



Remediation Options Appraisal **&** **Strategy**



Land at Thornlea **Carleton** **Egremont**

Client: L. Zarrini
Architect: Day Cummins Ltd

Report Sent by Email

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Site Investigation Steering Group (SISG), 1993

Introduction:

Geo Environmental Engineering Ltd (GEO) were commissioned by the Client, L. Zarrini to carry out a Remediation Strategy for land at Thornlea, Carleton near Egremont.

The following reports have been previously completed for the site and should be read prior to this report:

- Phase 1 Desk Study Report - Geo Environmental Engineering Ltd, Ref: 2018-3324 and dated January 2019.
- Phase 2 Ground Investigation Report - Geo Environmental Engineering Ltd, Ref: 2020-4302 and dated September 2021.

The site is located in the southern part of Carleton, c.1km south east of Egremont as indicated on the site location plan included in Appendix I. Access to the site is from an unnamed road to the north.

- National Grid Reference: 301683, 509230
- Post Code: CA22 2NU (approximate only)

The site is an area of scrub vegetation and bushes immediately north of an existing residential property.

The site undulates with a rise from the lowest area in the western part to the highest elevation in the east. to the south gently with a slight fall in level from south to north.

It is understood that the Client plans to develop the site for residential end use. Full development details are available from the Client.



Figure 1.1 Proposed Development Plan

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Scope of Previous Ground Investigation Works (Intrusive):

This intrusive ground investigation previously referred to includes the following scope of works:

- Machine Dug Trial Pits.
- Soil sampling for ground contamination.
- Laboratory ground contamination testing.
- Level 1 Generic Quantitative Risk Assessment (GQRA) to determine potential ground contamination and ground gas risks to the proposed end users

The trial pits were positioned by GEO to provide full site coverage, where access allowed.

Ground & Groundwater Conditions:

The following soil types were observed at each of the pit locations across the site:

- **MADE GROUND:** Made ground was encountered across the site to depths of between c.0.18m and c.0.50m bgl. The made ground comprised sandy gravelly loam with occasional ash and clinker, sandy gravel of mixed aggregate with occasional brick, clinker, slag, concrete and asphalt, and occasional fused slag.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) or any landfill type waste such as potentially biodegradable, decomposable or putrescible materials.

- **DRIFT DEPOSITS:** Natural drift deposits were encountered beneath the made ground in all of the trial pits and was noted as granular throughout. The drift comprised silty sandy fine to coarse sub-rounded gravel with many cobbles and bands or lenses of slightly silty gravelly sand. The pit walls were unstable.
- **SOLID DEPOSITS:** Not encountered.
- **GROUNDWATER:** Groundwater was encountered at depths of between c.1.40m and 1.50m bgl. The trial pits were left open and standing groundwater was recorded at similar levels after 20 minutes. Trial pits TP04, 05 and 07 which were excavated to depths of between c.1.70m and c.2.10m bgl in the south western part of the site were recorded as “dry”.

Ground Contamination – Laboratory Analysis:

Soil samples recovered from the trial pits were scheduled for the following analytical testing:

- **Inorganic Soil Suite (Human Health Risk Assessment):** Metals and Metalloids (*Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium and Zinc*) and Cyanide. and Total Organic Carbon.
- **Organic Soil Suite (Human Health Risk Assessment):** Speciated Polycyclic Aromatic Hydrocarbons (PAH – USEPA 16).
- **Other:** Asbestos and Total Organic Carbon.

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Ground Contamination – Generic Quantitative Risk Assessment (Human Health – Soils):

The following is a summary of the Human Health risk assessment based on a *Residential with plant Uptake End Use*:

- **Generic Contamination:** Elevated Lead contamination in the made ground (TP05, c.0.10m).
- **Organic Contamination:** None.
- **Other Contamination:** None.

Based on the Human Health risk assessment above, it can be seen that the concentration of Lead in the made ground encountered in trial pit TP05 only exceeds the assessment criteria for a residential end use where private gardens are proposed. The concentration of Lead was over 13 times the assessment criteria value at 2659mg/kg. The made ground at this location comprised sandy gravel of mixed aggregate, slag and concrete. No obvious sources for the lead were visibly noted (i.e., lead pipe fragments).

