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December 2019

PHASE 2 ENVIRONMENTAL RISK ASSESSMENT REPORT

20-23 Greville Street, London

FOR

SLQR Trustee No 1 Ltd & SLQR Trustee No 2 Ltd

as Co Trustees for SLQR Unit Trust No 1

CONSTRUCTIVE EVALUATION

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REPORT REVISED (response to significant changes in client requirements, methods of work etc).

Name: David Meredith	Signature: 	Date: 05/12/2019	Nature of revision: Response to client comments – addition of TP2 and pH & Sulphate results.
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1.0 INTRODUCTION

Constructive Evaluation (CE) Limited were instructed by Avison Young (EQ13564.1 dated 17th July 2019) to carry out a Phase 1 and Phase 2 Environmental Risk Assessment at 20-23 Greville Street, London, EC1N 8SS (hereafter referred to as the "site").

The purposes of this investigation and report are to investigate the nature of material that is present onsite through field investigations; identify whether there is any contamination onsite which is likely to cause significant harm to human health, the environment or other sensitive receptors; provide necessary design parameters for the underlying ground conditions to allow for geotechnical design and;

Attention is drawn to the fact that whilst every effort has been made to ensure the accuracy of the data supplied and any analysis derived from it, there is a potential for variations in ground and groundwater conditions between and beyond the specific locations investigated. No liability can be accepted for any such variations. Furthermore, any recommendations are specific to the client's requirements as detailed herein and no liability will be accepted should these be used by third parties without prior consultation with Constructive Evaluation Ltd.

A Desk Study as outlined in BS5930 "Code of practice for site investigations" was not requested and therefore has not been carried out.

1.1 SITE PROPOSAL

It is understood that the proposed development is to involve the refurbishment of the existing office space including extensions to the roof and rear of the building.

1.2 SUMMARY OF SITE INVESTIGATION

An outline of the intrusive works instructed are summarised below:

- Two boreholes (WS1 and WS2), were advanced using hand held mechanical window sampling methods, to a maximum depth of 3m below ground level to ascertain the underlying ground conditions.
- Two hand excavated foundations pits/concrete cores to prove the thickness of the internal concrete slab and layout of any reinforcement.
- One hand excavated foundations pits/concrete cores to prove the thickness of the external concrete slab and layout of any reinforcement.
- One borehole (BH1), undertaken using a cable percussive rig to a depth of 12mbgl to ascertain the underlying ground conditions at depth.
- One concrete core to prove the thickness and makeup of the existing retaining wall.

2.0 SITE BACKGROUND

2.1 SUMMARY OF PREVIOUS REPORTS

CE completed a Phase 1 Environmental Risk Assessment[1] in July 2019 which should be read in full for a comprehensive understanding of the site. A summary of the main findings are as follows;

Site Description

The site is accessed from the north via Greville Street with access to the basement gained via a fire escape to the south of the site in Bleeding Heart Yard. At the time of the site walkover, the site comprised a six storey brick office block including a basement with a small external area at basement level measuring approximately 5m east to west by approximately 4m north to south.

At the time of the site walkover the basement, ground and first floors of the office block were unoccupied with the upper floors of the building still occupied.

The external areas of the property in Bleeding Heart Yard to the south comprised brick paving parking areas surrounded by the cobbled paving of Bleeding Heart Yard. The external area at basement level was approximately 4m below ground level and was covered by concrete hard standing slabs upon which plant (possible air conditioning units) was situated.

Topography of Bleeding Heart Yard to the south of the property is generally flat, however to the north on Greville Street the topography slopes from west to east by approximately 1m. Figure 1 shows the site location.

Geology

References to the publications of the British Geological Survey (BGS), indicates that the site is underlain by superficial deposits of the Hackney Gravel Member and Alluvium underlain by bedrock geology of the London Clay Formation

Hydrogeology and Hydrology

The superficial deposits are designated as a Secondary A Aquifer, with the bedrock geology designated as unproductive strata. The site lies outside of any Environment Agency Source Protection Zone. The nearest surface water feature is an inland river located 341m west of the site boundary.

Land Uses within 250m

Chapman BDSP – Engineers ~45m NW (Inactive); Chamberlaine Cleaning Services – Commercial Cleaning ~63m S (Active); Cantate Communications – Printers ~198m NE (Inactive); R Perkins & Sons – Refrigerator Servicing/Repairs ~216m E (Active); Andrews Waste – Waste Disposal ~219m NW (Active); Hotel Care Ltd – Commercial Cleaning ~231m NW (Inactive).

[1] Constructive Evaluation Ltd. July 2019. Phase 1 Environmental Risk Assessment. 19.1170ERA.

Landfill Records

There are no BGS recorded landfill sites within 1000m of the site boundary. There are two records of historical landfill sites within 1000m of the site boundary, the closest of which is located ~709m east and previously accepted deposited waste including inert waste.

Site History

The site has been developed and contained a number of buildings since at least 1877. In maps dating from 1916, the site appears to comprise one larger building. The building footprint on site is representative of the current layout from the 1970's.

Potential Areas of Concern

No potential areas of concern were identified during the site walkover. The only potential source of contamination considered a risk to the site is potential made ground associated with previous historical land use.

All offsite potential sources of contamination have not been considered further due to the distance from site and/or low contamination potential. The site lies outside of any Source Protection Zones and >250m from any landfill sites. No historical pollution incidents have been recorded within 250m of the site boundary.

The potential contamination associated with PCBs (polychlorinated biphenyls) arising from the identified electricity substations ~60m north have been discounted as PCBs are not considered to be sufficiently mobile or soluble to pose a significant risk to future end users.

2.2 PRELIMINARY CONCEPTUAL SITE MODEL

A brief summary of the Preliminary Conceptual Site Model formulated in the Phase 1 Environmental Risk Assessment can be found in the table below.

