

Report No: 1321/1
Date: September 2011

REMEDIATION STRATEGY

for land at

**CLIFTON MILLS (AREA D)
AXMINSTER DRIVE
BAILIFF BRIDGE**

**Prepared for
C P GROUP LIMITED**



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**REMEDIATION STRATEGY
for land at
CLIFTON MILLS (AREA D)
BAILIFF BRIDGE**

1 INTRODUCTION

1.1 The Commission and Brief

- 1.1.1 Lithos Consulting Limited (Lithos), have been commissioned by C P Group Limited to prepare a Remediation Strategy for land at Clifton Mills (Area D).
- 1.1.2 Lithos have been supplied with a copy of the following report:
- Geoenvironmental Appraisal of land at Clifton Mills (Areas C & D) Bailiff Bridge. Report No. 9382/1, dated May 2007. Prepared by Encia Consulting Limited on behalf of CP Group Limited.
- 1.1.3 This document outlines the remediation objectives necessary to protect environmental receptors, and render the site suitable for the proposed development. A Method Statement should be prepared, in order to detail how the objectives will be achieved.
- 1.1.4 The Method Statement should be accompanied by a Designer's Risk Assessment in accordance with the CDM Regulations, 2007. The Method Statement and Risk Assessment should be submitted to, and approved by, the Engineer.
- 1.1.5 This report has been prepared to satisfy the likely requirements of the local planning authority.

1.2 The Proposed Development

- 1.2.1 The proposed development is shown on Drawing 1321/2. It includes a single, three storey, fifty-six bed residential care home in the south and a three retail units with a total area of 535m² in the north. Both areas of the development have associated parking, service yards and landscaping.
- 1.2.2 Access to the development will be from Axminster Drive to the east of the site.

2 BACKGROUND

2.1 Site Description

- 2.1.1 Site details are summarised below.

Detail	Remarks
Location	8 km south of Bradford city centre
NGR	SE 149 252
Area	0.47ha (1.16 acres)

- 2.1.2 Area D was most recently occupied by a single empty four storey mill building, which was located along the western boundary of the site. Areas of hardstanding and rough ground were located to the east of the building.
- 2.1.3 A location plan is shown on Drawing Nos 1321/1. The salient features during the Encia investigation of 2007 are shown on their Drawing 9382/2. Both drawings are presented in Appendix A of this report.

2.2 Ground Investigation

- 2.2.1 Encia's investigation included a review of previous intrusive site investigations and a ground investigation comprising fourteen trial pits.

Made Ground

- 2.2.2 Made ground has been encountered across the entire site area. The depth of made ground varies between 0.4m and 4.4m bgl. The made ground generally comprises a sandy gravel and clay with brick and concrete rubble.
- 2.2.3 Obstructions (brick walls and concrete slabs) associated with demolished mill buildings were encountered between 0.5m and 2.8m in the south of the Area D.

Natural Ground

- 2.2.4 Natural ground typically comprised firm becoming stiff brown and grey clay (weathered coal measures) overlying mudstone bedrock (coal measures strata).
- 2.2.5 Mudstone was encountered between 1.5m and 2.5m bgl.

Contamination

- 2.2.6 Slight inorganic contamination was encountered in the made ground.
- 2.2.7 Where residual made ground remains beneath landscaped areas it is recommended that a 600mm thick surface cover of "clean" soil comprising 500mm subsoil and 100mm topsoil be placed over the made ground.
- 2.2.8 In terms of the proposed redevelopment plausible pollutant linkages, and feasible remediation options, are summarised below:

Receptors	Pathways	Contaminants	Remediation Options
Human Health (Future residents) ♦	Consumption of contaminated vegetables	Metals in the made ground	Provision of 600mm soil cover will break the pollutant linkage
	Ingestion		
	Inhalation (dust)		
	Dermal contact		
Buildings	Contact with "aggressive" soil and/or groundwater	Sulphate in the made ground	Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1
Plants	Uptake of phytotoxic elements	Metals in the made ground	Provision of 600mm soil cover will break the pollutant linkage

♦ transient risks to construction workers will be addressed by the adoption of appropriate health and safety measures in accordance with the Health and Safety at Work Act 1974, and regulations made under the Act including for example the COSHH Regulations.

3 Earthworks Levels, Regrade & Anticipated Foundations

- 3.1.1 Encia's Geoenvironmental Appraisal Report (No. 9382/1, dated May 2007), indicates that the following foundation solutions are likely to be most appropriate.
- 3.1.2 Strip/trench fill footings are considered to be the most appropriate foundation solution within the north of Area D, where firm clay or competent rock is the founding material at depths of less than 2.5m below existing ground level.
- 3.1.3 Within the south of Area D, where made ground is deeper than 2.5m, rafts on engineered fill or piled foundations will be required.