There is a plausible risk to human health through dermal contact, inhalation or consumption associated with the made ground encountered in trial pit TP05 and potentially elsewhere on site. However, the risk is only present where there is a plausible pathway such as in areas of soft landscaping or private gardens. Any hardcover (roads, car parks, buildings, etc...) will effectively break the established Source – Pathway – Receptor pollutant linkage model, by removing the Pathway element.

There was nothing visually noted in trial pit TP05 to explain the elevated Lead concentration. As such, it is possible that elevated Lead may be present elsewhere on the site and it is recommended that further screening is undertaken to delineate the elevated Lead. Alternatively, remediation or protection measures should be adopted for the site as a whole where gardens or soft landscaping are planned. As the made ground was generally not considered suitable for re-use within landscaped areas, this may be the preferable option.

Based on the Human Health risk assessment above, contaminants have been identified as posing a potential risk to human health with respect to a residential end use with plant uptake. Therefore, remedial measures are required.

If any further contamination of concern is identified, in particular the presence of hydrocarbons then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer with respect to potential risks to the proposed development (i.e. “watching brief”).

Any materials removed from site, or moved around site may be subject to a Materials Management Plan (MMP) in accordance with CL:AIRE.

Remediation Options Appraisal:

Based on these results as well as the historical development of the site, if the made ground is to remain in areas of soft landscaping surrounding the proposed property, then they potentially represent a risk to the future end users.

Where future hardcover/hardstand will be present, there will be no risk to the proposed end users as the permanent hardstand (access road, driveways, paths and building footprint) will act as a physical barrier to prohibit the end users from coming into contact with the contamination source (i.e. made ground). This will effectively break the established *Source-Pathway-Receptor* pollutant linkage model.

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When considering the above, there are a range of suitable options available to adequately protect the proposed end users. Consideration will need to be made to the proposed finished levels and the volume of contaminated material present to determine the most suitable form of remediation. Potential forms of remediation may include one of the following:

- **Remove the Contaminated Made Ground:** By removing the made ground in areas of private gardens and/or soft landscaping surrounding the properties the contamination *source* would be removed and the risk to the end user would be mitigated. Consideration could be given to placing contaminated soils below any areas of hardstanding (buildings and car parking) as an engineered fill where it would not pose a risk to the proposed end users. This would be subject to approval of the Structural and/or Civil Engineer.
- **Clean Cover System:** If the entirety of the made ground cannot be removed from the gardens and/or soft landscaping (unlikely for this site) then based on the contamination results, a suitable clean cover system would be required to protect the end users from the contaminated materials. Based on the contamination concentrations, the clean cover system would need to be at least 600mm thick. This should include a suitably compacted “no dig layer” comprising 150mm of densely compacted clean quarry stone overlying a geotextile membrane to act as a marker layer. This should be capped by suitable sub-soils with at least 150mm of topsoil at the surface.

Remediation Strategy:

For this site, following the Remediation Options Appraisal the proposed remedial option is as follows:

- **Remove the Contaminated Made Ground:** The made ground identified across the site was not significant in terms of depth (average thickness noted being c.0.33m, although localised deepening may be present). By removing the made ground in areas of private gardens and/or soft landscaping surrounding the properties the contamination *source* would be removed and the risk to the end user would be mitigated. Consideration could be given to placing the excavated made ground soils below any areas of hardstanding (buildings and car parking) as an engineered fill where it would not pose a risk to the proposed end users. This would be subject to approval of the Structural and/or Civil Engineer. If the materials cannot be accommodated on site, then they would require appropriate disposal.

By undertaking the above option for proposed areas of soft landscaping, the *source* would be suitably removed from the *source-pathway-receptor* pollutant linkage and will therefore not represent a potential risk to the proposed end users. Following completion of the remediation a verification report should be compiled that will need Local Authority approval prior to occupation of the buildings.