Source	Pathway	Receptor	Likelihood	Potential Risk
Potential Made Ground from previous site uses.	Inhalation, ingestion and dermal contact	End Users	Unlikely	Low
		Site Workers (during development)	Probable	Moderate to High
	Impacted soils	Services	Unlikely	Low
	Volatilisation of hydrocarbons	End Users and Proposed Development	Unlikely	Low
		Site Workers (during development)	Possible	Moderate
	Infiltration and migration of contaminants	Superficial Secondary A aquifer underlying the site	Possible	Low to Moderate

3.0 FIELD WORK

The following intrusive works as located in Figures 2 and 3 were carried out over two stages of works, the first stage comprised hand held window sampling and foundation pits being undertaken on the 8th and 26th July 2019 and the second stage of works comprised a cable percussive borehole taking place taking place on the 16th and 17th October 2019. All works were supervised by an Engineering Geologist from CE, with photographs of the site investigation available in Appendix A.

- Prior to any excavations, a Cable Avoidance Tool (CAT) was used to check for the position of any underlying electrical services. In addition, starter pits were excavated to a maximum depth of 1.2 metres below ground level (mbgl) to clear test locations prior to any intrusive work, where possible.
- Two boreholes (WS1 and WS2) were advanced using hand held mechanical window sampling methods to a maximum depth of 3mbgl to ascertain the underlying shallow ground conditions.
- Three hand excavated foundation pits were undertaken both within the basement and the external basement level area to determine the thickness of the concrete slab and layout of any reinforcement with one concrete core taken through the external retaining wall.
- One borehole (BH1) was undertaken using a cable percussive rig to a depth of 12mbgl to ascertain the underlying ground conditions at depth.
- U100 (Within plastic liners) and Standard Penetration Testing (SPT) was carried out within BH1.

Full logs of the intrusive locations can be observed in Appendix B. The final exploratory positions are provided in Figures 2 and 3.

The Ground Investigation was undertaken in accordance with the scope of works agreed with the Client and in relation to statutory guidance including BS5930: 1999 Code of Practice for Site Investigations (Amendment 3: 2015) and BS10175: 2011+A1: 2013 Investigation of Potentially Contaminated Sites: Code of Practice.

3.1 SUMMARY OF FOUNDATION PITS AND CONCRETE CORES

In total, three hand excavated foundation pits were excavated in both internal and external areas at basement level and one concrete core was excavated through the external retaining wall. Internal pits TP1 and TP1A refused in extremely high strength reinforced concrete and the maximum thickness of the slab was not proven.

No evidence for the existence of pad foundations was found during the intrusive works.

External pit TP2 initially refused on extremely high strength concrete. The pit was relocated approximately 1.5m west and extended using concrete coring techniques to prove a slab thickness of 0.8m with follow on window sampling presented as WS1.

Foundation pit drawings can be found in Appendix C.

3.2 SUMMARY OF RETAINING WALL INVESTIGATION

One concrete core was carried out within the rear retaining wall to ascertain the thickness and makeup of the wall. A GPR Live Scan was also carried out to confirm the presence and location of any rebar. In addition the full thickness of the wall was confirmed using a Hilti Impact drill.

A summary of the tested concrete core can be found in the following table:

Sample ID	Maximum Failure Load (kN)	Measured Compressive Strength (N/mm^2)	Estimated In-Situ Cube Strength (N/mm^2)
Retaining Wall Core	104	27.0	24.9

The retaining wall was found to be composed of an engineering brick veneer covering 850mm concrete. A red brick backing layer was inferred from the results of the Hilti probe drill carried out.

The GPR Live scan suggested no rebar was present within the wall and this was confirmed during the coring.

Retaining wall drawings can be found in Appendix C.

4.0 GROUND CONDITIONS

4.1 OBSERVED STRATIGRAPHICAL UNITS

STAGE 1 OF THE INTRUSIVE WORKS

Stage 1 of the intrusive works took place at the basement level of the property, within the external areas of the building surrounded by the retaining wall at approximately 3.7mbgl.

The following anthropogenic (Made Ground) strata were encountered during this stage of the intrusive works:

> The surface cover comprised a concrete slab was observed in both WS1 and WS2 to an extent of 0.05mbbl (metres below basement level) in both locations. The sub base beneath each slab varied, with the sub base in WS1 comprising pinkish grey sandy GRAVEL fill extending to 0.2mbbl and the sub base in WS2 comprising orange brown gravelly SAND fill observed to 0.3mbgl where the hand held window sampler was refused and the intrusive location terminated. Beneath the sub base in WS1, a second concrete slab was observed to extend from 0.2mbbl to 0.8mbbl.

Beneath the Made Ground material, the natural stratigraphic sequence is as follows:

> **London Clay Formation**: firm brown thinly laminated CLAY with rare grey mottling and rare pockets of orange medium to coarse sand was observed from 0.8mbbl to the base of the borehole at 3mbbl.

STAGE 2 OF THE INTRUSIVE WORKS

Stage 2 of the intrusive works took place within Bleeding Heart Yard with excavations undertaken from ground level.

The following anthropogenic (Made Ground) strata were encountered during this stage of the intrusive works:

> In BH01, the surface cover comprised red brick tiles underlain by a concrete slab to 0.32mbgl. Beneath this was a layer of dark brown clayey sandy GRAVEL fill between 0.32m and 0.5mbgl underlain by a further concrete slab to 0.61mbgl. Made Ground soils underlying this comprised brown clayey sandy GRAVEL extending to 2mbgl and further underlain by dark brown sandy gravelly CLAY to 3.1mbgl.

Beneath the Made Ground material, the natural stratigraphic sequence is as follows:

River Terrace Deposits: medium dense orange brown gravelly fine to coarse SAND was observed between 3.1m and 3.4mbgl.

Weathered London Clay Formation: soft becoming firm orange brown sandy gravelly CLAY was observed between 3.4m and 4mbgl.