- 3.1.4 Sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1.
- 3.1.5 The foundation solutions outlined above assumed that ground levels would not change significantly from those existing at this time. However, final site levels will be determined by the Developer, in conjunction with his Earthworks Contractor and Engineering Designer.
- 3.1.6 The Developer should ensure that any digital terrain modelling undertaken by the Earthworks Contractor, with a view to enabling a "materials balance" (i.e. volume of cut to broadly equals the volume of fill) is made available to his Engineering Designer. The digital terrain modeller should consider:
- volume reduction caused by turnover (compaction of loose made ground; removal of obstructions\tanks etc);
 - whether or not processed arisings\treated soils are retained on site;
 - the thickness of the soil cover required in garden areas;
 - implications for foundations (i.e. those indicated in the Geoenvironmental Appraisal Report may no longer be the most appropriate).
- 3.1.7 Final site levels should then be issued by the Engineering Designer, via an External Works Drawing, which should show:
- proposed finished floor levels
 - proposed finished road levels
 - garden & driveway levels and gradients

4 REMEDIATION STRATEGY (General)

4.1 Aims

4.1.1 Remediation aims are:

- Resolve contamination issues in order to protect environmental receptors, and render the site suitable for the proposed development.
- Provide a stable development platform (to agreed levels and gradients) for subsequent construction of the proposed development and associated infrastructure.
- Satisfy requirements of the Local Planning.

4.2 Overview

4.2.1 The following remedial works are required:

- General site clearance of surface materials and vegetation.
- Re-grade of site to levels.
- Provision of a minimum 600mm thick cover layer of 'clean' soils in all garden and landscaped areas.

4.3 Site Set-up, Organisation and Safety

- 4.3.1 Site works shall be supervised throughout by a suitably qualified Engineer, who will report to a Project Manager. Supervision may be part-time for certain activities, but must be full-time during the removal of any grossly contaminated soil\fill and any placement of fill to an engineering specification.

- 4.3.2 Site cabins and welfare facilities are to be established at a location to be agreed with the Engineer. All welfare facilities must be established in accordance with the relevant health & safety statutory requirements.
- 4.3.3 All site personnel shall undergo a site-specific health and safety induction prior to commencement of work on site.
- 4.3.4 The Engineer shall be informed prior to any proposed entry of a confined space or deep excavation. Entry must be restricted to suitably qualified and equipped personnel.
- 4.3.5 During the remediation works, all personnel on site will comply with guidance provided in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land". In summary, the following shall be provided:
- Protective clothing, footwear and gloves. (Personnel should be instructed in why and how they are to be used).
 - Hand-washing and boot-washing facilities.
 - Designated smoking areas.
- 4.3.6 If at any time during the works personnel begin to feel unwell, they are to inform the Engineer, who will determine appropriate action.
- 4.3.7 Access into excavations etc. must be controlled and only undertaken in accordance with the Confined Spaces Regulations 1997. The atmosphere in shored trenches in excess of 1.2m should be monitored for oxygen and hazardous gas (methane & carbon dioxide), prior to personnel entering such excavations. Monitoring should continue whilst personnel are working in deep excavations.
- 4.3.8 All visitors to site must enter and register at the main Site Office.

4.4 Contractor's Responsibilities

- 4.4.1 Prior to the commencement of any works the Contractor, in agreement with the Engineer, shall:
- Comply with any requirements of Client's contract documentation.
 - Establish the boundaries of the site and the working areas.
 - Undertake a dilapidation survey of site boundaries, adjacent properties and highways, via dated photographs or video footage.
 - Liaise with the Local Authority regarding working hours, noise\dust\odour control, and protected trees.
 - Complete a full services search and liaise with all relevant utility companies regarding work in close proximity to their apparatus.
 - Prepare a detailed Method Statement outlining how the objectives of this Remediation Strategy will be achieved (and obtain approvals).
 - Inform the Engineer of any risk, identified and assessed, which could impact upon the Engineer's activities.
 - Prepare the necessary COSHH statements and Health & Safety Plan in accordance with CDM regulations.
- 4.4.2 The Contractor shall satisfy the Health & Safety Executive with regard to all matters concerning the health, safety and welfare of persons on the site.

4.4.3 The Contractor shall ensure that:

- Personnel, plant, materials and other equipment related to the contract are confined within the boundaries of the site.
- Any live services lying within the site boundary are marked and protected, or appropriate arrangements made to truncate them.
- Good practices relating to personal hygiene are adopted.
- Suitable precautions are implemented at all times to prevent off-site migration of pollutants via airborne dust and vapours.
- Suitable precautions are taken to prevent the spread of mud and debris on public highways.
- Refuelling of mobile plant is undertaken in a designated area. Above ground oil storage tanks shall comply with the requirements of Pollution Prevention Guideline PPG2. A spill kit shall be kept on site, adjacent to the designated refuelling area.

4.5 Engineering Supervision and Verification

4.5.1 The Engineer will ensure that the requirements of this Remediation Strategy are complied with in a safe and orderly manner.

4.5.2 The responsibilities of the Engineer shall include, but not be limited to, the following:

- Ensuring that all site personnel are suitably qualified and given an appropriate induction at the beginning of their first day.
- Supervision of the remediation and ground preparatory works.
- Advice on the correct handling of materials and conditions encountered.
- Guidance on the appropriate protective clothing and safety equipment that is to be made available and used.
- Ensuring that personal hygiene arrangements are adequate.
- Retrieval of soil and water samples and the subsequent scheduling of appropriate laboratory analysis to enable verification of various aspects of the works, and to advise the Project Manager of progress.
- Liaison with statutory authorities as required.

