



Land at Long Lane, Earlsheaton

For Wordsworth Property Developments Ltd

Report no: 2986/2A

Date: May 2024



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APPENDICES

Appendix A : Drawings

Drawing	Revision	Title
2986/1	-	Site Location Plan
0389_LON_103	C	Proposed Site Plan (eleven52 architects)
2986/3	-	Site Features
2986/7	-	Revised Conceptual Site Model
2986/9	-	Ground Condition & Site Areas
23590-DR-C-0601	P1	Proposed Earthworks (Dart Engineers)

Appendix B : Lithos Tier 1 Values

Appendix C : Protocol for Placement of Non-Engineered General Fill

Appendix D : Protocol for Importation & Use of Soil Cover (Capping)

REMEDIATION STRATEGY for land at LONG LANE, EARLSHEATON

1 INTRODUCTION

1.1 The commission and brief

- 1.1.1 Lithos Consulting Limited has been commissioned by Wordsworth Property Developments Ltd to prepare a Remediation Strategy for land off Long Lane in Earlsheaton, near Dewsbury.
- 1.1.2 Lithos has already issued the following report:
 - Geoenvironmental Appraisal: Land at Long Lane, Earlsheaton, Report ref. 2986/1B, dated June 2020.
- 1.1.3 The appointed Remediation Contractor will need to familiarise themselves with the above Reports, and comply with all relevant recommendations contained therein.
- 1.1.4 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.
- 1.1.5 The Method Statement should be accompanied by a Designer's Risk Assessment in accordance with the CDM Regulations, 2015. The Method Statement and Risk Assessment should be submitted to, and approved by Wordsworth Property's Site Manager.
- 1.1.6 This document is a revision of the Remediation Strategy (Report 2986/2) issued by Lithos in March 2024; Report 2986/2 is now superseded. This document now includes the latest layout and reference to Japanese Knotweed work undertaken by Ebsford Environmental, with the only significant revisions to 2986/2 having been made in Sections 1.2, 3 & 5.2.

1.2 The proposed development

- 1.2.1 The proposed residential development comprises 26 'traditional' two storey residential dwellings, with associated gardens, an area of POS and adoptable roads and sewers. A development layout has been prepared by eleven52 architects (Drawing 0389_LON_103, dated 28th February 2024) which is copied in Appendix A to this document.
- 1.2.2 Plots built in the west (Area B) are likely to be built on strip/trench footings. Plots in Area A will need trench fill or piled foundations.
- 1.2.3 Access to the development will be off Long Lane which runs along the site's western boundary.

2 BACKGROUND

2.1 Site description

2.1.1 Site details are summarised below:

Detail	Remarks
Location	1.6km south of Dewsbury town centre
NGR	SE 257 204
Area	0.6 hectares.
Known live services	Underground & overhead electric.

2.1.2 The site location and current salient features are shown on Drawings 2986/1 and 2986/3 in Appendix A.

2.1.3 Chickenley Beck flows south immediately beyond the eastern boundary.

2.1.4 The site falls down to the east with an overall gradient of 1v:9h and a maximum gradient of 1v:7h (in the centre-west). A steep bank (1v:1h to 1v:3h) about 2m high runs along the site's eastern boundary, adjacent to Chickenley Beck.

2.1.5 Whilst the site appears greenfield (based on historical OS mapping) At the time of Lithos' investigation the site's current owner suggested that the east of the site had formerly been used as a Victorian tip.

2.2 Ground investigation

2.2.1 Following completion of a desk study which culminated in a Preliminary Conceptual Site Model, ground investigation fieldwork was supervised by Lithos in on the 31st August 2018 and comprised excavation of 9 trial pits, with soakaway testing in 4 pits.

2.2.2 Soakaway tests undertaken into Granular Residual Soils typically gave very favourable results, although testing in TP04 (which was excavated into Cohesive Residual Soils and Mudstone bedrock) failed to reach 50% empty after a period of three hours.

2.2.3 A total of 11 samples were submitted for testing to determine the nature of any contamination and 7 samples were submitted for testing to determine geotechnical properties.

Made Ground

2.2.4 Made Ground was encountered across the centre and east of the site (referred to as Area A) to between 0.5m and 1.6m depth and comprised a veneer of Made Ground Topsoil over Sand or ash and Gravel of clinker, pottery, glass and occasional coal, brick, sandstone, mudstone and bone.

2.2.5 The extents of site areas (Areas A & B) are shown on Drawing 2986/9 in Appendix A.

Natural ground

2.2.6 Natural ground was encountered from surface in the west of the site (referred to as Area B) and from the base of made ground in the centre and east and comprised a veneer of Topsoil (east only); over Cohesive Residual Soil (firm to stiff sandy Clay); over Granular Residual Soil (sandy Gravel of sandstone with a low sandstone cobble content); over, sandstone bedrock from between 1.5m and 2.8 depth.

2.2.7 In the far-east, bedrock comprised thinly interbedded siltstones and sandstones.

- 2.2.8 Geotechnical testing confirmed that the Cohesive Residual Soil can be considered to be non-shrinkable due to a high portion of granular components (sand).

Groundwater

- 2.2.9 No significant inflows of groundwater were encountered during Lithos' investigation.
- 2.2.10 The made ground and natural Residual Soils are not considered likely to afford significant protection to groundwaters in the bedrock aquifer (a Secondary A Aquifer).

Mining

- 2.2.11 Report 2986/1B includes a desk-based Coal Mining Risk Assessment which concluded that, whilst the site is located in a Coal Authority Development Low Risk Area, no significant risks have been identified and an intrusive mining investigation and/or remediation of shallow mineworkings is not required.

Hazardous gas

- 2.2.12 The Public Health England UK radon map and the Landmark report indicate that the site is in an area where between 3% and 5% of homes are estimated to be above the action level, and basic radon protection measures are required in new dwellings.
- 2.2.13 The risks of hazardous carbon monoxide, carbon dioxide and methane gasses migrating beneath this site are considered low, but cannot be entirely discounted.
- 2.2.14 While the basic radon protective measures will provide afford some protection against any low levels of hazardous gas, the gas risk assessment (included in Geoenvironmental Appraisal 2986/1B) recommended the installation of gas protection measures in accordance with a Characteristic Situation 2 classification in all new dwellings.

Contamination

- 2.2.15 The 'natural' and Made Ground Topsoil and the Ash & Clinker beneath this site have all been found to be 'contaminated' with a number of inorganic and organic determinands and are not considered suitable to remain at/near surface in gardens and/or landscaped areas.
- 2.2.16 The Ash & Clinker beneath this site is also considered to be potentially combustible.
- 2.2.17 Consequently placement of cover to break pathways between contaminants and end users will be required.
- 2.2.18 Of three samples of Ash & Clinker tested for leachability, two returned elevated concentrations of arsenic, chromium and water-soluble boron in comparison to the relative Tier 1 screening values. Consequently the Ash and Clinker cannot be considered completely inert. Leachability is not considered to be a significant risk to end users following development, however, there could be considered to be a risk to surface waters (the adjacent Chickenley Beck); see comments in Section 5.8.

2.2.19 In terms of the proposed redevelopment plausible contaminant linkages, and feasible remediation options, are summarised below:

Receptors	Pathways	Contaminants	Plausible pollutant linkage? (and remediation options where required)
Human health (Future residents) ♦	Consumption of contaminated vegetables	Inorganics (metals)	Isolation beneath at least 1,000mm clean soil cover in garden and landscaped areas
	Ingestion	Inorganics (metals) & organics (PAHs)	
	Dermal contact		
	Inhalation (dust and/or vapours)		
Groundwater & Chickenley Beck	Surface water run-off	Metals, hydrocarbons in the made ground	Careful consideration during design of drainage solution

♦ 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 An Earthworks Drawing (Ref. 23590-DR-C-0601, dated January 2024) has been prepared by Dart Engineers, and a copy is included in Appendix A.

3.2 The Dart Earthworks Drawing shows only up to 0.4m of fill will be placed in the south of Area B, with levels in the north subject to cut. Consequently, strips should provide a satisfactory founding solution for all plots built in the west (**Area B**); see attached Drawing 2986/9.

3.3 Depths of made ground in the east (**Area A**) are currently between 0.5m and 1.6m, and the Earthworks Drawing shows up to 2.7m of fill will be placed across Area A; greatest in the south. Consequently, Plots in Area A will need trench fill or piled foundations.

3.4 Any digital terrain modelling undertaken by the Earthworks Contractor should be designed with a view to enabling a "materials balance" (i.e. volume of cut to broadly equals the volume of fill), and be made available to Wordsworth Property's 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)

3.5 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 to:

- 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 Authority and the warranty provider

4.2 Overview

4.2.1 The following remediation works are required:

- General site clearance of surface materials and vegetation.
- Excavation of natural soils from beneath made ground to source 'clean' subsoil for use in gardens and landscaped areas.
- Backfill of all resultant excavations, with appropriate compaction.
- Re-grade of site to levels specified by (approximately 1,000mm below final "soft" end use areas and 600mm below proposed slab levels).
- Excavation of up to a maximum depth of 2m beneath proposed adoptable road footprints and controlled re-engineering of selected materials in layers to approximately 600mm below final road levels.
 - Consideration may also be given to excavation, turnover and nominal compaction beneath plots & external areas to aid levels regrade & reduce uncertainties.
- Provision of a minimum 1,000mm thick cover layer of 'clean' soils in all garden and landscaped areas.
 - Placement of sufficient clean cover will require the import of clean & suitable Subsoil & Topsoil materials.

4.3 Site set-up, organisation and safety

- 4.3.1 Site cabins and welfare facilities are to be established at a location to be agreed with Wordsworth Property's Site Manager. All welfare facilities must be established in accordance with the relevant health & safety statutory requirements. Provision should be provided on site for car parking for all site employees
- 4.3.2 All site personnel should undergo a site-specific health and safety induction prior to commencement of work on site.
- 4.3.3 Wordsworth Property's Site Manager should be informed prior to any proposed entry of a confined space or deep excavation. Entry must be restricted to suitably qualified and equipped personnel.
- 4.3.4 Access into excavations etc. must be controlled and undertaken in accordance with the CDM Regulations 2015, most notably Regulation 22, to mitigate risk of collapse or asphyxiation.

