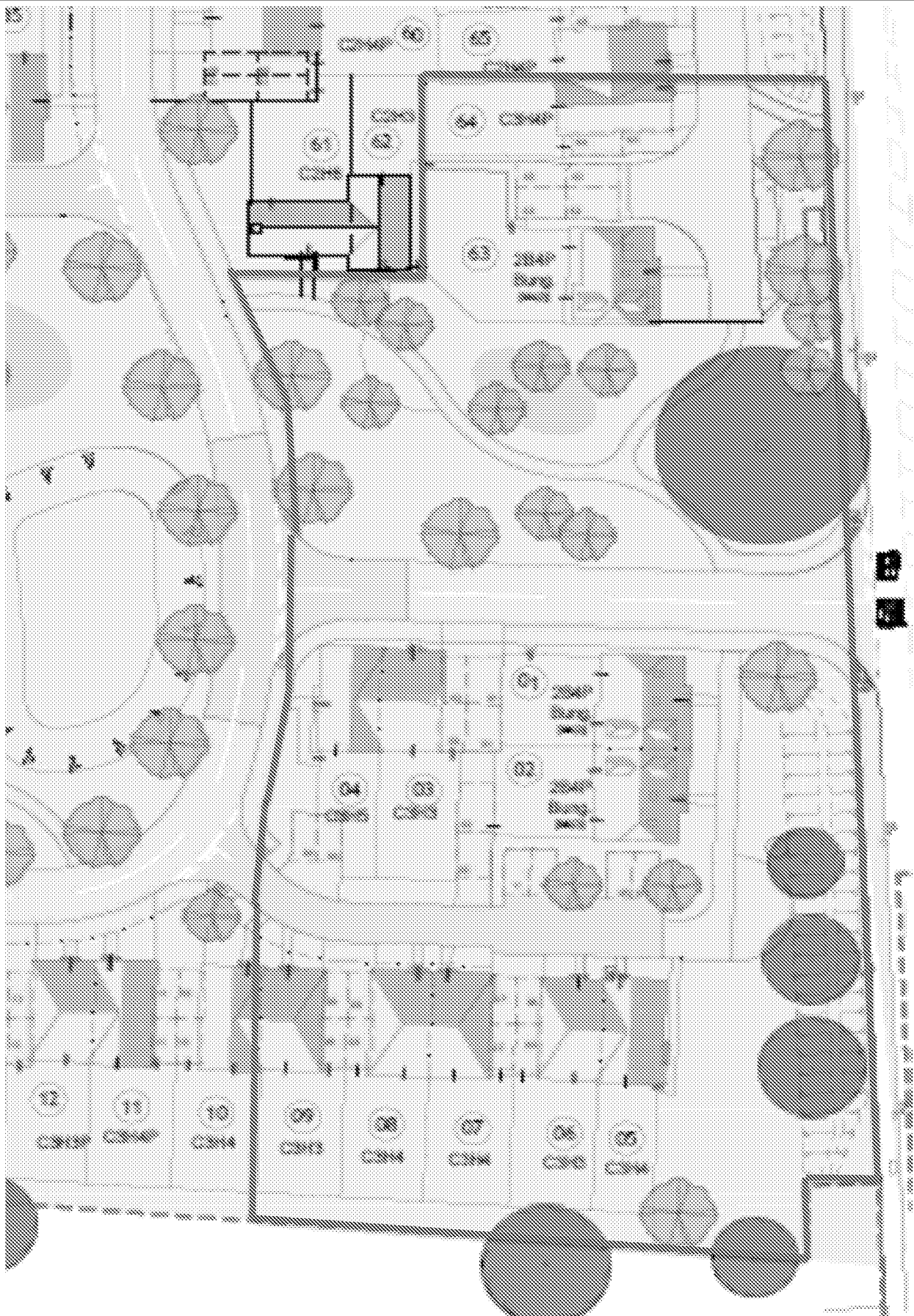
Site Location Plan



Project:	Land Off Lidsey Road, Woodgate			Title	Site Location Plan	
Client:	Thakeham Homes Ltd			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	 Geo-Environmental	
Ref No:	GE19228	Revision:	1.0			
Drawn:	AP	Date:	12/07/2021			
Figure:	1	Scale:	Not To Scale			