London Clay Formation: firm to very stiff brown to dark grey CLAY was observed from 4mbgl to the base of the borehole at 12mbgl. A possible band of Claystone, recovered as gravel and cobbles was noted to occur at approximately 4mbgl.

Reference should be made to the engineer's logs contained within Appendix B for a more detailed description.

4.2 GROUNDWATER

Groundwater was encountered during stage 1 of the site works both beneath the internal concrete floor slab and the concrete paving slabs in the external areas of the basement. This water was observed to inflow into all intrusive locations. This is thought to be standing groundwater beneath the impermeable concrete slabs and above the impermeable clay materials encountered. Groundwater was observed at 3mbgl during stage 2 of the investigation, settling at 2.3mbgl after 20 minutes. This has been inferred to represent possible perched water within the Made Ground or River Terrace deposits.

No groundwater was encountered within the London Clay Formation. It should be noted that due to the construction of a Crossrail Tunnel beneath the site, the local groundwater table may have been altered by dewatering and tunneling activities and may not be representative of the surrounding area.

4.3 FIELD EVIDENCE OF CONTAMINATION

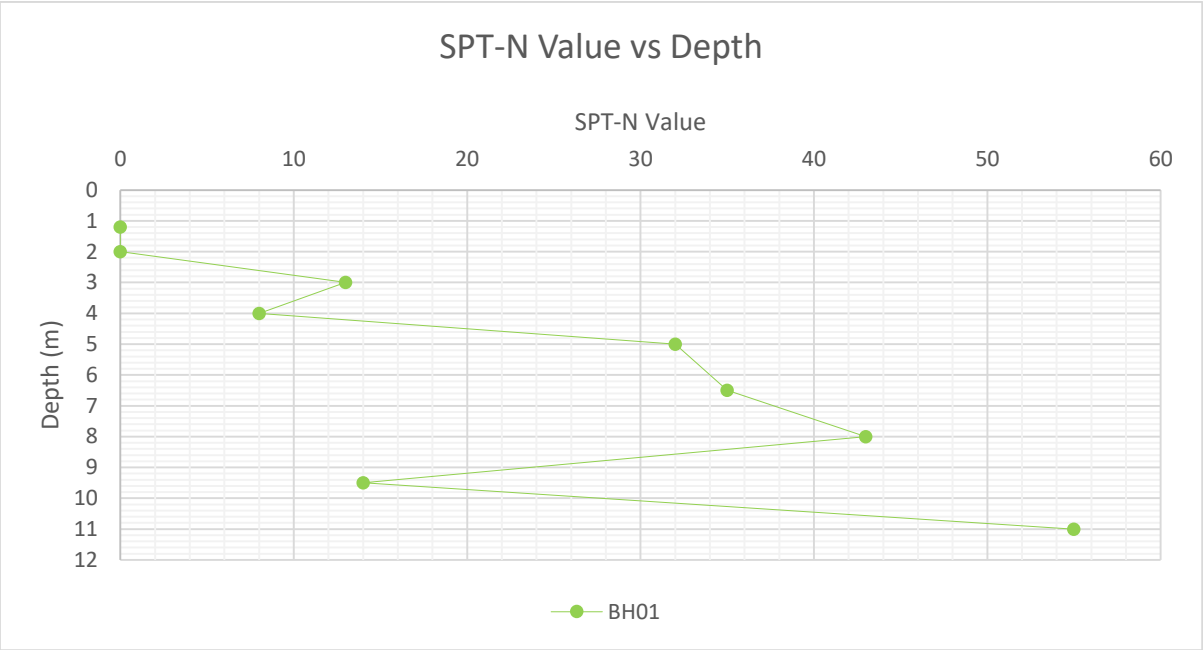
No visual or olfactory evidence of contamination was identified during the intrusive investigations.

5.0 INSITU TESTING

5.1 STANDARD PENETRATION TESTING

Standard Penetration Testing (SPT) was completed throughout the drilling of BH1 at 1m centres down to 5mbgl and then at 1.5m centres thereafter.

This form of testing is completed using a 63.5kg drop hammer weight, over a 750mm drop, measuring the blow counts for six, 75mm increments. The first two values are recorded as seating blows, with the remaining four values, added together to provide an 'N-value'. Results are presented in the graph below:



Two tests were carried out within Made Ground soils returning N values of N=0.

Within the underlying London Clay Formation, SPT N-values show initial values in the order of N=8 to N=55 with a general trend of increasing N value with depth. An N-value of 14 was recorded at 9.5mbgl, this was considered an anomaly.

All N values are uncorrected. A calibration certificate for the Hammer is included in Appendix F.

6.0 GEOTECHNICAL LABORATORY TESTING

6.1 NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS

Six samples of material were submitted for determination of their Natural Moisture Content (NMC) and Plasticity Index (PI). These were selected from possible reworked and undisturbed London Clay from BH1 at depths ranging from 5.00mbgl to 11.50mbgl. The results are tabulated below.

Sample ID	Moisture Content (%)	Modified Plasticity Index (%)	Plasticity	Volume Change Potential
BH1 – 5.00mbgl	32	34	Moderate	Medium
BH1 – 7.00mbgl	33	36	Moderate	Medium
BH1 – 9.00mbgl	24	33	Moderate	Medium
BH1 – 11.50mbgl	26	33	Moderate	Medium

6.2 UNCONSOLIDATED UNDRAINED TRIAXIAL COMPARISON

Two undisturbed (U100) samples of the London Clay were submitted for determination of their undrained shear strength (C_u) by single stage unconsolidated undrained triaxial compression testing.

Values of C_u between 59.0kN/m^2 and 67.8kN/m^2 indicating a medium strength.

A summary of triaxial test results is presented in the table below:

Sample ID	Bulk Density (Mg/m^3)	Moisture Content %	Undrained Shear Strength (kN/m^2)	Strength
BH1 – 8.00mbgl	2.02	32	59.0	Medium Strength
BH1 – 11.00mbgl	2.11	26	67.8	Medium Strength

Geotechnical laboratory results can be found in full in Appendix D.