Verification Criteria:

A Verification Report will be required upon completion of the remediation (and prior to occupation of the buildings); GEO can assist with the verification requirements and reporting at the necessary time.

The verification works would be in accordance with Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) Verification Requirements for Cover Systems, version 4.1 dated June 2021.

- The made ground is to be excavated and removed from the proposed gardens and soft landscaped areas. If the excavated made ground cannot be accommodated on site (i.e. beneath buildings or hardcover – driveways), then it will require appropriate off-site disposal at a licensed facility with a chain of custody to confirm this (i.e. waste transfer and disposal tickets). The developer should ensure

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that the accepting facility is appropriately licensed to accept the made ground on site, which they can do byway of the soil descriptions and laboratory test results within the P2 GIR. It may be the case that the accepting facility requires addition specific testing (i.e. Waste Acceptance Criteria – WAC).

- The natural underlying uncontaminated soils will be exposed, visually inspected by a GEO-Environmental Engineer and then “topped off” with clean imported topsoil to act as a growing medium (c.300mm minimum, but deeper where larger trees and shrubs are planned).
- For the import topsoil materials being brought to site verification testing is required from source and upon placement on site to ensure the materials are suitable for re-use in a residential setting. The laboratory analysis for the clean cover materials would be subjected to a Human Health Risk Assessment based on a residential end use with plant uptake, using the appropriate assessment criteria at that time (i.e. LQM S4UL or Defra C4SL). If the materials are do not meet those criteria, then they should not be used.
- The volume of testing will be in accordance with YALPAG, as per the performance criteria below.
- The topsoil should also be free from potential invasive plant species.
- The effectiveness of the remediation system (made ground removal) will be immediate upon its placement, subject to the previously mentioned performance criteria being met.
- Upon completion of the remedial works, in conjunction with the verification testing, the Verification Report will be completed.
- The remedial method chosen is simple and robust. No specialised remedial technologies are to be employed and therefore there is no anticipated shortfalls in the performance effectiveness.

Type	Number of Samples	Testing Schedule	Assessment Criteria
Please note that these guidelines apply to a typical residential development, and relaxation of the guidelines or more stringent requirements may apply dependent on local and site specific factors. Therefore, all parameters need to be agreed with the Local Authority.			
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)	The assessment criteria need to be UK based, e.g. LQM S4ULs, Defra C4SLs or other similarly derived GACs.
Crushed Hardcore, Stone, Brick (excluding asphalt)	Minimum 1 per 500m ³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	
Greenfield/ Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50m ³ and 1 per 250m ³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).	
Brownfield/ Screened Soils	Minimum 6 Dependent on source and receptor, between 1 per 50m ³ and 1 per 100m ³	Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	

Figure 1.2 YALPAG Verification Testing Criteria – Performance Criteria

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Under no circumstances should the made ground currently on site be used as part of any future soft landscaping or private gardens.

All reports will need to be submitted to the LPA for the discharge of any associated conditions prior to occupation of the houses.

General Comments:

GEO was provided with a specific brief for this report. Therefore, any items not specifically mentioned cannot be assumed to be covered. GEO is not responsible for the accuracy or completeness of third-party information or reports.

GEO recommends that a “watching brief” and “observational technique” be applied to this site to ensure that if ground conditions appear to vary from those identified within this investigation report then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer.

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Report Prepared By:

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Curtis Evans *BSc (Hons), FGS*
Director
Geo Environmental Engineering Ltd

Report Reviewed By:

.....
Andrew Hampson *BSc (Hons), FGS*
Associate
Geo Environmental Engineering Ltd

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End of Report

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GEO Environmental Engineering Ltd
North West (Registered Office):
4 Culgarth Avenue, Cockermouth, Cumbria CA13 9PL
North East:
19-20 Brenkley Way, Newcastle Upon Tyne, Tyne & Wear, NE13 6DS

Telephone: 01900 826 027
Email: info@geoenvironmentalengineering.com
Website: www.geoenvironmentalengineering.com
Company No.: 07180338
VAT No.: GB 986617072