- 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 should 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 Wordsworth Property's Site Manager, who will determine appropriate action.
- 4.3.7 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 Wordsworth Property's Site Manager, should:
- Comply with any requirements of Wordsworth Property'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.
 - Liaise with the Canal & River Trust (formerly British Waterways) and the Environment Agency regarding any work in close proximity to Chickenley Beck.
 - 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 Wordsworth Property's Site Manager of any risk, identified and assessed, which could impact upon Wordsworth Property's Site Manager activities.
 - Prepare the necessary COSHH statements and Health & Safety Plan in accordance with CDM regulations.
- 4.4.2 The Contractor should 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 should 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 contaminants 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 should comply with the requirements of Pollution Prevention Guideline PPG2.
- A spill kit should be kept on site, adjacent to the designated refuelling area.
 - (Lithos are aware that some of the EA PPG documents have been withdrawn from the gov.uk website. However, whilst some references to UK legislation and guidance are now outdated; the PPGs still set out key principles and provide a useful, concise overview).

4.5 Materials Management Plan

4.5.1 This project will involve the re-use of both natural and made ground soils on site and the import of natural soils from another development site(s). Therefore, the Contractor will need to prepare a Materials Management Plan (MMP) in accordance with the CL:AIRE Code of Practice (v2, March 2011).

4.5.2 The MMP will document how all of the materials to be excavated during the proposed site preparatory and remediation earthworks are to be dealt with. In summary the MMP should provide:

- Details of the parties that will be involved with the implementation of the MMP.
- A description of the materials in terms of potential use and relative quantities of each category.
- The specification for use of materials against which proposed materials will be assessed, underpinned by an appropriate risk assessment related to the place where they are to be used.
- Details of where and, if appropriate, how these materials will be stored.
- Details of the intended final destination and use of these materials.
- Details of how these materials are to be tracked.
- Contingency arrangements that must be put in place prior to movement of these materials.
- Verification Plan.

4.5.3 The MMP should include consideration of the following factors:

- Any risks posed by the excavated materials to both human health and the environment.
- Suitability for use.
- Certainty of use.
- Anticipated quantities of materials.

- 4.5.4 The MMP should also detail how materials will be tracked throughout the earthworks in order that the subsequent Verification Report can provide an auditable trail. The tracking system must include:
- Annotated plans of the site(s) identifying different excavation areas, stockpile locations, treatment areas (if applicable) and placement locations.
 - Inspection procedures.
 - Registered waste carrier and non-waste haulier.
 - Tracking form / control sheets.
 - Treatment results (if applicable).
 - Delivery tickets for non-waste materials (if moving from one site to another).
 - Acceptance procedures for non-waste materials.
- 4.5.5 Finally, the MMP will have to set out a Verification Plan that identifies how the placement of materials is to be recorded and the quantities of material to be used. It will contain a statement on how the use of the materials relate to the remediation or design objectives.
- 4.5.6 Once completed, the MMP will need to be reviewed by a Qualified Person (QP), who will submit an online Declaration to CL:AIRE and send a copy to Wordsworth Property. It should be noted that in accordance with the Code of Practice, Lithos cannot act as the Qualified Person because we have undertaken the site investigation and prepared this Remediation Strategy.

4.6 Engineering supervision and verification

- 4.6.1 Site works should be supervised throughout by Wordsworth Property's Site Manager, supported as/where necessary by a suitably qualified and experienced Geoenvironmental Engineer. 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.
- 4.6.2 Wordsworth Property's Site Manager will ensure that the requirements of this Remediation Strategy are complied with in a safe and orderly manner.
- 4.6.3 The responsibilities of Wordsworth Property's Site Manager should 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.
 - Provision of advice on the correct handling of materials and conditions encountered.
 - Provision of 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.

- 4.6.4 Wordsworth Property's Site Manager 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.
- 4.6.5 On satisfactory completion of all the works Wordsworth Property's Site Manager, with input from the Geoenvironmental Engineer as necessary, will prepare a Verification Report, in accordance with the Environment Agency's online guidance "Land Contamination Risk Management" which replaced CLR11 in October 2020.
- 4.6.6 Copies of the Verification Report will be issued to Wordsworth Property, the Local Authority and warranty provider.
- 4.6.7 The Verification Report will stand as certification that the remediation and ground preparatory works have been carried out in accordance with this Remediation Strategy.
- 4.6.8 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.
 - Moisture content and plate bearing test results associated with ground improvement beneath proposed highways.
 - Copies of any correspondence with Regulators relating to specific aspects of the remediation works.
 - Reference to the MMP and associated tracking system, including alterations made and why.
 - Reference to waste transfer documentation, including return loads (if applicable).
 - Signed delivery tickets (if applicable).
 - Record of quantity of materials used.
 - A receipted copy of the Qualified Person's Declaration.
- 4.6.9 The Verification Report will also provide recommendations with respect to:
- Foundation Solution(s).
 - Gas Measures.
 - Placement of Soil Cover.
 - Handling of Contaminated Soils.
- 4.6.10 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 Contingency for unknowns

- 5.1.1 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 remediation works.
- 5.1.2 If unanticipated ground is encountered during the remediation works, the Contractor should immediately seek further advice from the Geoenvironmental Engineer.
- 5.1.3 In accordance with the requirements of the planning permission all works (apart from investigation works) should cease immediately and the Local Planning Authority should be notified in writing within 2 working days. The planning permission also prohibits the recommencement of works until a revised Remediation Strategy is submitted to, and approved in writing, by the Local Planning Authority.
- 5.1.4 In order to assess the nature of any unanticipated grossly contaminated soil/fill, and (if necessary) allow revision of this Strategy document, it should be placed in temporary stockpiles on hardstand or an impermeable membrane, suitably covered and bunded.
- 5.1.5 Analysis of at least 6 samples, for an appropriate range of determinands should be undertaken. On receipt of the results, the Engineer will liaise with the Contractor regarding the most appropriate remediation option.

5.2 Japanese Knotweed Site clearance

- 5.2.1 Ebsford Environmental undertook an invasive non-native species walkover survey on 8th March 2023. The survey identified two species of concern; Himalayan balsam and Japanese knotweed.
- 5.2.2 A resurvey was conducted on the 21st March by Ebsford to assess the extent of the area due to be cleared and select appropriate plant for the site works.
- 5.2.3 Ebsford have issued the following reports:
- Invasive Species Management Plan, dated March 2023
 - Site Clearance, dated March 2023
- 5.2.4 The Contractor the Contractor should make reference to the above reports and liaise with Ebsford to ensure the works outlined in this Remediation Strategy do not conflict with Ebsford's proposed weed treatment and site wide clearance works.
- 5.2.5 Any trees currently under a preservation order should be identified and agreed with relevant authorities prior to the commencement of the works. All trees subject to a TPO should be clearly identified and protected by fencing in accordance with BS5837: 2012.
- 5.2.6 The site should then be cleared of all residual debris, any vegetation, shrubs, bushes and unprotected trees as instructed by Wordsworth Property.
- 5.2.7 Made Ground Topsoil and 'natural' Topsoil, typically 250mm thick is present across the whole site. Testing suggests this material is **not** suitable for re-use.

5.3 Topsoil stockpiling

- 5.3.1 Topsoil should be stripped and placed in a temporary stockpile. Ultimately, topsoil should be redistributed and isolated beneath clean soil cover; see Section 5.15, or disposed of off-site see Section 5.14.
- 5.3.2 Topsoil stockpiles should be located in areas of the site where the material can be left undisturbed and it won't interfere with site operations. Unnecessary double-handling of the soils should be avoided where possible.
- 5.3.3 Stockpiles should not be positioned within the root or crown spread of retained trees, or adjacent to watercourses, ditches or existing or future excavations.
- 5.3.4 Stockpile locations should first be cleared of any vegetation, made ground and development waste.

5.4 Turnover of made ground

- 5.4.1 Consideration could be given to turnover (excavation, screening/sorting and replacement in engineered layers, with nominal compaction) of the full thickness of made ground across the site, in order to:
 - Reduce the risk of uncertainties within the ground during subsequent development works
 - Aid the site regrade
 - Source suitable subsoil for use within the clean cover layer
 - Provide mitigation against the risk of spontaneous combustion within the Ash & Clinker
- 5.4.2 Further details of specific operations associated with turnover are described in the following sections.

5.5 General excavation

- 5.5.1 Excavation of made ground should be undertaken in a controlled manner, working from a line agreed with Wordsworth Property's Site Manager in linear panels.
- 5.5.2 Excavated material should be removed from each panel and screened to remove oversize (> 200mm) and other unsuitable (e.g. anthropogenic or biodegradable materials), prior to replacement.
- 5.5.3 Any stockpile of Topsoil, Made Ground Topsoil or Ash & Clinker 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.
- 5.5.4 Each panel should be inspected by Wordsworth Property's Site Manager, and have its depth and extent recorded by survey, prior to backfilling (see Section 5.13).
- 5.5.5 Any excavated and screened material that needs to be stockpiled temporarily should be placed in areas designated by Wordsworth Property's Site Manager.

5.6 Site regrade

- 5.6.1 Regrade of site is anticipated to facilitate the proposed housing layout. It is understood that Wordsworth Property will require the appointed earthworks contractor to undertake digital terrain modelling, with a view to:
- Achieving a materials balance (thereby avoiding the need for any significant import or export of soils)
 - Confirming final levels, including Plot FFLs
 - Achieving acceptable highway and drive gradients
 - Minimising foundation abnormalities
- 5.6.2 The earthworks modelling should consider the possibility of using site-won subsoil as cover material (subject to the Engineer's approval), and how excess foundation and drainage arisings will be accommodated.

5.7 Excavation of Ash & Clinker

- 5.7.1 Due to its combustibility, and the presence of a number of inorganic and organic contaminants, near-surface Ash & Clinker is to be placed beneath plots or areas of hardstand, or isolated beneath the 1,000mm clean cover (see Section 5.15).
- 5.7.2 Redistribution or isolation beneath cover will satisfactorily isolate the Ash & Clinker from both end-users and potential heat sources.
- 5.7.3 As further mitigation against the risk of spontaneous combustion, the ash should be placed in approximate 300mm thick layers, wetted and subjected to compaction, comprising at least 2 passes with a towed vibratory roller of at least 2,900 kg per metre width. Compaction will help to prevent the material drying out and reduce the ingress of oxygen.
- 5.7.4 Given the volume of made ground at this site, it is unlikely to be economically feasible, or in line with the principals of sustainable development, for Ash & Clinker arisings to be exported from site to a suitably licensed landfill facility; see Section 5.14.