4.5.3 The Engineer will maintain records of the works to include the following:

- Daily record sheets to include a summary of the day's activities.
- Date and weather conditions.
- Plant, personnel and visitors present.
- Aspects relating to Health and Safety, Environmental Control, or non-compliance with either this Remediation Strategy or the Contractor's Method Statement.
- Site surveys as necessary to record the locations of demolition, excavation and filling activity.
- Test results.

4.5.4 On satisfactory completion of all the works the Engineer will prepare a Verification Report. Copies of the Verification Report will be issued to the Developer and the Local Authority.

4.5.5 The Verification Report will stand as certification that the remediation and ground preparatory works have been carried out in accordance with this Remediation Strategy.

4.5.6 The Verification Report will include:

- A summary of the preparatory & remediation works undertaken, including any works associated with unforeseen ground conditions.
- Verification test results associated with proposed source materials for clean cover
- Copies of any correspondence with Regulators relating to specific aspects of the remediation works.

4.5.7 The Verification Report will also provide recommendations with respect to:

- Foundation Solution(s)
- Gas Measures
- Placement of Soil Cover

4.5.8 The above recommendations will take account of the actual remediation works undertaken, and may differ significantly from recommendations originally presented in the site investigation report.

5 REMEDIATION STRATEGY (SPECIFIC OBJECTIVES)

5.1 Site Clearance

5.1.1 The site shall be cleared of all residual debris, any vegetation, shrubs, bushes and unprotected trees as instructed by the Client.

5.2 Removal of Below Ground Obstructions

5.2.1 All relict structures will be chased out and grubbed-up, in order to remove potential obstructions to new foundations and infrastructure.

5.2.2 Deep excavations for the removal of structures etc will be unstable in the short term and continuous side support will be necessary.

5.2.3 Suitable materials derived from grubbing-up shall be stored in a location on site, to be agreed with the Engineer, prior to crushing. Any unsuitable materials shall be removed to a suitably licensed landfill site (see Section 5.5).

5.3 Processing of Arisings

5.3.1 Generation of a selected granular fill, Class 6 material as defined in the Highways Agency Specification (Series 600), should be possible.

5.3.2 The crushed product shall be screened to remove any unsuitable elements and stockpiled for reuse during the subsequent construction works.

5.3.3 The Engineer shall check the suitability of crushed product for re-use, instruct the removal of any unsuitable material and schedule appropriate confirmatory geotechnical or chemical testing.

5.4 Contingency for Unknowns

5.4.1 Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the remedial works.

- 5.4.2 If unanticipated ground is encountered during the remedial works, the Contractor should immediately seek further advice from the Engineer.

5.5 Export to Landfill

- 5.5.1 Any material exported from site to landfill should be hauled by a registered waste carrier in accordance with the requirements of the Duty of Care Regulations, 1991 and the Landfill (England & Wales) Regulations 2002.
- 5.5.2 A transfer note should be completed, signed and retained by the parties involved. The transfer note should include the volume of waste, the nature of the material and a statement of its chemical composition, details of the source and destination sites, and details of the haulier.
- 5.5.3 In order to provide the landfill facility with information regarding chemical composition of the waste, analysis of any material that requires removal from site will be undertaken.
- 5.5.4 A minimum of six samples per material\waste type will be scheduled for: pH, total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc), PAH, BTEX and TPH.

5.6 Backfill of Excavations

- 5.6.1 Excavations (to remove relict structures) should be backfilled with suitable materials as agreed with the Engineer, and subjected to appropriate compaction.
- 5.6.2 However, where an excavation conflicts with the footprint of a proposed highway, works should be undertaken in accordance with the Specification for Highway Works, further details are provided in section 5.8.

5.7 Engineering of Fill Materials

- 5.7.1 In areas where raft foundations are proposed, the full thickness of made ground shall be excavated, screened and placed in engineered layers (turned over). Excavations below proposed new-build should extend at least 3.0m beyond the footprint of structures. Excavation and screening will enable the removal of all relict foundations, oversize material and any grossly contaminated soil/fill.
- 5.7.2 Deep excavations to remove relict structures and/or soft ground could result in "hollows" in the natural ground surface. The natural ground around these "hollows" should be over dug in order to ensure that the thickness of fill below each proposed plot does not vary by more than 15%. Where this requires benching of the natural ground, each bench should have a maximum vertical height not exceeding 500mm.
- 5.7.3 Clearly, such works will be undertaken in accordance with the proposed layout, and it is essential that Lithos are provided with the most recent (and proposed final) scheme. Any subsequent revisions to the plot layout could result in rafts straddling a 'high wall', and Lithos should be consulted if any layout revisions are proposed.
- 5.7.4 Where it is not possible to provide an even thickness of fill beneath proposed plots, raft foundations are unlikely to be acceptable, and consideration should be given to an alternative foundation solution.
- 5.7.5 Fill within basements is to be replaced with engineered fill. Basement excavations will need to be enlarged to ensure that engineered fill, of even thickness, underlies and extends at least 3.0m beyond house footprints.
- 5.7.6 Any excavated and screened material that needs to be stockpiled temporarily shall be placed in areas designated by the Engineer. Any stockpile of made ground should be assumed to contain elevated concentrations of inorganic contaminants, and it should

be ensured that such materials are not allowed to cross-contaminate any clean soils or controlled waters.