FIGURE 2

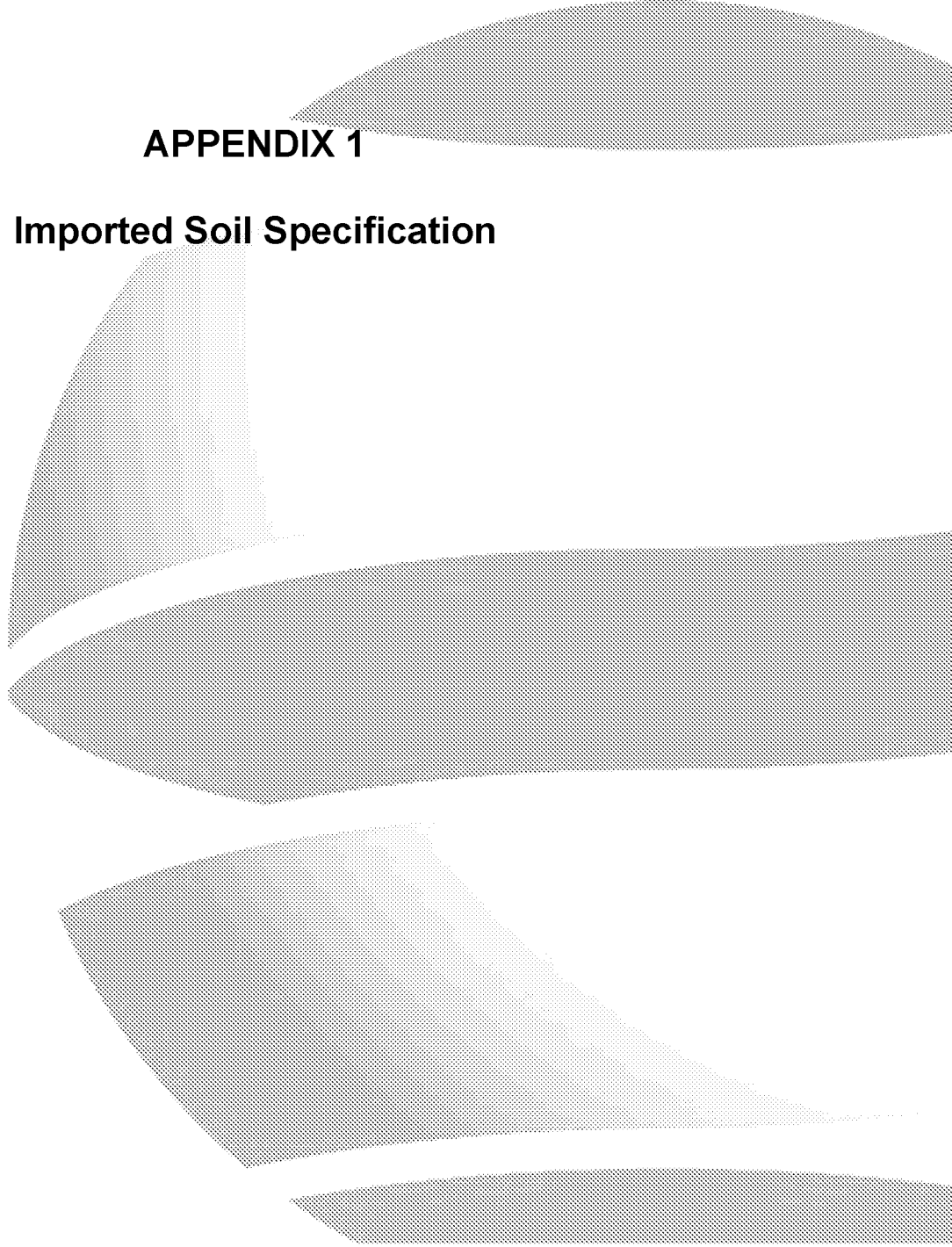
Site Plan with Likely Zonal Excavation Extent Shown



Project:		Lidsey Road, Woodgate		Title	Site Plan with Likely Zonal Excavation Extent Shown	
Client:		Thakeham Partnerships Limited		Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental		
Ref No:	GE19228	Revision:	v1			
Drawn:	AP	Date:	12/07/2021			
Figure:	2	Scale:	nts			