5.8 Control of water

- 5.8.1 Groundwater should be controlled in accordance with CIRIA report 113 "Control of Groundwater for Temporary Works".
- 5.8.2 Arrangements should be made to prevent ponding in any excavation "hollows"; the Contractor should ensure that ground levels are of sufficient gradient to enable the collection of surface water run-off in sumps or grips.
- 5.8.3 Pumping from over-excavated sumps may be required to maintain satisfactory working conditions.
- 5.8.4 The Contractor should make all necessary arrangements to prevent off-site migration of contaminated sediment via surface water run-off, and avoid any pollution of Chickenley Beck. This will necessitate the installation of surface water grips, and removal, sealing-off, or diversion of all redundant former site drains (and any land drains).
- 5.8.5 A Silt & Surface Water Management Plan (SSWMP) should be prepared by the Contractor, describing the mitigation measures that will be put in place to intercept direct run-off from any disturbed areas, stockpiles etc, thereby preventing any potential impact of adjacent land and nearby watercourses. Surface water run-off will probably require treatment (as a minimum to allow settlement of fines) prior to consented discharge.

- 5.8.6 Any potentially contaminated water should not be allowed to escape to other areas until the results of appropriate analysis are available and, if required, a suitable means of water treatment has been agreed.
- 5.8.7 Water collected in sumps should be passed through a series of oil/water separators to remove any oily contamination. Oils trapped in the absorbent medium should be disposed of to a suitably licensed landfill site.
- 5.8.8 Treated water should then be tankered off-site, or be discharged to sewer, subject to analytical results and local water treatment company consent.
- 5.8.9 Two of three samples of Ash & Clinker tested for leachability returned results for arsenic, chromium and water-soluble boron in excess of the relevant Tier 1 Screening Values and consequently, the Ash & Clinker could be considered to pose a potential risk to surface waters (Chickenley Beck).
- 5.8.10 Whilst there are a number of possible sources that could influence surface water quality in the surrounding area, it would be prudent to obtain up and down gradient surface water samples to provide a further line of evidence that this site is not contributing to any deterioration of surface water quality.
- 5.8.11 Whilst not readily soluble in water, dioxins & furans will attach to small particles of organic matter, plants and plankton. Organic matter, washed into surface waters, typically settles out into sediment and any sampling of the surface water should include up and down gradient kick samples to collect sediment.
- 5.8.12 Leachability should be considered during design of the development's drainage strategy.

5.9 Backfill of excavations (beyond line of highways)

- 5.9.1 Excavations should be backfilled as necessary to achieve the desired levels, with suitable materials and compacted in accordance with Lithos' Protocol for Placement of Non-Engineered General Fill; copy included in Appendix C.
- 5.9.2 However, where an excavation conflicts with the footprint of a proposed highway, compaction in accordance with the Specification for Highway Works will be required (see Section 5.11).
- 5.9.3 Trenches for services including site drainage and water supply should be cut over size in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.
- 5.9.4 The site surface should be initially left 1,000mm 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.
- 5.9.5 The anticipated backfill materials (predominantly Ash & Clinker) will require further geotechnical testing to determine their suitability for re-use. This should (ideally) be undertaken following excavation and stockpiling.
- 5.9.6 Excavated arisings will be inspected by Wordsworth Property's Site Manager, and any suspicious material or material yielding evidence of significant contamination (based on visual/olfactory observations), will be placed in temporary stockpiles from which an adequate number of samples will be taken (typically a minimum of 6 samples). The samples will be scheduled for an appropriate suite of contaminants in order to characterise the material and decide its fate.
- 5.9.7 Any material considered unsuitable for use as backfill will be exported from site (see Section 5.14).

5.10 Placement of a granular running layer

- 5.10.1 A minimum 200mm thickness of suitable granular fill (i.e. a “blanket” of 6F2) could be placed along the line of proposed haul roads to provide a firm and stable running layer for the subsequent construction works.

5.11 Highways

- 5.11.1 The natural soils (Area B, see Drawing 2986/9) present at shallow (anticipated formation) depth are predominantly Granular. Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published tables¹ indicate that the shallow deposits would be expected to provide a CBR value of at least 3%. This value should be verified prior to or during construction.
- 5.11.2 Whilst the CBR estimated above should be achievable, significant deterioration during/after periods of significant rainfall and/or site trafficking is likely. Consequently, it would be prudent to consider flexibility in the groundworks programme to enable highway construction during prolonged dry/warm weather (typically between April & September) when formation will be least vulnerable to deterioration. Alternatively, a minimum 200mm thickness of suitable granular fill (i.e. a “blanket” of 6F2) could be placed along the line of proposed highways to protect formation during the construction phase.
- 5.11.3 Where made ground is present (Area A, see Drawing 2986/9), the Contractor should consult the adopting authority regarding preparation of the ground beneath new highways (as outlined below, or in any proposed alternative specification) in advance of the works. The Contractor should also agree acceptable performance criteria, with the Engineer and the adopting authority.
- 5.11.4 However, it is considered that the following options would be suitable to enable the construction of the highways.
- 5.11.5 Made ground should be excavated from beneath new highway footprints to a maximum of depth of 2.0m - from existing ground level or proposed highway formation, whichever is the lower. Highways should then be raised to formation level, either with:
- Suitable aggregate placed & compacted in accordance with The Highways Agency Specification for Highway Works (SHW) Series 600, or
 - Suitable screened & selected site-won material, placed & compacted in accordance with SHW Series 600. Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, scrap metal, frozen & oversize material.
- 5.11.6 Some refinement of the above advice might be possible after highways design (with consideration of the proposed formation level cf existing ground level), and via inspection (and usually CBR testing) of the proposed formation during site preparatory groundworks.
- 5.11.7 Any residual made ground materials in the base of the excavation (i.e. in areas where the thickness of made ground exceeds 2m) should be inspected and (where necessary) any soft spots removed and replaced with suitable engineered fill.
- 5.11.8 Where excavation associated with ground improvement (e.g. turnover of made ground) beneath a highway results in sub-formation slopes greater than 1v:5h, the sub-formation should be stepped (max. 0.5m high) and benched (min. 1m wide). Where the excavation works exceed 1m in depth, the footprint of earthworks should be extended beyond the highway footprint a minimum of 1m, plus the depth of excavation. The Engineer will keep records of any such work undertaken.

¹ Interim Advice Note 73/06 Revision 1 (2009), Chapter 5. Characterisation of Materials Design Guidance for Road Pavement Foundations - Draft HD25

- 5.11.9 The suitability of site-won material for placement as engineered fill should be confirmed by field trials and geotechnical laboratory testing, which will yield the following information:
- Number of passes with the compaction plant (to be used during subsequent earthworks)
 - Maximum layer thickness (plant dependent)
 - Acceptance criteria: minimum dry density & moisture content range
- 5.11.10 The engineered fill should achieve at least 95% maximum dry density, with air voids comprising less than 10%, as determined by 2.5kg laboratory compaction tests.
- 5.11.11 Where the made ground is re-engineered in accordance with the above specification, it is considered that a CBR value of 5% should be achievable; however, this should be verified by field trials.
- 5.11.12 The Contractor should ensure that only suitable granular fill is placed within 450mm of estate road formation in order to protect cohesive sub-grade materials (including natural cohesive soils). Such fill should be placed in accordance with the Specification for Highway Works.
- 5.11.13 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. As a minimum this should comprise plate load tests, carried out to determine the CBR at formation level, at approximate 25m intervals. Test locations should be staggered across the width of the highway to ensure the whole highway area is assessed.

5.12 Boundary issues

- 5.12.1 Wordsworth Property's Designer should ensure that proposed levels tie in with the surrounding infrastructure, and ground levels of adjacent properties (after allowance for the placement of any required soil cover). Extra care and attention may be required to ensure that levels tie in to surrounding land following final design, earthworks and any levels regrade.
- 5.12.2 Advice should be sought from the Geoenvironmental Engineer if mobile contamination or redundant drains/utilities are encountered close to the site's boundaries.

5.13 Surveying

- 5.13.1 The Contractor should arrange for the following survey work as directed by Wordsworth Property's Site Manager:
- All setting out necessary to allow the works to proceed
 - Recording of the depth and lateral extent of all excavations
 - Recording the depth & extent of each excavation panel during turnover of made ground, prior to backfilling
 - Recording of natural ground levels, where natural ground encountered during the earthworks
 - Recording the final location of potentially combustible soils
 - Recording the locations and volumes of all stockpiles of suitable materials left on site for Wordsworth Property 's use during the development works
 - As-built survey of the finished surface on completion of the remediation contract
- 5.13.2 The Contractor should supply the results of this survey work to Wordsworth Property's Site Manager for inclusion in the Verification Report.

5.14 Export to landfill

- 5.14.1 Excavation arisings that are unsuitable for retention and re-use on site should be placed in temporary stockpiles on hardstand or polythene sheeting and be suitably covered to minimise the potential for dust/odour nuisance, and prevent surface water run-off.
- 5.14.2 Given the proximity of existing housing, and in order to avoid any potential dust/odour nuisance, stockpiles of material should be exported from site as soon as practically possible.
- 5.14.3 Any material exported from site to landfill should be hauled by a registered waste carrier in accordance with the requirements of the Waste Regulations 2011 and the Landfill (England & Wales) Regulations 2002.
- 5.14.4 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.
- 5.14.5 In order to protect the general public from dust and vapour emissions, wagons that are to be used for the haulage of the contaminated material from the site must be sheeted. In addition, the Contractor must ensure that no fluids seep from the wagons.
- 5.14.6 In order to provide the landfill facility with information regarding chemical composition of the waste, further analysis of any material that requires removal from site may be required.

