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PROPOSED HOUSE, VALE STREET, MANCHESTER, M11 4NR
SITE INVESTIGATION REPORT (AMENDED 15/7/2020)

INTRODUCTION

A residential development is proposed. Instructions were to carry out boreholes and tests to investigate potential geotechnical and soil contamination issues.

This is an amended version of our report dated 30/6/20, following completion of laboratory tests,

SITE LOCATION

The site is a rectangular plot, about 22 by 24 metres, located to the west of Vale Street in Manchester and at OS Grid reference 388212, 398847. The site is a vacant plot, although the location and layout suggest it is likely to have previously been occupied by housing.

PROPOSED DEVELOPMENT

It is proposed to build one pair of semi-detached houses, with associated gardens and drives.

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GEOLOGY OF SITE

The geology map indicates that the underlying solid rocks are Collyhurst Sandstone.

Surface drift is shown as glacial till (boulder clay) of unknown thickness.

GROUND INVESTIGATIONS

A series of three boreholes and three trial holes were carried out. These were positioned to target the proposed gardens to the rear, landscaping to the front and provide all round coverage. Details are given on the location plan and trial hole logs enclosed with this report.

Trial holes

Trial holes 1, 2 and 3 were excavated to 0.25m to collect samples for testing. These all showed made ground (sandy topsoil with brick and gravel) to 0.25m.

Boreholes

Borehole 1 was drilled on the northeast of the site and showed variable conditions to borehole 2 and 3 which were drilled on the southwest.

Borehole 1 encountered made ground (topsoil with brick, gravel, ash, clinker and clay) to 1.1m with probable made ground to 1.2m. This was underlain by high strength clay before sand and gravel was seen before 5.6m and the base of the borehole at 5.8m deep.

Borehole 2 and 3 both encountered made ground (topsoil with brick, gravel, ash, clinker, glass, coal and clay) at ground level which extended to their base at 5.6m and 7.0m respectively.

The following approximates to a section looking north.

Findings	BH3 (m)	BH2 (m)	BH1 (m)
Made ground	0.0 – 7.0+	0.0 – 5.0+	0.0 – 1.2
Clay	-	-	1.2 – 5.6
Sand and gravel	-	-	5.6+
Water	>6.1	Dry	Dry

CONTAMINATION TESTING

Four samples (three shallow and one deeper) were tested for a range of common contaminants. The results are included in table form with this report. Abbreviations and acronyms for chemical compounds are given after the appendix list.

CONTAMINATION COMPARISONS - INITIAL SCREENING

The maximum contamination values have been compared with residential C4Ls and soil guideline values provided by CLEA. Where these are not available, values are based on the LQM/CIEH S4ULS. In accordance with guidance provided by the AGS, threshold values from other sources have been used for screening purposes. This information has been brought together on the Comparison Table included with this report.

Asbestos

No asbestos fibres were detected/

Inorganics (metals etc.)

Levels of inorganic contaminants were below thresholds except lead which exceeds the threshold in all three samples at 0.25m.

Sulphate

Water soluble sulphate lead exceed the BRE action level for buried concrete in trial hole 3 at 0.25m.

Hydrocarbons

Levels of phenols are low, as are levels of PAHs in trial hole 1 and TPHs in trial holes 2 and 3.

Aromatic TPHs >C10 exceed their respective threshold, in trial hole 2 at 0.25m whilst levels of Benzo(a)pyrene, benzo(b)fluoranthene and dibenzo(ah)anthracene exceed residential thresholds in trial hole 2 and 3 at 0.25m.

Drinking Water Pipes

Comparing test results against trigger level, for drinking water pipes, show levels are below the thresholds.

DISCUSSION

Contamination

Contamination tests show raised levels of lead across the site with elevated PAHs on the southwest of the site (trial holes 2 and 3) and TPHs in trial hole 2 at the south corner. These pose a risk to householders arising from direct contact with surface soils and remedial works are required is below gardens, landscaping and non-permanent surfaces (path, patios, etc). Although only three tests have been undertaken, bearing in mind these all show raised levels of lead requiring remedial action, and this is a very small site, it is considered that no further testing will be beneficial and there is sufficient data to adequately characterise the site.

The contaminants seen at raised levels can remain below hard-surfacing (house, drive) with no risk and CLEA calculations for elevated TPHs are enclosed to demonstrate this.

Levels of volatile hydrocarbons are below the thresholds and there is no risk from hydrocarbon vapours.

Water Soluble Sulphate levels are raised and sulphate resistant concrete to class DS2 is required.

The findings suggest, subject to UU approval, the site is suitable for PE water pipes.