6.3 SULPHATE AND PH ANALYSIS

Nine samples were submitted for determination of pH and water soluble sulphate concentration (including three as part of the contamination screening). A summary of the results is tabulated below.

Sample ID	pH	Water Soluble Sulphate (mg/l)	Design Sulphate Class	ACEC classification
BH1 – 0.35mbgl	10.9	338	DS-1	AC-1
BH1 – 0.70mbgl	10.6	130	DS-1	AC-1
BH1 – 2.00mbgl	7.9	1510	DS-3	AC-3
BH1 – 2.00-2.45mbgl	7.9	669	DS-2	AC-2
BH1 – 5.00mbgl	8.3	307	DS-1	AC-1
BH1 – 7.00mbgl	8.4	139	DS-1	AC-1
BH1 – 8.50mbgl	8.5	245	DS-1	AC-1
BH1 – 10.00mbgl	8.7	282	DS-1	AC-1
BH1 – 12.00mbgl	8.4	127	DS-1	AC-1

For full laboratory test results please see Appendix E.

7.0 GEOTECHNICAL DISCUSSION

7.1 SOIL ENGINEERING PROPERTIES

Made Ground soils of slightly variable composition were observed to extend to a maximum depth recorded of 3.10mbgl within BH01 during stage 2 of the intrusive investigation. A concrete slab was observed to 0.80mbbl in the external area surrounded by the retaining wall during stage 1 of the intrusive investigation.

It is likely that the thickness of Made Ground present across the site be highly variable, with a possibility that uncontrolled fill / Made Ground materials has been utilised as part of the construction or backfill behind the retaining wall.

Two SPT tests completed in Made Ground material indicated N values of 0 indicating that these materials are of very low strength and not suitable for use as a founding medium.

The remaining SPT tests completed within the London Clay Formation showed a range of SPT N values between 8 and 55, indicating that the material is soft to very stiff.

Using the relationship described in Stroud & Butler (1975) and a characteristic F1 value of 4.5, the SPT tests completed within the London Clay Formation indicated a range of undrained shear strengths of between 36 and 247.5 kN/m^2 corresponding to a low to very high strength materials.

Laboratory plasticity index and triaxial testing has indicated that the Clay materials encountered of Medium volume change potential with undrained shear strength values ranging between 59.0 and 68.7kN/m^2 between 8.00m and 11.00mbgl.

It is recommended that the values of undrained shear strength obtained from laboratory triaxial testing be used for the purpose of any further design.

8.0 FOUNDATION DESIGN

8.1 SHALLOW AND DEEP FOUNDATIONS

The current proposal for the site is for the refurbishment of the existing office space including extensions to the roof and rear of the building.

Any foundations formed within Made Ground soils would be expected to be subject to total and differential settlement beyond tolerable limits therefore, due to the load generated by the proposed development and significant depths of Made Ground soils. These soils are frequently present in a variable and inconsistent nature such that would render them unsuitable as a founding strata, a piled foundation solution maybe more appropriate based on the ground conditions only.

If deep piles are to be considered, the presence of a Crossrail Tunnel, with a centerline at approximately 29.2mbgl exists beneath the site. Information provided by Crossrail on their tunnel protection zones, and approximate levels provided suggest maximum pile lengths of 13m beneath the existing basement could be possible.

If a deep piled foundation is utilized it is recommended that any thickness of Made Ground is regarded as having zero skin friction and not contributing to the load capacity of the pile or pile groups.

The presence of Claystone within the London Clay Formation should be passed onto any piling designers or contractors as this can prove problematic.

If piles are to be considered a specialist piling contractor should be approached for the purpose of design.

It is recommended the lower values of undrained shear strength from the triaxial data be used as the basis for any design. The makeup of the current foundations could not be proven during the site investigation but is inferred that the existing slab foundation has been constructed within the London Clay Formation and as such moderately conservative safe allowable bearing capacity of 150kN/m^2 could be achievable at this depth.

The clay soils encountered are of medium shrinkage potential. Although there are no semi mature or mature trees near the site currently this should be considered in line with current NHBC guidelines during the design of any further foundations.

8.2 FLOOR SLAB

The floor slab design will depend on the final foundation designs and is dependent on the underlying materials, including bearing capacity and the presence of any cohesive or Made Ground Soils. The makeup and ultimate thickness of the existing reinforced floor slab could not be confirmed but can be inferred to be founded within the London Clay Formation.

No evidence for pad footings were found during the intrusive works although this should not be taken as conclusive due to the limited nature and extent of the investigation.

8.3 EXCAVATIONS AND GROUNDWATER

It is likely that further excavation within the basement will remain stable due to the cohesive nature of the natural soils encountered during the intrusive investigation, however, adequate support should be provided in order to satisfy statutory safety regulations.

It is likely that excavations of less than 1.2mbgl within the yard area will require support to their faces due to the potentially granular nature of the soils encountered. Should excavations be taken below this, particularly due to the granular within the deeper granular Made Ground soils extending to 2.0mbgl, then adequate support should be provided in order satisfy statutory safety regulations.

Groundwater was encountered at the base of the concrete slab in WS1 and within BH01, this was thought to be perched above the impermeable London Clay materials. Groundwater levels are dependent upon seasonal variations and levels may change after periods of heavy rainfall or prolonged drought. Where groundwater or surface water is encountered within any excavations during the construction phase it should be dealt with appropriately and removed using good engineering practices.

The design of any temporary retaining structures to support excavation faces should be made assuming the following moderately conservative parameters:

Material	Effective angle of friction (Ø')	Effective Cohesion; c' (kPa)	Bulk Density kN/m^3
Made Ground	22-24	0	16-17
London Clay Formation	19-22	0	20

8.4 CONCRETE IN AGGRESSIVE GROUND

The results of laboratory testing have indicated that a worst case design class of DS-3 and subclass of AC-3 will be suitable for buried concrete on this site. This is in response to a maximum water soluble sulphate concentration of 1510mg/l and a minimum pH value of 7.9.