Waste classification

- 5.14.7 Sampling and characterisation of stockpiled materials generated during the site preparatory works is likely to be required if off-site disposal is proposed.
- 5.14.8 It should be noted that the classification and assessment of waste soils under the Environment Agency's Technical Guidance WM3², is a complex process.
- 5.14.9 It is critical if material is to be exported from site that this is allocated an appropriate waste code, following the steps within WM3. Waste carriers transporting, and sites accepting, this material should have a corresponding code within their permits. It is the responsibility of those generating the waste (i.e. the site), to ensure that the waste is handled and disposed of appropriately.
- 5.14.10 With respect to **asbestos**, waste soils will be classed hazardous if the soil mass contains more than 0.1% asbestos fibres that are free and dispersed. However, WM3 states that where the waste contains identifiable pieces of asbestos (i.e. any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye), then the waste is hazardous if the concentration of asbestos in the pieces alone is 0.1%. If a stockpile of soil contained rare fragments of broken asbestos-cement sheeting, the whole stockpile would be classed as hazardous unless all the fragments could be picked-out (even though the concentration of asbestos in the soil mass might be orders of magnitude less than 0.1%).
- 5.14.11 Contractors exporting waste from the site should review the site investigation data and make their own assessment. Alternatively, Lithos could undertake this assessment once exported waste streams have been identified.

² Technical Guidance WM3 – Guidance on the classification and assessment of waste. Environment Agency 2015

5.15 Placement of soil cover

- 5.15.1 Clean inert soil will be placed over the **Ash & Clinker** in proposed garden and landscaped areas (but not beneath hardstanding). This cover layer is to comprise **1,000mm of "clean" Subsoil and Topsoil**.
- 5.15.2 **Site-won Topsoil** (including Made Ground Topsoil) should also be placed beneath clean cover, but at a slightly reduced depth of at least **600mm**. Consequently, the uppermost 600mm of soil cover must be "clean", but the lowermost 400mm could include site-won Topsoil/Made Ground Topsoil.
- 5.15.3 Where Made Ground Topsoil remains beneath proposed garden/landscaped areas (beneath at least 600mm clean soil cover), given the compressible nature and gas generating potential of this topsoil it must be overlain by no more than 1m of soil.
- 5.15.4 In Area B (west of the site) some gardens may be underlain by natural soils only, and where this is the case placement of 150mm of topsoil will suffice. Subject to the extent of earthworks regrade undertaken, and based on the proposed layout this is only likely to affect Plots 1 to 5.
- 5.15.5 If any garden is directly underlain by bedrock, placement of 450mm of subsoil/topsoil will be required (in accordance with NHBC Standards, Chapter 10.2).
- 5.15.6 Some subsoil suitable for use as cover material may be sourced on site, subject to the Engineer's approval. The Engineer will assess accessibility, suitability, the conceptual site model (most notably the creation of new pathways by which mobile contaminants could impact controlled waters), and engineering implications (for example, increased foundation depth) before allowing any excavation of in-situ natural soils for re-use as clean cover. However, there almost certainly also be a need for soil import
- 5.15.7 Topsoil and subsoil quality should be assessed in accordance with Lithos' Protocol for Importation & Use of Soil Cover (Capping), copied in Appendix D.
- 5.15.8 This Protocol includes chemical assessment criteria which should not be exceeded.
- 5.15.9 This work may be undertaken as part of the contract for the preparatory & remediation 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.

5.16 Topsoil placement

- 5.16.1 Prior to placement of topsoil, the underlying subsoil should be loosened by ripping or rotovating. Stones and other objects greater than 50mm should be removed from the prepared surface, and the loosened subsoil should be roughly levelled so that an even depth of topsoil can be achieved.
- 5.16.2 NHBC Conditions require garden areas to be provided with topsoil to a thickness of not less than 100mm. Topsoil thicknesses in excess of 400mm should generally be avoided.
- 5.16.3 For the loosening to be most effective, it should be undertaken when the subsoil is dry to the full depth of working.
- 5.16.4 Subsequent trafficking over the loosened subsoil should be minimised.
- 5.16.5 Topsoil should not be placed during or immediately after heavy rain.
- 5.16.6 An excavator with a toothed bucket should be used to load the topsoil from stockpile into dumpers, to prevent excessive smearing.

- 5.16.7 The dumper should tip the topsoil onto the receiving surface, and topsoil should then be spread to the required depth by an excavator. Both the dumper and excavator should avoid tracking over the placed topsoil.
- 5.16.8 After re-spreading topsoil, any large compacted lumps should be broken down to produce a fine tilth suitable for planting, turfing and seeding (< 10mm maximum aggregate size).

5.17 Hazardous gas protection

- 5.17.1 Based on the identified gas regime, the proposed foundation solutions, and with reference to the gas protection "scoring" system outlined in BS 8485:2015, the following protective measures have been recommended:

Charac. situation (Wilson & Card, '99)	Gas "score" req'd by BS8485	Protective measures		
		Floor slab (BS8485 "score")	Sub-floor ventilation (BS8485 "score")	Membrane Type (BS8485 score")
2	3.5	Select one from: Block & Beam – (0). Reinforced ground bearing slab – (0.5). Reinforced, cast in-situ suspended slab (with minimal and suitably sealed service penetrations & joints) – (1.5). Reinforced ground bearing raft (with limited service penetrations cast into slab). Note: the venting area through any downstand beam should be 3 times greater than that provided by the side ventilation (air bricks) – (1.5).	Select one from: Passive sub-floor ventilation; venting layer could be: A min. 150mm clear void (2.5), or A proprietary void former providing an equivalent clear void depth of 60mm; see Section B7 in BS8485 (2.5), or Min. 300mm thick blanket of min. 20mm single size rounded or sub-angular gravel (1.0). Min. ventilation = 1,500 mm²/m run of external wall (via air bricks on each of 2 opposite sides), with 100mm pipes at 1.75m centres or honeycombing of any sub-floor sleeper walls.	Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; • a minimum 0.4 mm thickness (1600g polyethylene) reinforced membrane (virgin polymer); and • verified in accordance with CIRIA C735[∞] (2.0)

Footnotes:

- [∞] In accordance with CIRIA C735, a Verification Plan should be prepared which outlines the activities (inspection and testing), the relevant personnel, and the type of records to be collected. Gas membranes need to be visually inspected to establish possible damage. For CS3 sites inspection & verification should be carried out by an independent third party. However, whilst conflicts of interest in verification should be avoided, the Developer's staff on site could undertake inspection & verification on CS2 sites. In all circumstances, the verifier should be competent, experienced and suitably trained.
- Building Type A is defined in Table 3 and Section 7 of BS8485:2015+A1:2019 as: private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Examples include private housing and some retail premises
 - A combination of two or more of the three types of protection measures (slab, ventilation & membrane) should be used to achieve the BS8485 score.
 - The membrane should always be lapped and sealed in accordance with BRE\Environment Agency Report BR 414 (2001) – "Protective Measures for housing on gas-contaminated land". The membrane should be continuous across internal walls & the cavity, and there should be a cavity tray in external walls.
 - In all cases there should be minimum penetration of floor slab by services; any penetrations should be suitably sealed.

- 5.17.2 In order to ensure the effectiveness of gas protective measures, workmanship should be carried out by appropriately trained and qualified personnel.
- 5.17.3 In accordance with recent YALPAG guidance³, a detailed verification method statement should be issued to Kirklees Council in advance of the construction phase. This should address how the gas protection measures will be installed and what verification information will be provided to demonstrate the installation has been carried out in accordance with the appropriate guidance.
- 5.17.4 As a minimum the report should include (but not be limited to):
- A summary of the gas risk assessment.
 - The gas protection measures proposed and confirmation they will meet the gas protection requirements for the lifetime of the development.
 - Technical drawings showing how the gas protection measures will be incorporated.
 - Formal qualifications/experience/training of the person carrying out the installation.
 - Formal qualifications/experience/training of the person carrying out the verification.
 - Clear demonstration of the independence of the person carrying out the verification.
 - The manufacturer's specification of the gas protection membrane to be used.
 - Full details of what the verification process will comprise and at what stage verification will be carried out.
 - Details of how any non-conformance will be dealt with.
 - Details of the number of plots to be validated.
 - Timeline of when during the build, each of the gas protection measures will be installed.
 - Details of management measures proposed to ensure how damage to the membrane will be prevented prior to the floor being installed, post installation.
 - Details of how all site personnel (including follow-on trades) will be made aware of the presence of the membrane and that damage to the membrane must be prevented.
 - Details of the extent of overlap and method of sealing.
- 5.17.5 BRE/Environment Agency Report BR 414 (2001) – "Protective Measures for housing on gas-contaminated land" provides a practical guide to good practice for the detailing and construction of passive soil gas protection measures for new residential development. Of particular relevance are a list of 'Watchpoints', which offer practical information for installation and buildability.
- 5.17.6 Designers/Architects should be made aware of the importance of gas protection measures, and their house designs should take account of potential constraints associated with Building Regulations (most notably those relating to access thresholds, noise and insulation), flood mitigation measures, and utility providers (external meter boxes may have to be located away from air bricks) etc.

5.18 Trees & root protection zones

- 5.18.1 Wordsworth Property will need to appoint an Arboriculturist to provide a Method Statement that sets out measures to avoid tree damage whilst undertaking the works outlined in this Remediation Strategy. The Arboriculturist will also need to provide a Tree Protection Plan and attend site as/when necessary.
- 5.18.2 The following general comments relating to tree and root protection are provided for general guidance and further advice should be sought from a Arboriculturist.

³ Verification Requirements for Gas Protection Systems - Technical Guidance for Developers, Landowners and Consultants. Yorkshire and Lincolnshire Pollution Advisory Group, December 2016.

- 5.18.3 Any trees currently under a preservation order should be identified and agreed with relevant authorities prior to the commencement of the works. All trees subject to a TPO should be clearly identified and protected by fencing in accordance with BS5837:2012⁴.
- 5.18.4 Before work of any kind begins, the Site Manager and Arboriculturist should meet on site to discuss the construction methodology, identify and resolve any difficulties relating to tree protection requirements, and mark out fence lines and ground protection areas.

Tree protection

- 5.18.5 Trees including the ground containing their roots require protection against impact, soil stripping, soil compaction and other forms of damage arising from remediation and construction activity. To avoid damage, adequate tree protection is essential.
- 5.18.6 After tree works are complete, and before any other work begins, 2m high metal weld mesh fencing should be erected in locations shown on a Tree Protection Plan to be provided by the Arboriculturist.
- 5.18.7 Feet should be firmly pegged to the ground and panels bolted together. Fencing should be fully braced with scaffolding on the tree side to prevent movement in accordance with BS5837:2012.
- 5.18.8 Pre-printed laminated A4 notices are to be attached to the site side of each panel stating "**CONSTRUCTION EXCLUSION ZONE – NO ACCESS**".
- 5.18.9 The Arboriculturist should inspect the fencing after erection, to check location and adequacy of protection.
- 5.18.10 The Arboriculturist should provide the Council with written notice of the completion of tree protection fencing at least 7 days before site works recommence.
- 5.18.11 For the avoidance of doubt, fencing should remain in situ and be maintained in an effective condition, until all building works are complete.
- 5.18.12 The Site Manager should undertake daily checks of the tree protection fencing to ensure that it is maintained in an effective and serviceable condition, and to ensure that any defects are immediately rectified.