Disposal of Excavated Soils

Test results have been compared with hazardous waste thresholds and a Hazwaste report is enclosed. This shows that excavated soils from trial hole 2 would be classed as hazardous waste due to TPH levels. WAC testing indicates soils from TH2 would be suitable for disposal to hazardous waste landfill

Test results from THs 1 and 3 are below thresholds and should not be classed as hazardous. This suggests excavated soils from the southwest of the site would be classed as hazardous, whilst excavated soils from the northeast should not be classed as hazardous.

Bearing in mind the size of the site there is no suitable area to excavate and stockpile excavated hazardous waste soils.

Disposal of soil is now a complicated issue and the test results should be issued to the receiving site to for confirmation of its status.

Landfill Gas/Ground Gas

There is over 7m of made ground on the west of the site and up to 1.2 metres on the east, this presumably extends beyond the western site boundary. TOC levels range from 3.6% to 1.8%, averaging 2.8%.

The nature of the made ground (topsoil, brick, gravel, ash, clinker, glass, coal and clay) is considered to be typical of similar sites filled pre 1950s. Although this has potential for generation of ground gases, the nature of the made ground suggests a low to very low gas generation potential. The age of filling suggests household waste is unlikely, and furthermore, if present, would be unlikely to include large volumes of degradable waste.

Based on a visual inspection of the made ground, and TOC levels, it is considered a low gas generation potential is likely to be present, with little or no gas outflow. A characteristic situation 2 (CS2) is expected at worst.

The developer would prefer to install precautionary gas protection measures, in-lieu of testing, and this is considered to be a proportionate response bearing in mind the findings of the investigation.

Where gas protection measures are required, for private housing, on a low CS2 site, a minimum gas protection score of 3.5 is required to BS 8485:2015. To meet this requirement, the following scores are considered.

Ventilation

Passively ventilated Sub-floor void	2.5
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Membrane

Gas barrier	2
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Total	4.5
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These are also considered appropriate for a moderate risk CS3 site where a score of 4.5 is required.

The following will therefore offer suitable protection for this site in accordance with BS 8485:2015.

- Ventilation of confined spaces within building
- Suspended floor with sub-floor venting (houses)
- Reinforced concrete floor slab (garage)
- A low-permeability gas membrane (Visqueen Gas Barrier - blue with foil layer)
- Minimum penetration of ground slab by services.
- Also gas precautions should continue across the cavity.

Each membrane should be used with the appropriate matching cavity tray (or cavity membrane), DPC and service duct 'top hat'. Joints to be lapped and sealed.

The installed gas protection membrane will need to be independently inspected to verify it has been correctly installed, in accordance with manufacturer's instructions.

Foundations

The boreholes show made ground at shallow depth which is not suitable for traditional strip footings. Although clay was seen in borehole 1 at the northeast, the made ground extends to over 6m on the southwest of the site. This suggests, between the northeast and southwest of the site there is the edge of a filled feature, possibly a brick/clay pit from historical maps. A raft spanning this would have potential for differential settlement between the two areas, and a raft is not considered suitable.

A piled foundation is considered to be the most suitable option. However, there is insufficient details at this strength to determine a depth for piling.

CONCEPTUAL MODEL

Source	Receptors	Pathway	Complete Pollutant Linkage
Asbestos (none)	Construction workers	Inhalation	No
	End-users	Inhalation	No
Inorganic contaminants (raised levels)	Construction workers	Short-term direct contact, inhalation of dust, ingestion	Yes
	Householders	Direct contact, ingestion, from home grown vegetables, inhalation of dust	Yes
Sulphate (raised)	Building fabric	Concrete directly in contact with soil	Yes
Hydrocarbons (raised PAHs/TPHs)	Construction workers	Short-term direct contact, inhalation of dust, ingestion	Yes
	Householders	Direct contact, ingestion, from home grown vegetables, inhalation of dust	Yes
Hydrocarbon vapours (very low)	Construction workers	Short-term inhalation	No
	Householders	Inhalation of vapours indoors and outdoors	No
Landfill/ground gas	End-users - in buildings	Seeping into buildings, explosion, asphyxiation	Probable

BREAKING PATHWAYS

Construction Workers

Site personnel, should be made aware of the hazards of working with contaminated materials found on the site. Personal hygiene should be observed and suitable personal protective equipment (PPE) should be worn. Normal precautions for an urban renewal type project are required. These would include the use of gloves and the provision of washing facilities to avoid ingestion of contaminants.

Garden/Landscaped Areas

Contamination by lead, PAHs and TPHs was found to be present in the made ground and one method would be to remove the source by excavating the contaminated material below gardens, paths, patios, and disposing off site:

- Excavate made ground to 0.6m and dispose off-site.
- Backfill with imported soils comprising (bottom up):
 - Geotextile warning barrier.
 - 100mm single size gravel to act as a capillary break layer.
 - 350mm sub-soil
 - 150mm topsoil

An alternative is a 600mm cover layer of clean, imported, soils comprising (bottom up):

- Geotextile warning barrier (gardens, landscaping and non-permanent hard-surfaced areas).
- 100mm single size gravel to act as a capillary break layer.
- 350mm sub-soil
- 150mm topsoil

Sulphate

Sulphate-resisting cement (Class DS2) will be required for buried concrete.