- 5.7.7 Prior to placement of engineered fill, the excavation base shall be inspected by the Engineer, and then surveyed.
- 5.7.8 Given the nature of the made ground at this site (including a significant proportion of material coarser than 37.5mm), a method specification based on site trials, is proposed for compaction works.
- 5.7.9 On-site trials will be required prior to the commencement of any compaction works.
- 5.7.10 The Contractor shall allow the Engineer at least five working days to assess the trial data and associated laboratory test results. The Engineer will then provide the Contractor with the following information:
- number of passes with the specified compaction plant
 - maximum and minimum layer thickness
 - acceptable moisture content range
 - proposed control testing
- 5.7.11 In areas where raft foundations are not proposed, the uppermost 1.5m of made ground shall be subjected to "turnover". Deeper excavation may be required in order to:
- "chase out" relict foundations and structures.
 - remove grossly contaminated soil/fill
- 5.7.12 The screened material shall generally be placed with nominal compaction, comprising at least 2 passes with a towed vibratory roller of at least 2,900 kg per metre width.
- 5.7.13 All buried structures, foundations and any grossly contaminated soil/fill shall be chased out to their full extent.
- 5.7.14 The site surface shall be initially left 600mm below proposed finished garden levels to allow for placement of the cover. In areas of highways the ground surface will be left approximately 600mm below finished road level.
- 5.7.15 Crushed product derived from screening and crushing the relict foundations, concrete slabs and oversize materials will yield good quality granular material which does not require a site trial to confirm the method specification for its compaction.
- 5.7.16 The Contractor shall ensure that only suitable granular fill is placed within 600mm of estate road formation level to ensure CBR values exceed 5%.

5.8 Highways

- 5.8.1 In the footprint of proposed highways, the contractor, under supervision, must ensure that relict obstructions are removed to a minimum of 1.0m below finished road level. In addition, any "cellar fill", or other unsuitable material, must be removed to its full depth. Any retained cellar floor slabs should be punched through to limit the risk of perched groundwater and confirm that loose ground does not exist below the slab. The resultant sub-formation should then be proof rolled, in accordance with the Specification for Highway Works.
- 5.8.2 If any deep excavation beneath a highway, results in sub-formation slopes greater than 1:5 (v:h), the sub-formation should be stepped (max. 0.5m high) and benched (min. 1m wide). Where excavation works exceed 1m, the footprint of SHW earthworks should be extended beyond the highway footprint a minimum of 1m, plus

the depth of excavation. The supervising engineer will keep records of any such work undertaken.

5.8.3 The following options are considered suitable for treating the made ground below highways.

- Excavation of the full thickness of made ground and replacement with suitable aggregate in accordance with Series 600 (Earthworks) of The Highways Agency (HA) "Specification for Highway Works" 1998.
- Excavation of the full thickness of made ground, screening, selection and replacement of suitable made ground materials in engineered layers to approximately 650mm below final road levels in accordance with Series 600. Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, peat or lignite, scrap metal, frozen material and material which, by virtue of its particle size or shape, cannot be properly and effectively compacted (e.g. oversize material or gravels which are tabular).

5.8.4 To prevent damage to the engineered fill, a granular running layer using crushed material (125mm down), shall be placed at formation beneath highways and haulage routes as directed by the Engineer. This running layer shall have a minimum CBR of 2% and extend 1.0m beyond proposed curb lines. This granular running layer shall not constitute a capping layer in terms of highway construction.

5.8.5 The Contractor should agree acceptable performance criteria, and an appropriate Specification for any necessary ground improvement, with the Client and the adopting authority.

5.8.6 The Contractor will arrange for the necessary compliance testing to be undertaken at formation level on road alignments, as required by the adopting authority and Engineer.

5.9 Surveying

5.9.1 The Contractor shall arrange for the following survey work as directed by the Engineer:

- Establishment of profile boards
- Setting-out of estate roads
- Depth and extent of localised areas of overdig (such as those required to remove tanks)
- Depth and extent of excavations associated with removal of contaminated soil\fill
- The ground surface prior to placement of fill to raise site levels/provide clean cover in garden/landscaped areas
- The finished surface

5.9.2 The Contractor should supply the results of this survey work (disc & hard copy) to the Engineer for inclusion in Lithos's Verification Report.