Removal of Tree Protection fencing

- 5.18.13 Once satisfied that the site is free from construction activity, the Arboriculturist should issue written instructions for the removal (by hand) of the tree protection fencing.
- 5.18.14 The edges of soil spread outside root protection areas should be married-in by hand, under arboricultural supervision using landscaper rakes, with existing ground level inside root protection areas, ensuring that the levels inside the latter are not raised or lowered.
- 5.18.15 Cultivation for seeding, turf laying and planting inside root protection areas should be carried out by hand under arboricultural supervision using a pedestrian rotovator to a maximum depth of 100 mm taking care to avoid root damage.

5.19 Site regrade & import of fill

- 5.19.1 A clean cover of 1,000mm is required to isolate the Ash & Clinker from potential ignition sources and also to break contaminant pathways to end users. Given the sloping nature of the site, some regrade of site levels is also anticipated to enable the proposed construction.

⁴ BS5837 (2012) - *Trees in relation to design, demolition and construction – Recommendations*.

- 5.19.2 This will require the import and placement of naturally occurring, geotechnically suitable materials from a donor site(s).
- 5.19.3 However, topsoil first needs to be stripped; see Section 5.2.
- 5.19.4 To minimise this import volume, site won natural soils (Cohesive Residual Soils) should be used wherever possible.
- 5.19.5 The appointed Contractor should undertake their own modelling exercise to confirm quantities for tendering/construction purposes.
- 5.19.6 Importation of soil for use as bulk fill will need to comply with Lithos' **Protocol** included in Appendix D. This Protocol requires that only clean, naturally occurring soils be imported from donor site(s) and that such soils shall have been tested at source for a specified suite of determinants and at a specified frequency, with results compared against the acceptance criteria stated in the Protocol.

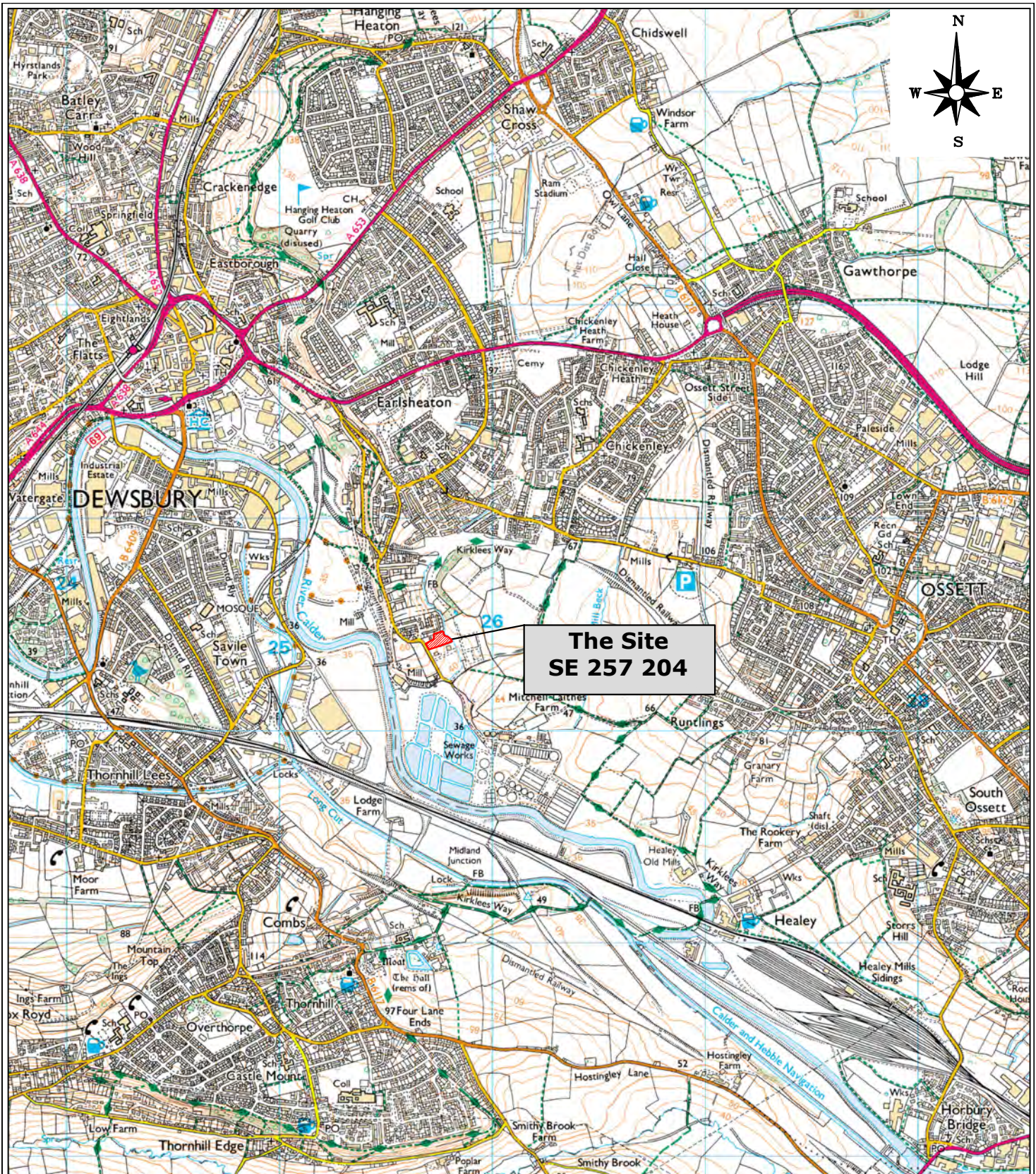
5.20 Management of unknowns

- 5.20.1 Whilst extensive ground investigation has been undertaken across the site some uncertainties remain. It is highly unlikely that even with further intensive phases of ground investigation, these uncertainties would be addressed.
- 5.20.2 The remediation tasks detailed below should provide a framework for addressing uncertainties as these arise.
- 5.20.3 Uncertainties include the **heterogeneity** of made ground and **suitability** for use as engineered fill – it has been assumed that the bulk of Ash & Clinker can be processed and reused as engineered fill. This is supported by shallow trial pits, but detailed material description in boreholes is not possible and as such a provision for off-site disposal of some made ground should be included.
- 5.20.4 Area A is a former tip, probably associated with placement of material, in the late 1800s to early 1900s, above original ground (rather than as backfill to a former pit/quarry) to reduce the slope down to Chickenley Beck. Consequently, difficulties unrelated to ground should be anticipated if development is proposed in Area A.
- 5.20.5 As the tip does not have an active waste disposal permit, excavation and replacement of material is likely to be considered as remediation activity and covered by the deployment of a mobile treatment permit, regulated by the Environment Agency.
- 5.20.6 A robust materials management plan and strategy to mitigate nuisance to surrounding land users would be required to support the necessary permit required to undertake any remediation works.
- 5.20.7 Wordsworth Property Group will be purchasing this site with knowledge of the former old tip. It is Lithos' understanding that Wordsworth Property could be liable, under Part IIA of the Environmental Protection Act 1990, for any pollution associated with the migration of contaminants from this old tip. Therefore, specialist legal advice should be sought prior to making an unconditional offer for the site.
- 5.20.8 However, Part IIA is a 'last resort' where significant risk exists and is considered unlikely here. If a leachate release to waters were to occur, it would be considered an offence under Environmental Permitting Regulations 2010, and likely result in enforcement or even a works notice, with onus on landowner to investigate and mitigate. Consequently, whilst the old tip is considered unlikely to pose a risk to the proposed residential development, careful consideration should be given at the earliest opportunity to restoration, ongoing maintenance, and appropriate uses of this area.

- 5.20.9 Whilst there are a number of possible sources that could influence surface water quality in the surrounding area, it would be prudent to obtain up and down gradient surface water samples to provide a further line of evidence that this site is not contributing to any deterioration of surface water quality.

APPENDIX A

DRAWINGS



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CLIENT

BRITOLGY LTD

JOB TITLE

LONG LANE,
EARLSHEATON

DRAWING TITLE

SITE LOCATION
PLAN

DRAWN

GLM

DATE

23/08/2019

CHECKED

ASw

DATE

23/08/2018

STATUS

FOR COMMENT ☐

DRAFT ☐

FOR APPROVAL ☐

FINAL ☒

SCALE

1:25 000

SHEET

A4

DRAWING NO.