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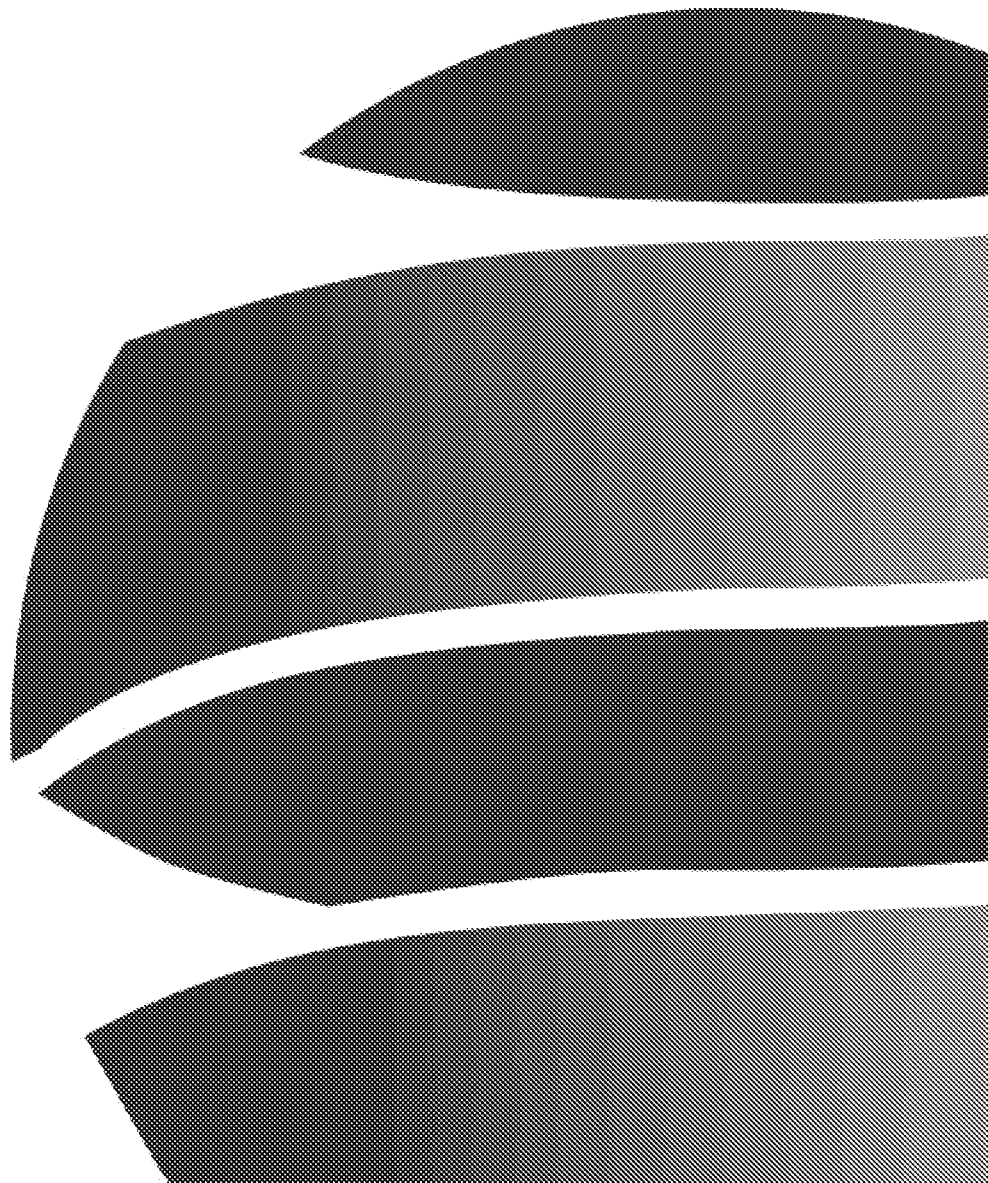
APPENDIX 1

Imported Soil Specification



Geo-Environmental

IMPORTED SOIL SPECIFICATION
for the site at
LAND OFF LIDSEY ROAD, WOODGATE
CHICHESTER, WEST SUSSEX
PO20 3SU
on behalf of
THAKEHAM PARTNERSHIPS LIMITED





Report:	IMPORTED SOIL SPECIFICATION
Site:	LAND OFF LIDSEY ROAD, WOODGATE, CHICHESTER, WEST SUSSEX, PO20 3SU
Client:	THAKEHAM PARTNERSHIPS LIMITED
Date:	JULY 2021
Reference:	GE19228 – RSVPv1VB210712
Revision:	1.0
Prepared by:	 VERONICA BENNETT BSc (Hons), MSc, FGS SENIOR CONSULTING ENGINEER
Reviewed by:	 KATIE BRAYNE CSci BSc (Hons), MSc, FGS MiEnvSc REGIONAL MANAGER -EAST

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AMENDMENT RECORD

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1.0	12/07/2021	First issue	VB



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1.0 Introduction

This document sets out the requirements for imported Subsoil and Topsoil materials for any project undergoing redevelopment or other works where capping work is required.