Pyrite was noted within the London Clay Formation from 8.50mbgl. If deep foundations are to be considered further testing for the presence of oxidisable sulphide may be required. It should be noted that the groundwater was not noted to be present within the London Clay Formation.

9.0 GEO-ENVIRONMENTAL TESTING

9.1 SOIL ANALYSIS

Three soil samples were submitted to QTS Environmental, a UKAS and MCERTS accredited laboratory testing facility, for a screen of contamination testing from the Made Ground.

Testing included an asbestos screen, heavy metals and hydrocarbons including speciated Total Petrol Hydrocarbons (TPH LQM aromatic/aliphatic split), BTEX, MTBE and speciated Polycyclic Aromatic Hydrocarbons (PAH), as well as a background suite of pH, SOM, total cyanide, and total phenols.

One sample of the Made Ground material was also subjected to a full suite of Waste Acceptance Criteria (WAC) analyses.

9.2 SCREENING CRITERIA

The results of this laboratory testing have been compared to published guidance criteria, widely referred to by consultants and Regulatory Authorities within the industry, and include the following:

- Published Land Quality Management (LQM) Suitable for Use Levels (S4UL) (LQM, 2015);
- As there is no UK GAC for Cyanide, the Dutch Intervention Value (DIV) will be adopted;
- As there is no UK GAC for Lead, the Category 4 Screening Level (C4SL) will be adopted (CL:AIRE, 2014);
- In the case of Asbestos and MTBE, the Detection Limits have been adopted as the GAC.

Comparisons were made against guidance criteria for the '**commercial'** land use setting, based on the end use of the site.

9.3 SOIL RESULTS

A summary of soil results is presented in the following paragraphs and tables, including further discussion.

9.3.1 COMPARISON OF LABORATORY ANALYSIS WITH ADOPTED COMMERCIAL GACS (mg/kg)

Determinand	GAC	Source	Min	Max	Exceeded
Asbestos	*DL*	*CE*	*ND*	*ND*	-
Total Cyanide	*50*	*DIV*	*BDL*	*BDL*	-
Total Phenols	*760*	*LQM*	*BDL*	*BDL*	-
Arsenic	*640*	*LQM*	*12*	*13*	-
Cadmium	*190*	*LQM*	*0.3*	*0.4*	-
Chromium	*8600*	*LQM*	*14*	*18*	-

Copper	*68000*	*LQM*	*77*	*127*	-
Lead	*6600*	*C4SL*	*156*	*352*	-
Mercury	*1100*	*LQM*	*1.9*	*2.1*	-
Nickel	*980*	*LQM*	*19*	*55*	-
Selenium	*12000*	*LQM*	*BDL*	*BDL*	-
Zinc	*730000*	*LQM*	*71*	*89*	-
Naphthalene	*190*	*LQM*	*BDL*	*0.92*	-
Acenaphthylene	*83000*	*LQM*	*BDL*	*BDL*	-
Acenaphtene	*84000*	*LQM*	*BDL*	*1.06*	-
Fluorene	*63000*	*LQM*	*BDL*	*0.64*	-
Phenanthrene	*22000*	*LQM*	*BDL*	*8.50*	-
Anthracene	*520000*	*LQM*	*BDL*	*1.29*	-
Fluoranthene	*23000*	*LQM*	*BDL*	*9.91*	-
Pyrene	*54000*	*LQM*	*BDL*	*8.00*	-
Benzo(a)anthracene	*170*	*LQM*	*BDL*	*3.75*	-
Chrysene	*650*	*LQM*	*BDL*	*3.58*	-
Benzo(b)fluoranthene	*44*	*LQM*	*BDL*	*3.69*	-
Benzo(k)fluoranthene	*1200*	*LQM*	*BDL*	*1.33*	-
Benzo(a)pyrene	*35*	*LQM*	*BDL*	*2.58*	-
Indeno(1,2,3-cd)perylene	*500*	*LQM*	*BDL*	*1.89*	-
Dibenz(a,h)anthracene	*3.5*	*LQM*	*BDL*	*0.31*	-
Benzo(ghi)perylene	*3900*	*LQM*	*BDL*	*1.59*	-
Benzene	*27*	*LQM*	*BDL*	*BDL*	-
Toluene	*56000*	*LQM*	*BDL*	*BDL*	-
Ethylbenzene	*5700*	*LQM*	*BDL*	*BDL*	-
Total Xylenes	*5900*	*LQM*	*BDL*	*BDL*	-
MTBE	*DL*	*CE*	*BDL*	*BDL*	-
Aliphatic >C5-C6	*3200*	*LQM*	*BDL*	*BDL*	-
Aliphatic >C6-C8	*7800*	*LQM*	*BDL*	*BDL*	-
Aliphatic >C8-C10	*2000*	*LQM*	*BDL*	*BDL*	-
Aliphatic >C10-C12	*9700*	*LQM*	*BDL*	*BDL*	-
Aliphatic >C12-C16	*59000*	*LQM*	*BDL*	*BDL*	-
Aliphatic >C16-C21	*1600000*	*LQM*	*BDL*	*BDL*	-
Aliphatic >C21-C35	*1600000*	*LQM*	*BDL*	*BDL*	-
Aromatic >C5-C7	*2600*	*LQM*	*BDL*	*BDL*	-
Aromatic >C7-C8	*5600*	*LQM*	*BDL*	*BDL*	-
Aromatic >C8-C10	*3500*	*LQM*	*BDL*	*BDL*	-
Aromatic >C10-C12	*16000*	*LQM*	*BDL*	*BDL*	-
Aromatic >C12-C16	*36000*	*LQM*	*BDL*	*8*	-
Aromatic >C16-C21	*28000*	*LQM*	*BDL*	*39*	-
Aromatic >C21-C35	*28000*	*LQM*	*BDL*	*41*	-

The soil laboratory analysis has revealed no exceedances of the adopted **commercial** GAC values, therefore no additional remedial actions are considered to be warranted regarding contamination at this site. It would be prudent to follow a Discovery Strategy during the construction phase.