2986/1

REVISION



BCP BIN COLLECTION POINT

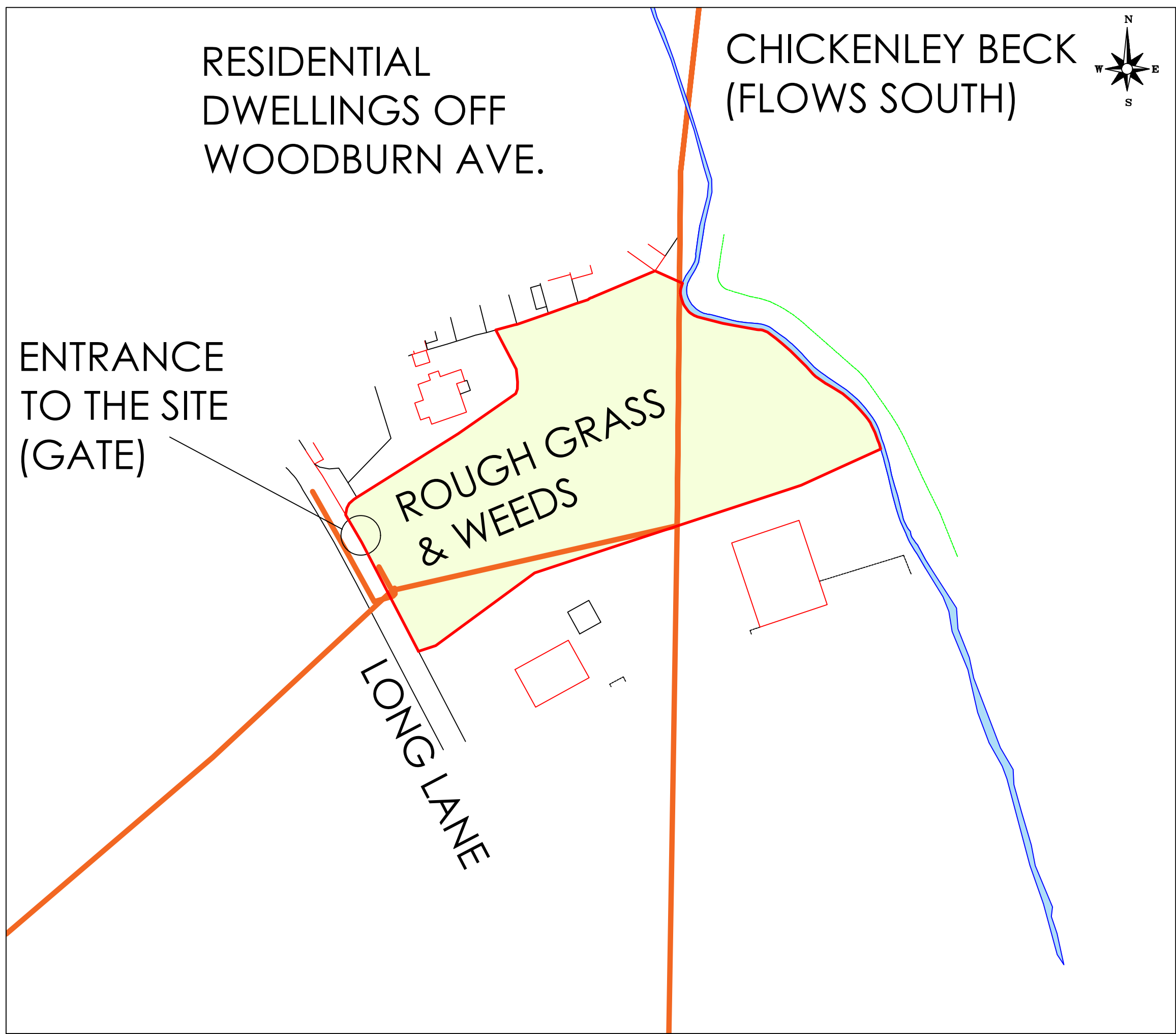
Indicative schedule of accommodation
17 x Type C: 3 Bed House @ 92m2(1001sqft)
3 x Type E: 3 Bed House @ 92m2(1001sqft)
6 x Type QH: 2 Bedroom @ 61.5m2 (661sqft)
Total 26 Units

Notes:
Unless indicated, this drawing is for information only.
Do not scale, use figured dimensions only.
All dimensions to be checked on site

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Project: **LONG LANE**
Earlsheaton, Dewsbury
Drawing Title: Proposed Site Plan
Scale: As shown
Drwg. Created: 28.02.2024

Drwg. No:	0389_LON_103
Status:	Planning (*)
Revision:	C



CHICKENLEY BECK
(FLOWS SOUTH)

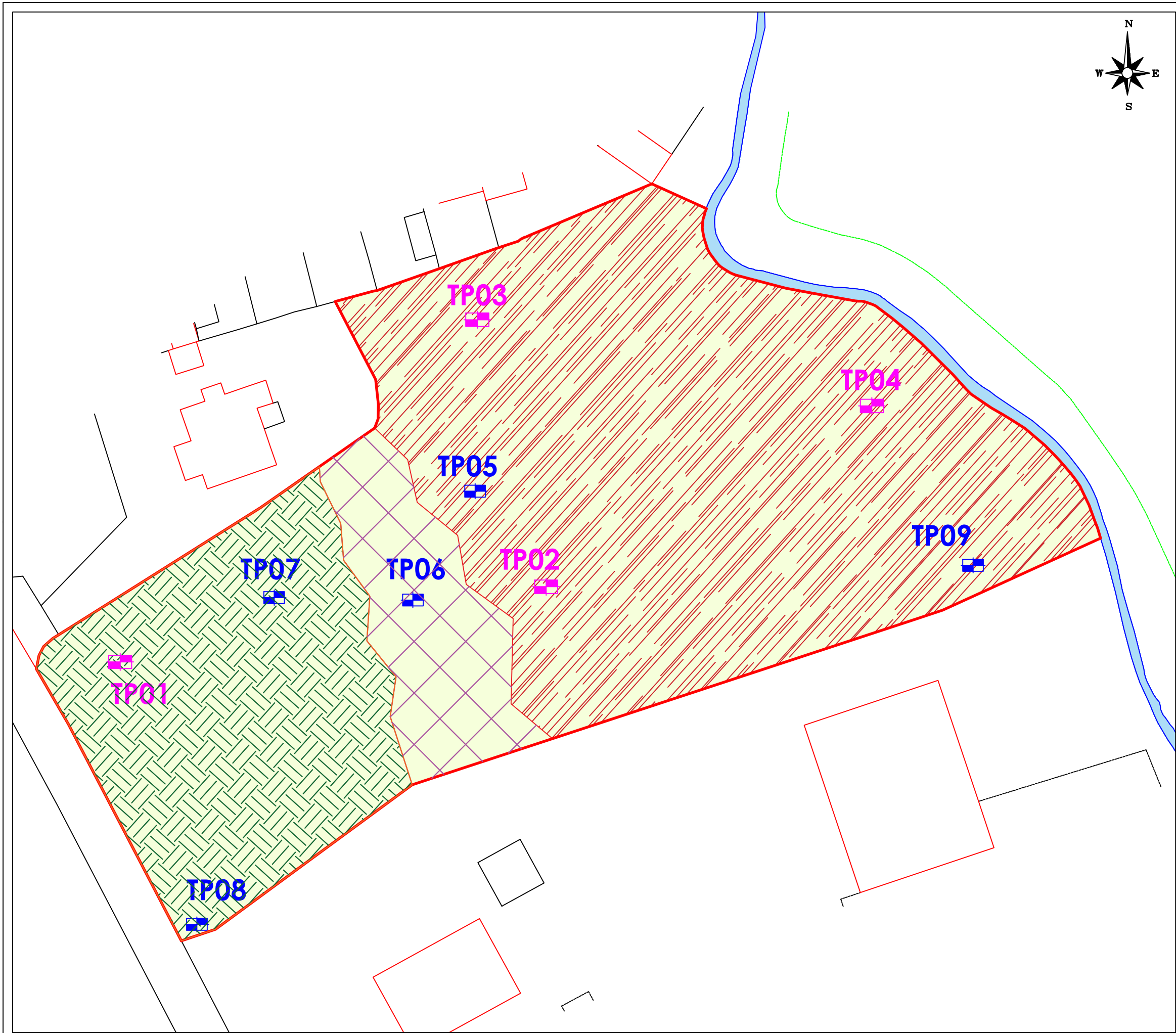


NOTES		
	GRASS & OVERGROWN AREAS	
	WATERCOURSE	
	LINE OF OVERHEAD ELECTRICAL UTILITY	
	APPROXIMATE SITE BOUNDARY	
REV.	DESCRIPTION	DATE



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CLIENT			
BRITOLOGY LTD			
JOB TITLE			
LONG LANE, EARLSHEATON			
DRAWING TITLE			
SITE FEATURES			
DRAWN	GLM	DATE	30/08/2018
CHECKED	ASw	DATE	30/08/2018
STATUS		FOR COMMENT	
		FOR APPROVAL	
		DRAFT	
		FINAL	
SCALE	1:1,000	SHEET	A3
DRAWING NO.	2986/3	REVISION	



NOTES		
	TRIAL PIT LOCATION	
	SOAKAWAY TEST LOCATION	
	FOOTPRINT OF FORMER TIP (ASH & CLINKER) WITH TOTAL MADE GROUND TO >1,000mm; CORRESPONDS TO AREA A	
	FOOTPRINT OF FORMER TIP (ASH & CLINKER) WITH TOTAL MADE GROUND TO <1,000mm; CORRESPONDS TO AREA A	
	AREA BEYOND FOOTPRINT OF FORMER TIP. CORRESPONDS TO AREA B	
	APPROXIMATE SITE BOUNDARY	
REV.	DESCRIPTION	DATE



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CLIENT

BRITOLGY LTD

JOB TITLE

LONG LANE,
EARLSHEATON

DRAWING TITLE

GROUND CONDITIONS & SITE AREAS

DRAWN	GLM	DATE	01/10/2018	STATUS	FOR COMMENT	☐
CHECKED	ASw	DATE	01/10/2018	FOR APPROVAL	DRAFT	☐
				FINAL		☒
SCALE	1:500	SHEET	A3	DRAWING NO.	2986/9	REVISION



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Status Preliminary			
No.	Revision	Date	Drwn

Key:

- Denotes Depth of fill
- Denotes Depth of cut

Site Strip - Total Site Area = 5907m² x 0.15m = 886m³ to be reused on gardens/landscapings where suitable

Formation Build Ups
150mm Landscaping
200mm Footway
500mm Carriageway Build Up
400mm Buildings
380mm Private Drive

4109m³ of fill to be imported on site or won from arisings

Cut/Fill Summary

Name	Cut	Partial	Fill	Partial	2d Area	Cut	Partial	Fill	Partial
Volume	1,190	1,000	5907	5907	5907	1425.275	0.0	1178.195	0.0
Volume	1,190	1,000	5907	5907	5907	1425.275	0.0	1178.195	0.0



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CLIENT
WORDSWORTH PROPERTIES

PROJECT
LONG LANE

DRAWING TITLE
Proposed Earthworks

Drawn	RT	Chkd	AD	Date	JAN 24	Scale	1/250
Sheet Size	A1	Drawing No.	23590-DR-C-0601	Revision			P1

APPENDIX B
LITHOS TIER 1 VALUES

Soil screening values used by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 and 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 and 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software Handbook, Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

In December 2013 Defra published the results of research project SP1010 – Development of Category 4 Screening Levels (C4SLs) for Assessment of Land Affected by Contamination. The objective of this project was to provide technical guidance in support of Defra's revised Statutory Guidance for Part 2 A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- Demonstration of the methodology, via derivation of C4SLs for 6 substances – arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene.

The methodology for deriving both the previous Soil Guideline Values and the Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of C4SLs has been achieved by modifying the toxicological and/or exposure parameters used within CLEA (while maintaining current exposure parameters).

The Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Lithos consider C4SLs to be suitable for use as Tier 1 Screening Values. Lithos have discussed this matter with both NHBC and YALPAG (collection of Yorkshire & Lincolnshire local authorities) and received confirmation that they are satisfied with this approach.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). However, many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with revised, lower screening values may be required. Other CLEA default characteristics adopted by Lithos are:

Sandy Loam characteristics (source)	Default values adopted
Total porosity (fraction)	0.53
Water filled porosity (fraction)	0.33
Air filled porosity (fraction)	0.2

Lithos have derived Screening Values for five different CSMs (scenarios); these are:

- A - Residential with gardens, but no cover (or only up to 300mm)
- B - Residential with gardens and 600mm 'clean' cover
- C - Residential apartments with landscaping (i.e. no home grown produce)
- D - Commercial/industrial with landscaping
- E – Importation of soil cover

The **exposure** pathways considered for each scenario are detailed in the table below.

Scenario	Land use	Pathways	Justification
A	Residential with garden, but no cover (or only up to 300mm)	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant.
B	Residential with garden minimum 600mm cover	• Inhalation of indoor vapours • Inhalation of outdoor vapours	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.
D	Commercial/ industrial with landscaped areas no cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.
E	Importation of soil for cover in garden and landscaped areas	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of outdoor vapours and dust	Material used as cover to break existing pathways therefore all direct and indirect pathways relevant; however cover is not placed below plots therefore indoor inhalation is not relevant.

Lithos have assumed the source of contamination is directly below the building foundations; i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default.

Lithos have derived Tier 1 values for a number of inorganic and organic determinands in the context of the five Scenarios A to E. The Tier 1 values are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part 2A of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; and
- Controlled waters

04A - Contamination analysis & interpretation (including WAC)

Generic notes – geoenvironmental investigations



Inorganic Tier 1 values for scenarios A to E

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen" If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			4,000		4,000	28,767	4,000	Assumes Cr is CrIII
Pb	450	200	200		314	2,330	200	C4SL adopted
Ni	130		109		123	892	109	Assessment of health risk only
Se	350		434		596	13,018	434	
Hg	170		199		244	3,603	199	Assumes in an inorganic compound
Vn			584		586	4,994	584	
B			5		5	5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu			100		100	100	100	
Zn			200		200	200	200	

Organic Tier 1 values for scenarios A to E

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.7	<1^	<1^	63	<1	<1 based on professional judgement and lower than calculated value.
Toluene	610		836	2,048	1,912	5,000	<1	Scenario D based on professional judgement and lower than calculated value.
Ethyl Benzene	350		379	592	566	5,000	<10	Scenario E based on professional judgement and lower than calculated value.
Xylenes	240		535	590	585	5,000	<10	Scenario E based on professional judgement and lower than calculated value.
Phenol	420		1,434	3,360	2,264	5,000	<10	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5	76	5	C4SL adopted. Scenario B 5 times scenario A
Naphthalene			6	6	6	619	<10	Scenario E based on professional judgement and lower than calculated value
Gasoline Range Organics			22	23	23	2,178	626	See 3-step assessment of TPH below ^Based on professional judgement and lower than calculated value
Diesel Range Organics			215	218	215	^5,000	1429	
Lubricating Range Org			3,299	5,000	3,829	^5,000	3,299	

* For a residential end use

The significance of PAHs can be determined by considering indicator compounds. In most cases benzo(a)pyrene (BaP) is adopted as an indicator due to the amount of toxicological data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. A surrogate marker approach can be used to estimate the toxicity of a mixture of PAHs in soil using toxicity data for individual indicator compounds within that mixture. Exposure to the surrogate marker is assumed to represent exposure to all PAHs in that matrix. The surrogate marker approach relies on a number of assumptions:

- Surrogate marker (BaP) must be present in all soil samples
- Profile of the different PAH relative to BaP should be similar in all samples
- PAH profile in the soil samples should be similar to that used in the pivotal toxicity study¹

To assess the PAH profile in a soil sample, the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated. The ratio relative to BaP should lie within an order of magnitude above and below the mean ratio to BaP.

Naphthalene should also be considered separately against its generic screen. Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than most other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach.

Similarly, TPH cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the bandings.

¹ SP1010 Appendix E, Provisional C4SLs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

The significance of speciated TPH results can be assessed by following the 3 steps outlined in the tables below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, naphthalene, benzo(a)pyrene above their respective Tier 1 values?	Yes	Remediation or dQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	Remediation or dQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	Remediation or dQRA required
	No	TPH compounds pose no significant risk

The equation used to assess cumulative effects in step 3 is shown below.

$$HI = \sum_{F_i=1}^{16} HQ F_i = \frac{\text{Measured concentration } F_i \text{ (mg kg}^{-1}\text{)}}{SGV F_i \text{ (mg kg}^{-1}\text{)}}$$

where

HI	=	Hazard Index
HQ	=	Hazard Quotient
F _i	=	Fraction _i
SGV	=	Soil Guideline Value

Statistical Assessment

Current UK guidance is provided by CL:AIRE², and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by **heterogenous made ground**, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 values).

The CL:AIRE (2020) guidance replaces the withdrawn "Guidance on Comparing Soil Contamination Data with a Critical Concentration" (2008).

The old approach to statistical analysis was based on a definitive yes/no answer which required limited consideration of the dataset and Conceptual Site Model, it was widely accepted that this did not allow sites or risk to be adequately assessed. The updated approach requires a comprehensive understanding of the datasets within the context of the Conceptual Site Model.

The current guidance requires that:

- A robust CSM is in place which identifies source areas, averaging areas and averaging zones
- Sampling locations are relatively evenly spread across the site and were selected using simple or stratified random sampling with no targeting being undertaken
- The field data and CSM do not suggest the presence of a hotspot of contamination which should be treated as a separate zone
- The samples are all taken from a similar same depth and within the same material type across the zone being assessed
- A minimum of 10 samples have been taken. It should be appreciated that confidence in a dataset increases as the number of samples obtained and tested from a zone increases.

The statistical analysis assumes a homogenous distribution of strata and contamination and therefore the dataset will be normally distributed (symmetric, log symmetric or fat tailed).

The normally distributed dataset is assessed using a number of statistical tools to generate a Dot and Box Plot which includes summary statistics and confidence intervals. The review of statistical data enables the assessor to make a decision, with an associated level of confidence, where the true mean of the sample population lies in relation to the critical concentration.

It is essential when using statistics to assess sample data that all decisions relate back to the conceptual site model. Statistics cannot indicate if contamination on a site is likely to present a risk to the end user, this is the role of the 'competent person' i.e. Lithos.

However, broadly speaking the following applies:

- Mean and UCL below the critical concentration – no further assessment required.
- Mean below the critical concentration, but UCL above – consider the CSM and likely sources.
- Mean and UCL above the critical concentration – further assessment required, remediation likely depending on the CSM.
- LCL, Mean & UCL above the critical concentration – further assessment required, remediation likely.

² CL:AIRE, 2020. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.

Other screening values used by Lithos

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents (and further information is presented in Generic Note No. 5 – Hazardous Gas):

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2015 – Code of Practice for the characterisation & remediation from ground gas in affected developments

With respect to the assessment of potential **phytotoxic effects** of contaminants, Lithos refer to The Sewage Sludge in Agriculture: Code of Practice 2018 for copper and zinc (at pH 5.5 to 6.0). The CLEA derived Tier 1 value is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that: "In general ... it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn".

Tier 1 **groundwater risk assessments** are always site specific and compare leachate or groundwater concentrations with the appropriate water quality standard based on the CSM and consideration of relevant water quality impacts and assessments.

Waste classification & WAC

In the context of waste soils generated by remediation and/or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics)
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds)
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds)

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

Landfill operators require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Lithos typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc. If off-site disposal of soils classified as hazardous waste during redevelopment is anticipated, then WAC analysis should be scheduled at an early stage in the remediation programme. However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous, and these contaminants can often be dealt with by alternative technologies (e.g. by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

APPENDIX C
LITHOS PROTOCOL FOR THE PLACEMENT OF NON-ENGINEERED FILL

1 INTRODUCTION

- 1.1 This protocol is aimed at providing general guidance to contractors in the placement of general earthworks fill materials in areas of a site that do not require high quality, controlled engineering eg Public Open Space. No guarantee can be made as to the degree of settlement that may occur in such fill masses; however, the protocol should mitigate significant differential settlements.
- 1.2 General fill will be either inert soil or contaminated soil that is deemed chemically suitable for reuse in certain specific site areas or beneath a specified 'clean' soil cover layer. All soft and compressible soils or existing fill shall, if comprising unsuitable fill be removed from site. Suitable fill materials may be compacted on site.
- 1.3 Unsuitable fill shall comprise:
 - Cohesive soils having a liquid limit in excess of 90% or Plasticity Index in excess of 65%
 - Chalk having a fine fraction (<400µm) in excess of 10% at the borrow pit
 - Any material containing topsoil, wood, peat or lignite
 - Any material containing biodegradables
 - Any material containing scrap metal
 - Frozen or waterlogged substances
 - Material defined as unsuitable by the Engineer because of its type or level of contamination
 - Material which, by virtue of its particle size or shape, cannot be properly and effectively compacted (eg oversize material, gravels which are tabular and some slate wastes)
 - Expansive steel slag
 - Non-inert or contaminated material
 - Putrescible waste
 - Materials containing minerals hostile to the built environment such as pyritic shales, gypsiferous clays, burnt colliery discard, pulverised fuel ash, spent oil shale or incinerator waste
- 1.4 The base of the area to be filled shall be proof rolled with a dead weight roller and all soft materials removed and replaced with compacted fill. Where unsuitable material has been excavated, the underlying ground shall be compacted to the same specification as adopted for subsequent compaction works.
- 1.5 Fill shall be placed and compacted in near-horizontal layers of maximum 200mm thicknesses and be brought up at a uniform rate so that all parts of the site or particular sections of the site reach finished (formation) level at the same time. Each layer will be subjected to nominal compaction, comprising at least two passes with a towed vibratory roller of at least 2,900 kg per metre width (or equivalent). If the compacted fill demonstrates excessive rutting, excessive roller 'bow-waving' or other soft behaviour then it shall be deemed unsuitable.
- 1.6 Cobbles, boulders, rock or waste fragments, the largest dimension of which is greater than two-thirds of the compacted layer thickness (or greater than 250mm in any dimension), shall not be incorporated into the fill.
- 1.7 When compacting fill in the vicinity of existing trenches, excavations, retaining walls or other structures all work shall be performed in such a way as to ensure that their existing stability is not impaired; this will require careful selection of both compaction plant and compaction method.