Landfill/Ground Gases

Deep made ground was seen on-site, this extends beyond the site boundary and is considered to have potential for generation of ground gases. Based on the findings it is considered that a gas situation 2 (CS2) is likely to be present at worst.

The following would be suitable for the anticipated level of risk:

- Ventilation of confined spaces within building.
- A suspended ground floor with ventilated underfloor void >150 mm.
- A low-permeability gas membrane (see membranes below).
- Minimum penetration of ground slab by services.
- Also gas precautions should continue across the cavity.

The following membrane (or equivalent) is suggested:

- Visqueen gas barrier (blue with foil layer - resists methane, carbon dioxide and radon).

Each membrane should be used with the appropriate matching cavity tray (or cavity membrane), DPC and service duct 'top hat'. Joints to be lapped and sealed.

The installed gas protection membrane will need to be independently inspected to verify it has been correctly installed, in accordance with manufacturers instructions. This will require:

- Details of who carried out installation.
- Details of who carried out verification and inspection regime.
- Details of non-conformances and how they were rectified (if any).
- A signed statement confirming that the gas protection measures were installed as agreed, the membrane was free from tears and punctures, lapped and sealed as agreed at joints around services. This to be included in the Verification Report.

Imported Soils

All soils (e.g. topsoil, bulk fill hardcore) and similar materials imported on-site to be proved to be uncontaminated, to be screened against residential values, based on 1% SOM.

Imported Soils

All soils (e.g. topsoil, bulk fill hardcore) and similar materials imported on-site to be proved to be uncontaminated. Imported material will require testing as follows:

- Greenfield soils – minimum of 3 tests or 1 test per 100m³ (whichever is greater). Testing to include arsenic, cadmium, chromium (total), chromium VI, copper, mercury, nickel, lead, selenium, zinc, PAH (16 USEPA speciation), asbestos, TPHs (speciated), boron, cyanide, thiocyanate, sulphide, sulphur, sulphate, pH, Som.
- Brownfield/screened/manufactured soils – minimum of 3 tests or 1 test per 50m³ (whichever is greater). Testing to include arsenic, cadmium, chromium (total), chromium VI, copper, mercury, nickel, lead, selenium, zinc, PAH (16 USEPA speciation) asbestos, TPHs (speciated), boron, cyanide, thiocyanate, sulphide, sulphur, sulphate, pH, Som.

Validation

A validation report will be required on completion, this will require but not necessarily be limited to:

- Tickets from waste removal contractor and receiving landfill.
- Contamination test results for tests on imported soils.
- Photographs to confirm thickness of imported soil types.
- Document (receipt, delivery notes) to show soil types and sources.
- Independent inspection of gas membrane and report.

This report is usually a collaboration between the contractor, who will collect the above documentation and Worms Eye, who can assist in preparing the Validation Report

OPINION

Contaminated Soils

Test results show raised levels of lead, PAHs and TPHs which pose a risk to householders in garden areas. Remedial works are required and the most suitable options are considered to be:

- Excavated made ground to 600mm in garden and non-permanent hard surfaces areas (paths, patios), removed from site and backfill with clean, imported, soils.
- Create a 600mm cover layer across the site using clean, imported, soils.

There are no risks from hydrocarbon vapours.

Sulphate resistant concrete to class DS2 is required.

The findings suggest the site is suitable for PE water pipes, subject to UU approval.

Landfill/Ground Gas

There is deep made ground on-site. It is considered that a CS2 situation is likely, at worst, and that gas protection measures can be appropriately designed based on this.

The proposal is to create a passively ventilated sub-floor void, and install a gas membrane. This is considered to offer suitable protection for a CS2 site.

Excavated Soils

Excavated soils from the southwest of the site (see plan) would be classed as hazardous waste.

The findings suggest excavated soils from the northeast of the site should not be classed as hazardous.

Foundations

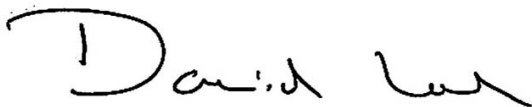
Ground conditions are poor and not considered suitable for strip or raft foundations.

A piled solution is considered most appropriate, however, there is insufficient data at present to determine likely pile depth and the following is suggested:

- Series of probes around the site to determine the rock level, and likely pile depths.

Yours faithfully

on behalf of Worms Eye Ltd

A handwritten signature in black ink, appearing to read 'David Lord', with a stylized flourish at the end.

David Lord
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