Full laboratory results can be viewed in Appendix E.

9.4 WAC TESTING

One WAC tests were undertaken to determine the likely landfill classification for the offsite disposal of materials. Results are summarised in the table below.

Sample ID	Material	Location and Depth	Likely Landfill
WAC1	*Made Ground*	*BH1 – 0.70mbgl*	*Inert Landfill*

10.0 GEO-ENVIRONMENTAL DISCUSSION

10.1 DISCUSSION OF FINDINGS

The aims of the Site Investigation were to: target proposed areas of development and; provide additional coverage of the remainder of the site.

Laboratory testing revealed no exceedances of the adopted **commercial** GACs. As a result, no large scale remedial measures are likely to be required as a part of the redevelopment of site.

10.2 UPDATED CONCEPTUAL SITE MODEL

The original conceptual site model outlined in the Phase 1 Environmental Risk Assessment[1] identified potential made ground from previous site uses to be the only potentially significant source of contamination on site.

The results of the laboratory analytical testing and observations during the site works has allowed for this model to be updated to reflect the findings of the investigation.

A revised source-pathway-receptor assessment is presented in the following table.

Source	Pathway	Receptor	Likelihood	Potential Risk
Potential Made Ground from previous site uses.	Inhalation, ingestion and dermal contact	End Users	Unlikely	Low
		Site Workers (during development)	Probable	Low
	Impacted soils	Services	Unlikely	Low
	Volatilisation of hydrocarbons	End Users and Proposed Development	Unlikely	Low
		Site Workers (during development)	Possible	Low

	Infiltration and migration of contaminants	Superficial Secondary A aquifer underlying the site	Possible	Low

11.0 GEO-ENVIRONMENTAL RECOMENDATIONS

The following recommendations are based on the plans proposed at the time of writing this report and may be subject to change.

11.1 IMPLEMENTATION OF A DISCOVERY STRATEGY

No exceedances of the adopted GACs were observed during laboratory testing, however, it is recommended that the following discovery strategy is followed during the construction phase of the project.

If any previously unidentified contamination is observed or suspected during the construction phase, the following procedures should be adhered to. Materials excavated should be placed onto an impermeable cover to prevent any potential cross contamination.

Potential Contamination

Potential contamination can be identified by the following;

- Oily odour or sheen
- Solvent odour
- Potentially contaminative anthropogenic materials
- Fragments of asbestos sheeting

This list is not exhaustive and a thorough watching brief should be maintained throughout works.

If any previously unidentified contamination is observed during the watching brief, it is recommended that the site manager decides if the material is potentially contaminated and to inform Constructive Evaluation, who will send a representative to site for sampling and a visual appraisal of the materials. It is recommended that the material is cordoned off until it has been determined as contaminated or otherwise.

11.2 WASTE DISPOSAL

WAC testing of materials on site indicates that the material can be disposed of at an inert landfill. An explanation of Waste Disposal Guidance is presented below:

According to Technical Guidance WM3 – Waste Classification: Guidance on the classification and assessment of waste (2015), as part of Duty of Care, waste must be classified:

Before it is collected, disposed of or recovered;
To identify the controls that apply to the movement of the waste;
To complete waste documents and records;

To identify suitably authorised waste management options;
To prevent harm to people and the environment.

Before waste can be accepted at a landfill site, the landfill operator must be satisfied that the waste meets permit conditions, the waste acceptance procedures (WAP) and waste acceptance criteria (WAC).

11.3 WASTE ACCEPTANCE PROCEDURES

The WAP consist of three steps to identify and periodically check the main characteristics of the waste.

Level 1: basic characterisation – before waste is sent to landfill, its composition and properties must be verified to determine it is suitable for acceptance and at which class of site.

Level 2: compliance testing – if production of waste is regular, waste must be periodically checked to ensure that properties have not changed.

Level 3: on-site verification – each delivery must be checked to ensure that it is the expected waste and that it has not been contaminated in storage or transport.

11.3.1 WASTE ACCEPTANCE CRITERIA

The European Waste Catalogue (List of Waste Regulations) should be used in the determination of whether a waste is hazardous.

Waste producers must characterise waste for the Duty of Care Description whether or not it is intended to send it to landfill. This includes making an assessment of its hazardousness (is it classified hazardous waste or not) unless it is an absolute non-hazardous entry waste. This is achieved by reference to the List of Waste Regulations.

Note, WAC testing cannot be used to make an assessment of whether a waste is hazardous.

11.3.2 SUMMARY

Before a waste producer can take waste to a landfill site for disposal, they must check the landfill has the appropriate permit, and must have completed the following:

- Duty of Care transfer note/ Hazardous Waste consignment note;
- Pre-treatment declaration form;
- Waste code (using List of Wastes);
- Composition of the waste (by testing, if necessary); and
- WAC testing (if required).

Requirements are considered in more detail within Waste Acceptance at Landfills (2010).

It is prudent to ascertain the testing requirements of the waste facility prior to the movement of any spoil. All relevant dockets will need to be kept to provide evidence of the removal of waste. If in doubt, the Environment Agency should be contacted for advice at an early stage to avoid any delays.

A copy of such documentation should be retained and forwarded to CE for inclusion into a verification/validation report, where required.