-
- 1.8 When placing fill against structures the Contractor must only use only the following types of compaction plant for fill within 2m of a structure:
- Vibratory roller, mass per metre width of roll not exceeding 1300 kg and total mass not exceeding 1000 kg
 - Vibrating plate compactor, mass not exceeding 1000 kg
 - Vibro-tamper, mass not exceeding 75 kg
- 1.9 If weather conditions are such that the fill is adversely affected, the Contractor shall cease work until such time as the fill can be placed and compacted to meet the protocol requirements. No fill shall be placed and left uncompacted at the end of the working day. Compacted fill shall be graded to falls to ensure free run-off of rainwater without ponding.
- 1.10 Drainage grips or trenches shall be excavated, as necessary, uphill of the area to be filled to prevent the area becoming flooded. Drainage shall be affected without causing siltation or erosion and water shall be disposed of. The area to be filled shall be graded to falls, and sump pumping or other suitable dewatering facilities shall be provided as necessary by the Contractor to keep the base of the excavation dry at all times.

APPENDIX D
LITHOS PROTOCOL FOR IMPORTATION & USE OF SOIL COVER (CAPPING)

1 INTRODUCTION

- 1.1 Isolation of made ground in garden and landscaped areas beneath a cover of “clean” subsoil, and topsoil is often recommended on new developments; most notably when the made ground contains inorganic (and non-volatile organic) contaminants at concentrations above relevant 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.
- 1.2 The thickness of cover is dependent on the end use of the development, nature and degree of contamination (and sometimes the Local Authority whose area the site lies within), Typically for a commercial development between 300mm and 1,000mm thickness is required and for a residential development between 600mm and 1,000mm thickness is required. Regardless of the type of development, where contamination is more significant a granular hard-dig layer or geotextile marker membrane may also be required at the base of the cover.
- 1.3 The “clean” soil cover blocks potential linkages between the contaminated made ground and future site users. Soil cover is not required beneath areas of hardcover including buildings, private drives, carparking and roads.
- 1.4 If the made ground is essentially “clean”, but contains materials generally considered undesirable as near-surface material in garden and landscaped areas (e.g. oversize materials such as construction/demolition rubble) then placement of cover is also required. In private gardens, in accordance with NHBC Standards Chapter 10.2, a 450mm thick soil cover should be adequate. In landscaped areas a 300mm thick soil cover should be adequate. For both gardens and landscaped areas if the made ground is essentially “clean” and comprises reworked natural soil, the only cover likely to be required is 100mm topsoil.
- 1.5 The **CML initiative** came into force in April 2003 and relates specifically to residential developments. It requires housebuilders to submit to NHBC (or other warranty providers) a validation report confirming the thickness and quality (i.e. contaminant-free) of the placed soil cover. Validation reports should normally be prepared by independent geoenvironmental consultants.
- 1.6 Failure to submit cover validation reports promptly will delay issue of the cover note by the warranty provider, which will subsequently delay the release of mortgage funds and hence legal completion; i.e. the financial implications are significant. Consequently, it is essential that cover validation is requested at least 2 weeks prior to the anticipated finishing date.
- 1.7 For all land uses 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.
- 1.8 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, where relevant, without compromising the DPC and any sub-floor ventilation.
- 1.9 Ideally soil quality should initially be determined by sampling of the source (at least 7 working days before importation to the development site) to demonstrate suitability for use. Further sampling of the material at the site may also be required to demonstrate cross contamination did not occur during the importation process. Samples could also be obtained from stockpiles of site won material on site; there may comprise surplus natural ground development arisings. Soil samples could be obtained after placement of the cover layer, but this is not recommended.

- 1.10 Imported topsoil should be subject to testing, unless it is being sourced from a reputable commercial supplier able to provide robust certification (certificate date less than 2 months prior to import date). In addition, some analysis in accordance with BS3882 may occasionally be appropriate.
- 1.11 Where sampling of the source has been carried out, and on receipt of the laboratory results, Lithos will issue a confirmation of soil suitability for importation to the client, who will in turn instruct his contractor to commence importation.
- 1.12 Clearly, if soil cover is imported and placed before confirmation of its suitability, no guarantee can be given that validation work will yield the desired results. It may therefore be necessary to excavate and export the placed soil cover and/or import further "clean" soil.
- 1.13 It is likely that it will be necessary to stockpile imported soil cover material at the site. Where soils have been confirmed as suitable for use and temporarily stockpiled on site, stockpiles should be fenced-off and marked as containing certified topsoil/subsoil. The soil should be inspected prior to placement to confirm that it is the same material as previously tested, and that it has not been cross-contaminated with miscellaneous arisings generated during the construction works. Where material has been stockpiled on site for an extensive period of time further sampling may be required at the development site to demonstrate cross contamination has not taken place.
- 1.14 Soil **thickness** can only be checked after placement; this should be done before turfing / landscaping, but ideally after scaffolding has been dismantled.
- 1.15 **Sampling Frequency (to check Soil Quality):** The number of samples tested will be dependent on the nature of the source, and the quantity of material to be imported. However, in accordance with current YALPAG (Yorkshire & Lincolnshire Pollution Advisory Group) guidance¹, the testing frequency should be as follows:

Nature of source	Number of samples (from any single source material)	
	Up to 500m ³	Per additional 500m ³
Greenfield	At least 3 [#]	1 [*]
Brownfield	At least 6 [#]	1 [*]
Crushed product	At least 3	1 [*]

* To be agreed with the relevant Local Authority

But could be up to 10 samples (if 500m³), depending on the Local Authority area within which the site is located.

- 1.16 On a typical residential development where gardens comprise a total area of 100m² (front and rear), and a soil cover thickness of 600mm including 100mm topsoil, for a brownfield source this testing frequency equates to approximately one topsoil sample per ten plots and one subsoil sample per two plots. Given the requirement to test a minimum number of samples from any one source, the testing frequency effectively increases for sites with only a small number of plots.

¹ Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners & Consultants; Version 4.1, June 2021.

1.17 **Inspection Frequency (to check soil thickness):** The number of inspection pits excavated to check cover thickness (and collect samples, if required) should be dependent on the end use of the development.

1.18 For **residential developments** the number of plots associated with a given site will dictate the number of inspection pits. The following frequencies are recommended for residential plots.

No. plots within development	Frequency of inspection pits	Remarks
1 to 5	1 pit per plot	e.g. for 3 plots, dig 3 inspection pits
6 to 20	1 pit per 2 plots	e.g. for 9 plots, dig 5 inspection pits
21 to 30	1 pit per 3 plots	e.g. for 23 plots, dig 8 inspection pits
≥ 30	1 pit per 4 plots	e.g. for 39 plots, dig 10 inspection pits

1.19 For **areas of landscaping**, regardless of development type, a minimum of 3 pits per area of soft landscaping are recommended where the landscaped area is greater than 25m². In individual landscaped areas smaller than 25m² inspection pits are not required.

1.20 Photographs should be taken of each inspection pit to show:

- The thickness of cover material present
- The presence of any geotextile marker or granular hard-dig layer (if required)
- The position of each inspection pit in relation to the plot/area of landscaping

1.21 **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.

1.22 The soil material should comply with the following requirements:

- Be clean and free of foreign debris, building waste materials, glass sharps, and 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 75mm 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)

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

1.24 Additional determinands may be scheduled dependent on the history of the source site, although if this is considered necessary it may suggest the material is unlikely to be suitable for use as clean cover.

Table 1 – Test schedule

Source	Test schedule
Greenfield & Manufactured topsoil	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC & speciated PAH Asbestos ID
Brownfield & Soil transfer stations	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC, Speciated PAH & banded TPH* Asbestos ID
Crushed product	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC & Speciated PAH Asbestos ID

Note: The schedules detailed above have been prepared in accordance with the Secondary Model Procedures and Land Contamination Risk Management, 2020. This document states that analysis should be relevant to potential sources and not merely a set list of parameters applied to each site.

* The YALPAG guidance recommends speciated TPH (TPH CWG) analysis for brownfield sources, but this should not be necessary unless the banded TPH analysis fails the assessment criteria detailed in Table 2 below.

Where crushed product is used at least 600mm below finished garden level, only asbestos analysis will be required.

- 1.25 Chemical assessment (Tier 1) criteria for imported soils are provided in Table 2, these reflect exposure and toxicological amendments proposed within the C4SL report. Where no C4SL value has been published generic assessment criteria have been derived based on the C4SL assumptions using the CLEA model (version 1.701).

Table 2 - Chemical assessment criteria for imported soils

Contaminant	Source	Tier 1 assessment criteria (mg/kg)	Comments/notes
pH	CLEA		
As	C4SL	37	
Cd	C4SL	26	
Cr (III)	CLEA	4000	
Cr (VI)	C4SL	21	
Pb	C4SL	200	
Ni	CLEA	109	Assessment of human health risk only.
Se	CLEA	434	
Hg	CLEA	199	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.
Vn	CLEA	584	
B	Lithos	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependent).
Cu	DoE	100	
Zn	DoE	200	
Benzo(a)pyrene	C4SL	5	
Naphthalene	CLEA	6	
GRO	CLEA	22	Conservative value based on value for aromatic fraction C7 to C8 range, but assuming indoor inhalation pathway still relevant (it shouldn't be).
DRO	CLEA	215	Conservative value based on value for aliphatic fraction C10 to C12 range, but assuming indoor inhalation pathway still relevant (it shouldn't be).
LRO	CLEA	1,000	Calculated value above hazardous waste screen in WM3, therefore 1,000mg/kg adopted. This may be reviewed on a site specific basis depending on the source and nature of transfer.

2 VALIDATION REPORTS

- 2.1 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.
- 2.2 Interim plot validation certificates for residential plots should be issued to warranty providers on a plot by plot (or block by block) basis as development proceeds. Once the full development has been completed these should be pulled together into a final verification report, for submission to the Local Authority to satisfy planning conditions.
- 2.3 Interim validation certificates will be issued by Lithos for each landscaped area or set of landscaped areas once completed. After Lithos have been able to confirm placement of agreed thicknesses of suitable soil cover in all 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.