5.10 Placement of Soil Cover

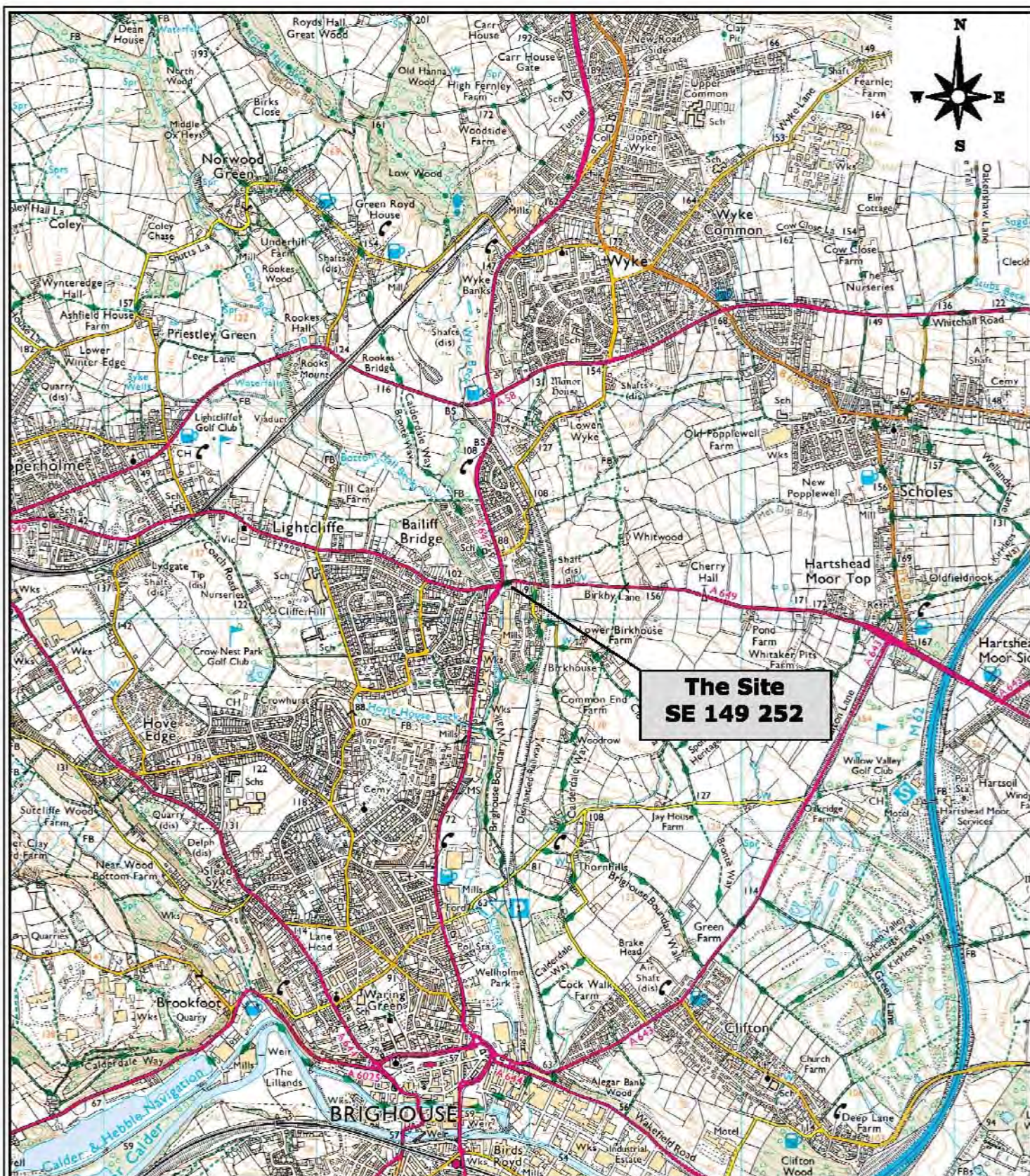
5.10.1 Clean inert fill will be placed over the made ground in proposed landscaped areas (but not beneath hardstanding). This cover layer is to comprise 500mm of "clean" subsoil plus 100mm of topsoil.

5.10.2 It is considered unlikely that a significant volume of subsoil suitable for use as cover material will be sourced on site. Consequently, there will be a need for soil import.

- 5.10.3 Any material imported for use as cover should be validated in accordance with Lithos's Protocol for Soil Importation, copied in Appendix B. This Protocol includes chemical assessment criteria which should not be exceeded.
- 5.10.4 This work may be undertaken as part of the contract for the preparatory & remedial works, in which case imported soils should be stockpiled in a location agreed with the Engineer. Alternatively, the developer may choose to import soil at a later stage in the development.

**APPENDIX A
DRAWINGS**

Drawing No.	Title
1321/1	Site Location Plan
9382/2	Site Features
1321/2	Proposed Layout



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CLIFTON MILLS
BAILIFF BRIDGE

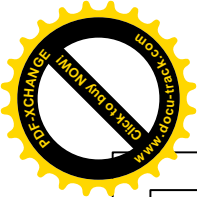
SITE LOCATION PLAN

RJH 21/09/2011

REG 22/09/2011

STATUS FOR COMMENT ☐ DRAFT ☐
FOR APPROVAL ☐ FINAL ☒

SCALE 1:25,000 SHEET A4 DRAWING NO. 1321/1 REVISION A



- NOTES
- = Rough Ground
 - = Mill Building
 - = Hardstanding
 - = Compound
 - = Stockpile
 - = Approximate Line of Culvert
 - = Approximate Site Boundary

REV.	DESCRIPTION	DATE
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CLIENT