Within the specification reference has been made to Topsoil and Subsoil. Topsoil relates to the top layer of natural soil that can support healthy vegetation growth. Subsoil relates to the layer of soil immediately below the Topsoil to the depth of the underlying broken rock or geological parent material.

The specification considers the chemical, nutritional and physical properties of soils that are to be imported onto site in order to ensure materials used are suitable for their intended use and do not introduce any new hazard or pollutant linkage on to the site.

Where there is any discrepancy between this specification and BS3882:2015 or BS8601:2013, the latter documents shall take precedence unless otherwise formally confirmed by the relevant regulator.

2.0 Chemical Composition

The chemical criteria listed below are based on the published Category 4 Screening Levels (C4SLs) by DEFRA and/or the relevant Suitable for Use Levels (S4ULs) published by LQM, for a residential end use with plant uptake. From time to time these values may change in line with regulatory or UK policy changes. Such changes will require revision and re-issue of this document.

Where C4SLs or S4ULs are published for a range of Soil Organic Matter (SOM) values, these ranges and their respective SOM values have been presented and would be considered when assessing compliance with this Specification.

2.1 Method of Analysis

Samples should be analysed using UKAS or MCERTS accredited laboratories. For TPH analysis sample preparation must not include air drying.

2.1.1 Poly Aromatic Hydrocarbon (PAH)

The PAH analysis must include the EPA priority 16.

2.1.2 Total Petroleum Hydrocarbons (TPH)

The analysis for TPH should be undertaken on the 'as received' sample and not be subject to any pre-treatment and shall include aliphatic and aromatic carbon banding split.

2.2 Topsoil (0-300mm depth)

Tables 1, 1a, 1b and 1c provide a list of the maximum acceptable concentrations for a range of determinants for imported Topsoil.



Determinant	Maximum concentration (mg/kg)
Inorganic	SOM 6%
Arsenic (total)	37
Boron (water soluble)	290
Cadmium (total)	11
Chromium (total)	130
Copper (total)	2400
Cyanide (total)	250
Lead (total)	200
Mercury (total inorganic)	40
Nickel (total)	180
pH	5.5 – 7.8
Selenium (total)	250
Sulphate (total)	2000
Zinc (total)	3700
Asbestos	Absent
Organic	
Phenols (total)	110
Poly Aromatic Hydrocarbon (speciated)	See Table 1a
Total Petroleum Hydrocarbon (speciated)	See Table 1b

Table 1 Chemical Specification for Topsoil

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Anthracene	2400	5400	11000
Benz(a)anthracene	7.2	11	13
Benzo(a)pyrene	2.2	2.7	3.0
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(ghi)perylene	320	340	350
Benzo(k)fluoranthene	77	93	100
Chrysene	15	22	27
Dibenz(ah)anthracene	0.24	0.28	0.30
Fluoranthene	280	560	890
Fluorene	170	400	860
Indeno(1,2,3CD)pyrene	27	36	41
Naphthalene	2.3	5.6	13.0
Phenanthrene	95	220	440
Pyrene	620	1200	2000

Table 1a Topsoil Specification for Speciated PAH

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic			
EC 5-6	42	78	160
EC >6-8	100	230	530
EC >8-10	27	65	150
EC >10-12	130	330	760



Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
EC >12-16	1100	2400	4300
EC >16-35	65000	92000	110000
EC >35-44	65000	92000	110000
Aromatic			
EC 5-7 (benzene)	70	140	300
EC >7-8 (toluene)	130	290	660
EC >8-10	34	83	190
EC >10-12	74	180	380
EC >12-16	140	330	660
EC >16-21	260	540	930
EC >21-35	1100	1500	1700
EC >35-44	1100	1500	1700
Aliphatic and Aromatic			
EC >44-70	1600	1800	1900

Table 1b Topsoil Specification for Speciated TPH

Determinant	Phytotoxicity GAC (mg/kg)		
	pH <6.0	pH 6.0-7.0	pH >7.0
Zinc	200	200	300
Copper	100	135	200
Nickel	60	75	110

Table 1c Topsoil Specification for phytotoxicity

2.3 Subsoil (300-1000mm depth)

Tables 2, 2a, 2b and 2c provide a list of the maximum acceptable concentrations for a range of determinants for imported Subsoil.