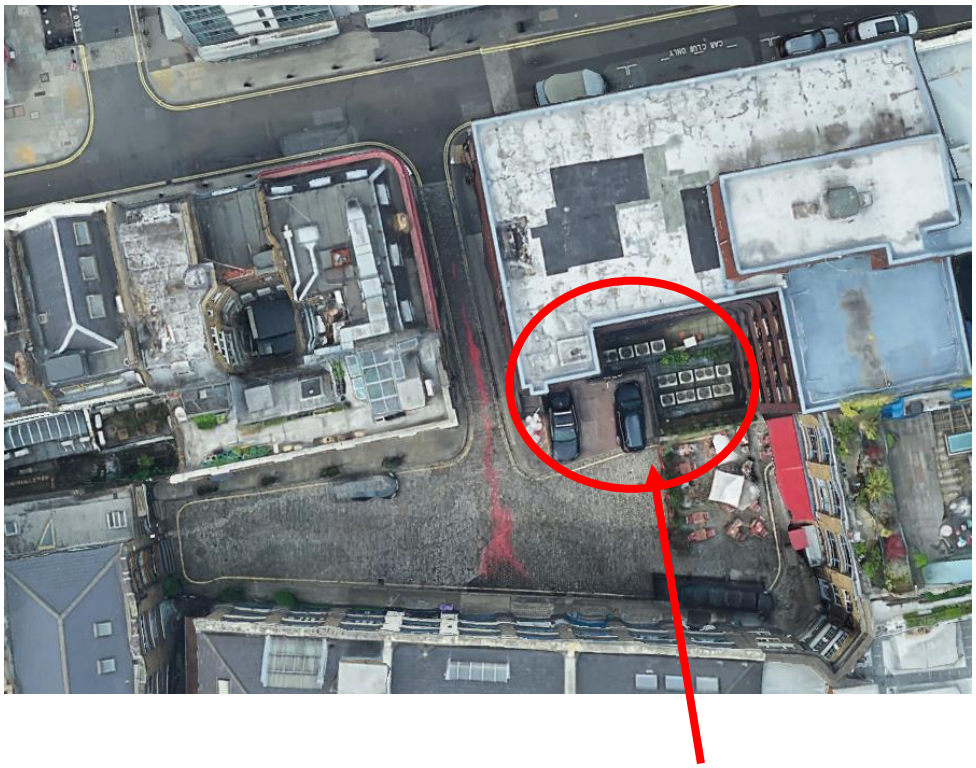
12.0 STATUTORY CONSULTEES

We would recommend that this report be forwarded to the relevant Statutory Consultees including the Local Council's Environmental Health and Planning Department to seek their comments and subsequent approval prior to works commencing on site.

The Statutory Authorities may require a Validation and/or closure report providing documentation/audit trail for the importation/removal/reuse of material on site and any other remedial works completed on site.

Figures

constructiveevaluation site investigation • building pathology	20-23 Greville Street			Project Ref. **19.1170**
Unit 15 & 16, Ford Lane Business Park, Arundel, BN18 0UZ				Sheet 1 of 1
Telephone: 01243 533499 Web Address: www.celtduk.com	Created By: **ME**	Checked: **DH**	Approved: **DH**	Date: January 2020



Greville Street location is within Holborn, a borough of south east London at the approximate grid reference TQ 31460 81725. The postcode of the site is EC1N 8SJ

Reproduced by permission of H.M. Stationery Office.	Map extracted at a scale of 1:25,000	N

Site Location

Scale: NTS

FIGURE 1

Appendix A – Site Investigation Photographs

Investigation Photographs

Project Ref: 19.1170

Site Name: 20-23 Greville Street

1.

2.

3.

4.

1) The site from Bleeding Heart Yard
2) WS1 concrete core
3) WS1 completed location
4) Window sampling at WS2

Investigation Photographs

Project Ref: 19.1170

Site Name: 20-23 Greville Street

5.

6.

:

5) Cable Percussive Rig at BH1

6) Concrete core through retaining wall

Appendix B – Borehole Logs

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Borehole Log

Borehole No.
BH01
Sheet 1 of 2

Project Name: 20-23 Greville Street	Project No. 19.1170	Co-ords:	Hole Type CP
Location:		Level:	Scale 1:50
Client: Avison Young		Dates: 16/10/2019	Logged By DCM

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.02			Red Brick Tiles CONCRETE
					0.32			Dark brown clayey sandy GRAVEL. Sand is fine to coarse, Gravel is angular to sub-rounded, fine to coarse of flint, brick and concrete. (MADE GROUND)
		0.50	ES		0.50 0.61			CONCRETE
		1.00	D		1.00			Brown clayey sandy GRAVEL. Sand is fine to coarse. Gravel is angular to sub-rounded, fine to coarse of flint, red brick and rare plastic. (MADE GROUND)
		1.20 - 1.65 1.20	D SPT	N=0 (1,0/0,0,0,0)				Brown slightly clayey to clayey gravelly fine to coarse SAND. Gravel is angular to sub-angular, fine to coarse of red brick, ceramic, flint and rusted metal. (MADE GROUND)
		2.00 2.00 - 2.45 2.00 - 2.45 2.00	D B D SPT	N=0 (1,0/0,0,0,0)	2.00			Dark brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-angular, fine to coarse of red brick and flint. Occasional pockets up to 10mm black organic clays. Occasional pockets up to 10mm grey white clayey sand. (MADE GROUND)
		3.00 3.00 - 3.45 3.00	D D SPT	N=13 (3,5/4,3,3,3)	3.10			*Becoming green brown.*
					3.40			Orange brown gravelly fine to coarse SAND. Gravel is sub-rounded to rounded, fine to coarse of flint. (RIVER TERRACE DEPOSITS)
		4.00 4.00 - 4.45 4.00	D B SPT	N=8 (1,2/2,1,2,3)	4.00			Soft becoming firm orange brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub-rounded to rounded, fine to coarse of flint. Occasional blue grey gleying within clays. (WEATHERED LONDON CLAY FORMATION)
		5.00 5.00 - 5.45 5.00 - 5.45	D B U					Firm to stiff dark brown CLAY. Occasional sub-angular, fine to coarse gravel of claystone. Rare fine sand size selenite crystals. 1no. 100 x 45mm cobble claystone. (LONDON CLAY FORMATION)
					5.40			Stiff fissured dark grey CLAY. Fissures are randomly orientated, planar, curved and polished. Rare sub-angular, fine gravel of claystone. (LONDON CLAY FORMATION)
		6.00	D					
		6.50	SPT	N=35 (25 for 145mm/21,7,4,3)				
		7.00	D					
		8.00 8.00 - 8.45	D U					
		8.50	D		8.50			Very stiff dark grey silty CLAY. Occasional partings grey white fine sand. Occasional 1-2mm white foram tests. Occasional pyritised wood and nodular pyrite. (LONDON CLAY FORMATION)
		9.00	D					*Dark greenish grey with rare fine sand size selenite.*
		9.50	SPT	N=14 (1,2/3,3,4,4)				
		10.00	D					