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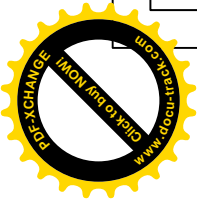
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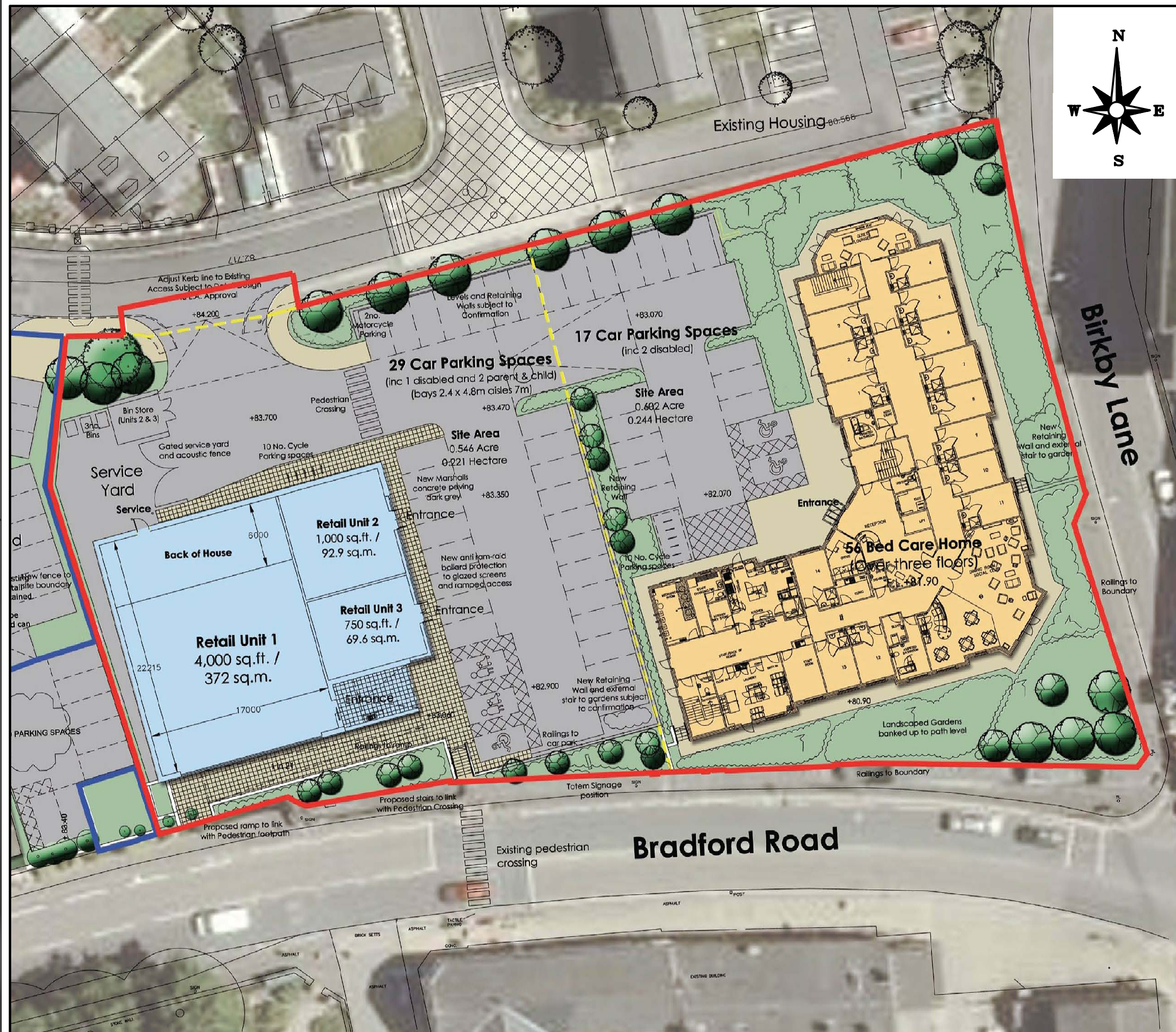
**CLIFTON MILLS
BAILIFF BRIDGE**

DRAWING TITLE

SITE FEATURES PLAN

DRAWN BY JWH	SIGNATURE	DATE APRIL 07	STATUS FOR COMMENT <input type="checkbox"/> FOR APPROVAL <input type="checkbox"/> DRAFT <input type="checkbox"/> FINAL <input checked="" type="checkbox"/>
APPROVED BY RLM	SIGNATURE	DATE APRIL 07	
SCALE 1:500	SHEET SIZE A2	DRAWING NO. 9382/2	REVISION A





NOTES

Based on Harris Partnership
Drawing 1152-V102E-Site Plan,
dated 18/04/2012

REV.	DESCRIPTION	DATE

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Tel 0845 680 9781

CLIENT

CP GROUP LIMITED

JOB TITLE

CLIFTON MILLS, BAILIFF BRIDGE

DRAWING TITLE

PROPOSED LAYOUT

DRAWN	ASw	DATE	01/06/2012	STATUS FOR COMMENT FOR APPROVAL DRAFT FINAL
CHECKED	RJH	DATE	01/06/2012	

SCALE	Not to Scale	SHEET	A3	DRAWING NO.	1321/2	REVISION	B
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APPENDIX B
LITHOS PROTOCOL FOR IMPORTATION & USE OF SOIL COVER

Introduction.