Determinant	Maximum concentration (mg/kg)
Inorganic	SOM 6%
Arsenic (total)	37
Boron (water soluble)	290
Cadmium (total)	11
Chromium (total)	130
Copper (total)	2400
Cyanide (total)	250
Lead (total)	200
Mercury (total inorganic)	40
Nickel (total)	180
pH	5.5 – 7.8
Selenium (total)	250
Sulphate (total)	2000
Zinc (total)	3700
Asbestos	Absent
Organic	
Phenols (total)	110
Poly Aromatic Hydrocarbon (speciated)	See Table 2a



Determinant	Maximum concentration (mg/kg)
Inorganic	SOM 6%
Total Petroleum Hydrocarbon (speciated)	See Table 2b

Table 2 Chemical Specification for Subsoil

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Anthracene	2400	5400	11000
Benz(a)anthracene	7.2	11	13
Benzo(a)pyrene	2.2	2.7	3.0
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(ghi)perylene	320	340	350
Benzo(k)fluoranthene	77	93	100
Chrysene	15	22	27
Dibenz(ah)anthracene	0.24	0.28	0.30
Fluoranthene	280	560	890
Fluorene	170	400	860
Indeno(1,2,3CD)pyrene	27	36	41
Naphthalene	2.3	5.6	13.0
Phenanthrene	95	220	440
Pyrene	620	1200	2000

Table 2a Subsoil Specification for Speciated PAH

Determinant	Maximum Concentration (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic			
EC 5-6	42	78	160
EC >6-8	100	230	530
EC >8-10	27	65	150
EC >10-12	130	330	760
EC >12-16	1100	2400	4300
EC >16-35	65000	92000	110000
EC >35-44	65000	92000	110000
Aromatic			
EC 5-7 (benzene)	70	140	300
EC >7-8 (toluene)	130	290	660
EC >8-10	34	83	190
EC >10-12	74	180	380
EC >12-16	140	330	660
EC >16-21	260	540	930
EC >21-35	1100	1500	1700
EC >35-44	1100	1500	1700
Aliphatic and Aromatic			
EC >44-70	1600	1800	1900

Table 2b Subsoil Specification for Speciated TPH



Determinant	Phytotoxicity GAC (mg/kg)		
	pH <6.0	pH 6.0-7.0	pH >7.0
Zinc	200	200	300
Copper	100	135	200
Nickel	60	75	110

Table 2c Subsoil Specification for phytotoxicity

3.0 Nutritional Composition

The nutritional criteria listed below are based on BS3882:2015 for topsoil and BS8601:2013 for subsoil. In the absence of published criteria, current guidance and best practice has been applied to derive appropriate criteria.

3.1 Topsoil & Subsoil

Table 3 details the minimum acceptable concentrations for imported topsoil and subsoil. The nutrient concentrations set out in Table 3 for Topsoil are based on those set out in BS3882:2015 which states “*Multipurpose topsoil is the grade suited to most situations where topsoil is required; however, there can be situations where specific purpose topsoil is required*”. In the event that an alternative specific Topsoil grade is required, i.e. acidic; calcareous; low fertility; low fertility acidic; or low fertility calcareous, the compliance criteria set out in BS3882:2015 shall be applicable in place of those set out in Table 3 below.

Topsoil/Subsoil	Parameter	Concentration
Topsoil (multipurpose grade only)	Phosphorous	16 – 140 mg/l
	Potassium	121 – 1500 mg/l
	Magnesium	51 – 600 mg/l
	Nitrogen	0.15 % m/m
	Carbon:nitrogen ratio	<20:1
Subsoil	Phosphorous	16 mg/l
	Potassium	121 mg/l
	Magnesium	51 mg/l
	Nitrogen	0.15 %
	Carbon:nitrogen ratio	<20:1

Table 3 Nutritional Specification for Topsoil and Subsoil

4.0 Physical Composition

The physical criteria listed below are based on BS3882:2015 Specification for Topsoil. In the absence of published criteria, current guidance and best practice has been applied to derive appropriate criteria.

4.1 Topsoil

Table 4 details the physical suitability requirements for imported topsoil and subsoil. Table 4 sets out acceptability criteria from BS3882:2015 for multipurpose Topsoil. In the event that an alternative specific Topsoil grade is required, i.e. acidic; calcareous; low fertility; low fertility acidic; or low fertility calcareous, the compliance criteria set out in BS3882:2015 shall be applicable in place of those set out in Table 4 below.