Isolation of made ground in garden and landscaped areas beneath a cover of "clean" subsoil, and topsoil is often recommended on residential developments; most notably when the made ground contains inorganic (and non-volatile organic) contaminants at concentrations above guidance threshold values. A cover solution is not appropriate for volatile or semi-volatile organic contaminants (fuels, solvents etc); removal or treatment will usually be required.

The thickness of cover is dependant on the nature and degree of contamination (and sometimes the Local Authority whose area the site lies within), but typically between 600mm and 1,000mm is required. However, if the made ground is essentially "clean", but contains materials generally considered undesirable as a near-surface material in garden areas (colliery spoil, construction\demolition rubble etc) then a 300mm thick cover, in accordance with NHBC Standards, Chapter 9.2, should be adequate. If the made ground is essentially "clean" and comprises reworked natural soil, the only cover likely to be required is topsoil.

The "clean" soil cover blocks potential linkages between the contaminated made ground and future residents. Soil cover is not required beneath drives, garages or houses.

The **CML initiative**, which came into force on 1st April 2003, requires house builders to submit to NHBC (or other warranty providers) a validation report confirming the thickness and quality (ie contaminant-free) of the placed soil cover. Validation reports are normally prepared by independent geoenvironmental consultants such as Lithos.

Failure to submit cover validation reports promptly will delay NHBC finalling plots (this will delay the release of mortgage funds and hence legal completion) ie the financial implications are very significant. Consequently, it is essential that Lithos are instructed at least 2 weeks prior to the anticipated finalling date.

Soil cover is usually placed many weeks after completion of the preparatory\remediation works, and issue of the associated Verification Report, typically at a relatively late stage in the construction programme.

Prior to placement of soil cover, the appointed remediation contractor and\or groundworker should ensure that ground levels are low enough to accommodate the required cover thickness, taking account of any boundary issues, and without compromising the DPC.

Ideally soil **quality** should be determined by sampling of the **source** at least 7 working days before importation to the development site. However, samples could be obtained from stockpiles on site; these may on occasion comprise subsoils associated with foundation\drainage excavations in natural in-situ strata. Alternatively (but not recommended) soil samples could be obtained from gardens after placement.

Clearly, if soil cover is imported and placed before confirmation of its suitability, Lithos cannot guarantee that our validation work will yield the desired results. In which case, it may be necessary to excavate and export the placed soil cover and\or import further "clean" soil.

Where samples have been tested at source, and on receipt of laboratory results, Lithos will issue confirmation of soil suitability to the Client, who in turn will instruct his Contractor to commence importation. It will probably be necessary to stockpile soil cover materials prior to placement in garden\landscaped areas. Lithos should inspect the stockpiled material prior to placement, to confirm that it is the same material as previously tested, and it has not been cross-contaminated with miscellaneous arisings generated during the construction works.

Soil **thickness** can only be checked after placement; this should be done before turfing, fencing etc, but ideally after scaffolding has been dismantled.

Sampling Frequency (to check Soil Quality): The number of samples taken will be dependant on the nature of the source, and the quantity of material to be imported. However, typically a minimum of 6 samples of each soil type (from each source) should be tested, with a further sample for each 200m³ of soil, where the quantity exceeds 1,200m³. This frequency applies to both subsoil and topsoil; i.e. a minimum 6 samples of each will be required. Clearly, if subsoil were obtained from two different sources, it would usually be necessary to test a minimum of 12 samples.

For a development with (relatively large) gardens comprising a total area of 100m² (front and rear), and a soil cover thickness of 600mm, including a minimum 100mm topsoil, this testing frequency equates to approximately one subsoil sample per four plots. In effect, because of the need to test a minimum of 6 samples per source, the sampling frequency increases where the number of plots on given site is less than 24; e.g. on a 12 unit site, the sampling frequency would be one sample per two plots.

It should be noted that the thickness of placed topsoil is only 100mm to 150mm (cf subsoil thicknesses of around 500mm). Consequently, where samples are collected after placement (although testing at source is always preferable) testing one sample per four plots results in a higher frequency; typically equating to one topsoil sample per 40m³ to 60m³. This is not unreasonable anyway, since from a potential contaminant perspective, topsoil, being present at surface, is more important than underlying subsoil.

Occasionally a developer just places 600mm of topsoil (i.e. no subsoil is used). In such circumstances, assuming the topsoil is from a single source, Lithos would test a minimum of 6 samples.

A less frequent sampling rate may be appropriate for soils from a greenfield source or where large volumes (say > 5,000m³) of soil are imported from a single, relatively homogenous source.

Another problem with assessing soil quality post-placement is that usually less than 5 or so plots are validated at a time. Consequently, only 1 or 2 samples are analysed in the laboratory after each visit. This has significant implications for data assessment; whilst results can be compared against appropriate screening criteria, it is not sensible to undertake statistical analysis on data sets of less than 6. Therefore statistical analysis of results can only really be done after 3 or 4 visits; and then only if the material in question has come from a single source.