Topsoil/Subsoil	Parameter	Specification requirements
Topsoil (multipurpose Topsoil only)	Textural Classification	Sandy clay loam, sandy loam, loamy sand, sandy silt loam (as defined in BS3882:2015, Figure 1)
	Loss on Ignition	3 - 20% (for 5-20% clay soil) 5 - 20% (for 20-35% clay soil)
	Maximum Stone content:	>2mm = 30% >20mm = 10% >50mm = 0%
Subsoil	Textural Classification	Refer to BS8601:2013 Figure 1
	Loss on Ignition	2%
	Maximum Stone content:	>2mm = 40% >20mm = 20% >75mm = 0%

NB: Topsoil and Subsoil must be free from glass, brick fragments, plastic, metal, asbestos and other deleterious materials.

Table 4 Physical Specification for Topsoil & Subsoil

5.0 Source Requirements

5.1 Topsoil and Subsoil

The following will be provided with all soils imported to site:

- A site plan detailing the location and address of the source site, including grid reference.
- Location description of source material, including historic and current site uses.
- Sample analysis results of material at source, including details of laboratory, date of sampling, date samples received by laboratory etc.

5.2 Manufactured soils

Where natural soils are unavailable manufactured soils may be utilised, and the following should be provided:

- Details of the soil manufacturing process, including criteria for received soils, quality control procedure and validation protocol.
- Soils should be tested at a minimum ratio of one sample per 50m³.

6.0 Testing Rates and Compliance

Sampling shall be undertaken in accordance with BS3882:2015 and BS8601:2013.

6.1 Topsoil

Where natural sourcing is proposed, the provenance of the material shall be determined by analysis of the soils at a minimum rate of 3No. samples per source site (up to 250m³) and 1 sample per 250m³ thereafter. Imported soils should be sampled once it has been laid on the site to support the analysis provided by the source supplier.

Where Topsoil is derived from a manufactured source, testing would be undertaken at a rate of 1 sample per 50m³, with a minimum of 3No. tests for any given potential source material (or production batch).



6.2 Subsoil

Where the source of the material is known validation sampling should be undertaken at a minimum rate of 3 samples per source (up to 250m³) and 1 sample per 250m³ thereafter. Imported soils should be sampled once it has been laid on the site to support the analysis provided by the source supplier.

Where subsoil is derived from a manufactured source, testing would be undertaken at a rate of 1 sample per 50m³, with a minimum of 3No. tests for any given potential source material (or production batch)

Where the source of the material is not known the validation sampling should be undertaken in-line with the testing rates as set out for cover systems to ensure the materials are suitable for their intended use. Further guidance on minimum testing under this scenario is presented in Section 6.3 below.

6.3 Cover Systems

Where a cover system/ capping layer is proposed as part of the required remedial measures, sampling frequency will follow the guidance set out by the NHBC in their guidance for clean cover systems (2010) and supplemented within NHBC Technical Extra Guidance Issue 8, November 2012, outlined below:

- Sites with more than 30 plots testing should be conducted at a rate of one plot in four, with a minimum of 10 tests across the site;
- Sites with between 20 – 30 plots testing should be conducted at a rate of one plot in three, with a minimum of 7 tests across the site;
- Sites with between 5 -20 plots testing should be conducted at a rate of one plot in two with a minimum of 5 tests across the site;
- Sites with fewer than 5 plots testing should be conducted in every plot with a minimum of 3 tests across the site.

6.4 Sample failure

In the event that a sample fails to meet the specified criteria for any parameter the Environmental Consultant should be contacted for advice on the suitability of the materials.

Further testing may be required to provide reassurance that the exceedances are not representative of the soil and to provide clarification whether the soil is suitable for importation and/or proposed use.

6.5 Timing

Sampling and analysis undertaken by a manufactured topsoil supplier shall be no earlier than two weeks from the date of import, any results which are older than two weeks will be deemed not to be representative of the soils to be imported and rejected. Results showing consistency of batching may be requested to demonstrate consistency of the physical, chemical and nutritional composition of the material.

Imported soil suppliers and groundwork contractors are required to take reasonably practicable measures to ensure that compliance with this Specification does not hinder formal completion of individual plots or developments.



6.6 General Compliance

All analytical suites shall correspond with the chemical, nutritional and physical compliance criteria (as set out in Tables 1 to 4). The soil supplier shall ensure that the analytical limits of detection are equal or lower than the compliance values presented within this Specification. Where either testing suites or limits of detection do not comply with this Specification, the entire set of results shall be rejected.