Inspection Frequency (to check Soil Thickness): The number of inspection pits to check cover thickness (and collect samples, if testing at source has not been undertaken), should be dependant on the number of plots associated with the given development. The following frequencies are recommended:

No. Plots within Development	Frequency of Inspection Pits	
1 – 5	1 pit per plot	e.g for 3 Plots, dig 3 inspection pits
6 – 12	1 pit per 2 plots	e.g for 9 Plots, dig 5 inspection pits
13 – 24	1 pit per 3 plots	e.g for 20 Plots, dig 7 inspection pits
>25	1 pit per 4 plots	e.g for 40 Plots, dig 10 inspection pits

Soil Material Suitability: Inspection pits should be excavated through the entire thickness of any proposed in-situ source material, or cover material (if inspection is post-placement). Stockpiles should be assessed from both the surface and by digging into the “core”, to ensure the material is reasonably homogenous.

The soil material should:

- be clean and free of foreign debris, building waste materials, glass sharps, or contaminants;
- topsoil should not have a gravel content of greater than 30% by dry weight and should generally have a maximum stone size of 50mm in any one direction;
- subsoil should generally have a maximum stone size of 150mm in any one direction;
- not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc).

Laboratory Analysis: Whether samples are taken at source, from stockpiles on site, or from gardens after placement, they should be forwarded to an analytical laboratory for testing in accordance with one of the Schedules detailed in Table 1.

Imported topsoil should be subject to such testing, wherever it is *not* being sourced from a reputable supplier; soil transfer stations would not usually be classed as a reputable supplier. In addition, some analysis in accordance with BS3882 may occasionally be appropriate.

Table 1 – Test schedule

Source	Definition	Test Schedule	Other requirements\Remarks
Greenfield	No ‘source’ of contamination present i.e. undeveloped; absence of made ground.	<i>pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron.</i>	Photographs of site and stockpiles. If review of an SI report confirms source site has always been greenfield (and redevelopment is yet to commence), there should be no need for speciated PAH testing.
“Low-risk” Brownfield	Development site (on former greenfield land) with excess soils, or a “low-risk” brownfield site (eg former school, offices, housing estate etc).	<i>pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC & Speciated PAH.</i>	Photographs of site and stockpiles.
Soil Transfer Stations & Other Brownfield	Source is a soil transfer stations. Potential source anticipated i.e. current or historical industrial or commercial use; evidence of bonfires; presence of made ground.	<i>pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC, Speciated PAH and banded TPH.</i>	Photographs of site and stockpiles.

NB The schedules detailed above have been prepared in accordance with the Secondary Model Procedures. This document states that analysis should be relevant to potential sources and not merely a set list of parameters applied to each site.

Additional determinands could be scheduled, although if considered necessary, would probably suggest the material is unlikely to be suitable for use as clean cover in gardens.

Protocol for Importation & Use of Soil Cover (Capping)



Chemical assessment (Tier 1) criteria for imported soils are provided in Table 2.

Table 2 - Chemical Assessment Criteria for Imported Soils

Contaminant	Source	Tier 1 Assessment Criteria (mg/kg)	Comments/Notes
pH	CLEA		
As	CLEA	32	
Cd	CLEA	5	
Cr (III)	CLEA	3,000	
Cr (VI)	CLEA	4	
Pb	CLEA	450	Based on former SGV
Ni	CLEA	127	Assessment of human health risk only
Se	CLEA	350	
Hg	CLEA	180	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.
B	Lithos	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu	DoE	80-200	
Zn	DoE	200	
Benzo(a)pyrene	CLEA	3	Where source is not a coal tar and historic use of site does not suggest possible presence of coal tar
Naphthalene	CLEA	5	Calculated target was 142mg/kg driven by outdoor inhalation and direct contact. However, concentrations of this magnitude are likely to present a DRO issue and would not be considered appropriate as cover. Value for Scenario C of Lithos Screening values adopted as a precautionary approach.
GRO	CLEA	335	Based on an outdoor inhalation and direct contact value for Aromatic fraction C7-C8
DRO	CLEA	854	Based on an outdoor inhalation and direct contact value for aromatic C10 to C12 range.
LRO	CLEA	2,230	Based on an outdoor inhalation and direct contact value Aromatic C21-C35

It should be noted that many of the compounds detected by laboratory analysis for TPH and PAH are naturally occurring in coal, humic acid, bark, leaf litter etc; these are clearly not 'sources' within the legal definition. Lithos can undertake further risk assessment where PAH screening values are exceeded, *but* inspection of the soils has not identified any petroleum or combustion derived material.

However, it should be noted that Lithos will only analyse for TPH where a possible source is identified or where cover material is obtained from a Brownfield site or transfer station, Lithos will not undertake this sampling as a matter of routine on proven Greenfield sites.

Validation Reports

The analytical testing will usually be undertaken on a 3 or 5-day turnaround and the Client\Contractor will be notified of the soil's suitability (or otherwise) immediately after receipt of the results.

Interim validation letter reports will be issued by Lithos as each plot, or set of plots, is completed. After Lithos have been able to confirm placement of agreed thicknesses of suitable soil cover in all garden\landscaped areas across the site, and where required to satisfy a Local Authority planning condition, we will prepare and submit a final validation letter report.