Remarks

AGS

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Borehole Log

Borehole No.
BH01
Sheet 2 of 2

Project Name: 20-23 Greville Street	Project No. 19.1170	Co-ords:	Hole Type CP
Location:		Level:	Scale 1:50
Client: Avison Young		Dates: 16/10/2019	Logged By DCM

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00	D					Very stiff dark grey silty CLAY. Occasional partings grey white fine sand. Occasional 1-2mm white foram tests. Occasional pyritised wood and nodular pyrite. (LONDON CLAY FORMATION)	11
		11.00 - 11.45	U					*Locally fissured. Fissures are sub-vertical, planar, smooth and matt.*	
		11.50	D						
		12.00	D		12.00			End of Borehole at 12.000m	12
									13
									14
									15
									16
									17
									18
									19
									20

Remarks

AGS

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Borehole Log

Borehole No.
WS1
Sheet 1 of 1

Project Name: 20-23 Greville Street	Project No. 19.1170	Co-ords:	Hole Type WS
Location:		Level:	Scale 1:25
Client: Avison Young		Dates: 26/07/2019	Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05			CONCRETE SLAB
					0.20			Pinkish grey sandy subangular to rounded medium to coarse GRAVEL FILL. Sand is medium to coarse.
								CONCRETE SLAB
					0.80			Firm brown thinly laminated CLAY with rare grey mottling and rare pockets of orange medium to coarse sand.
		0.90	ES					
		1.00	B					
		1.50	B					
		2.00	B					
		2.50	B					
		3.00	B		3.00			End of Borehole at 3.000m

1
2
3
4
5

Remarks

AGS

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Borehole Log

Borehole No.
WS2
Sheet 1 of 1

Project Name: 20-23 Greville Street	Project No. 19.1170	Co-ords:	Hole Type WS
Location:		Level:	Scale 1:25
Client: Avison Young		Dates: 26/07/2019	Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05			CONCRETE SLAB
					0.30			Orange brown gravelly medium to coarse SAND FILL. Gravels are medium to coarse angular to subrounded.
								End of Borehole at 0.300m

1
2
3
4
5

Remarks
Location refused at 0.30mbgl due to dense granular materials.

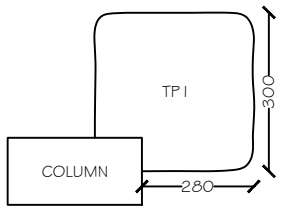
AGS

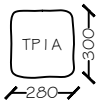
Appendix C - Foundation Pit Drawings

NOTES

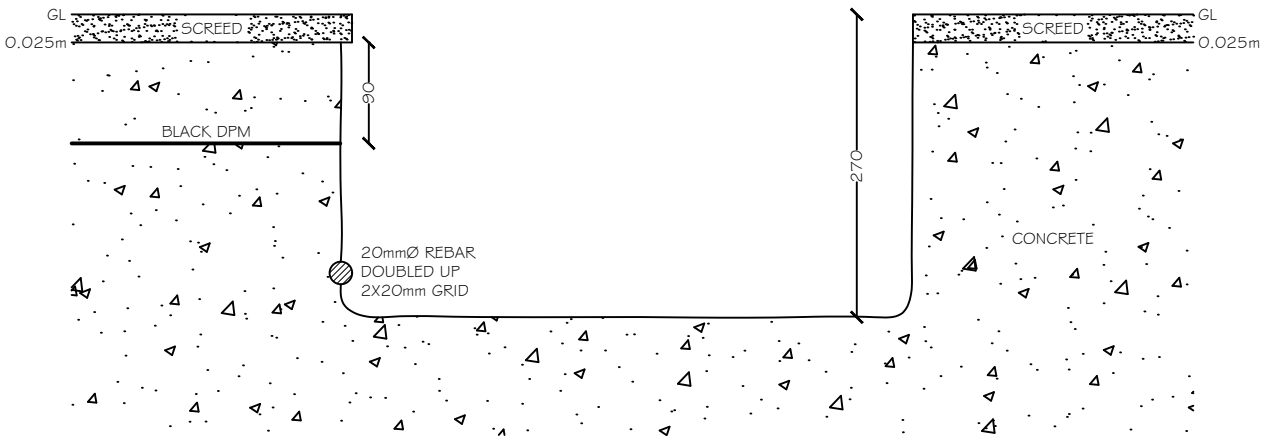
1. Do not scale from this drawing Use figured dimensions only.
2. All dimensions must be checked on site prior to commencement of work.
3. Where applicable this drawing is to be read in conjunction with other consultants drawings.
4. This drawing is the copyright of Constructive Evaluation Ltd.

TRIAL PIT 1 PLAN





TRIAL PIT 1 SECTION



rev	date	amendment	check

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Client.
AVISON YOUNG

Project.
20-23 GREVILLE STREET

Drawing. TP1 scale NTS

date JUL 19	drawn D.Y	checked
drawing number 19.1170		revision

NOTES

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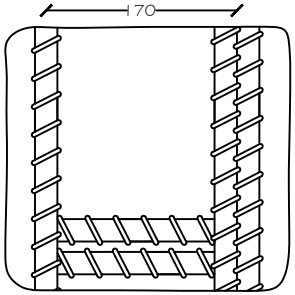
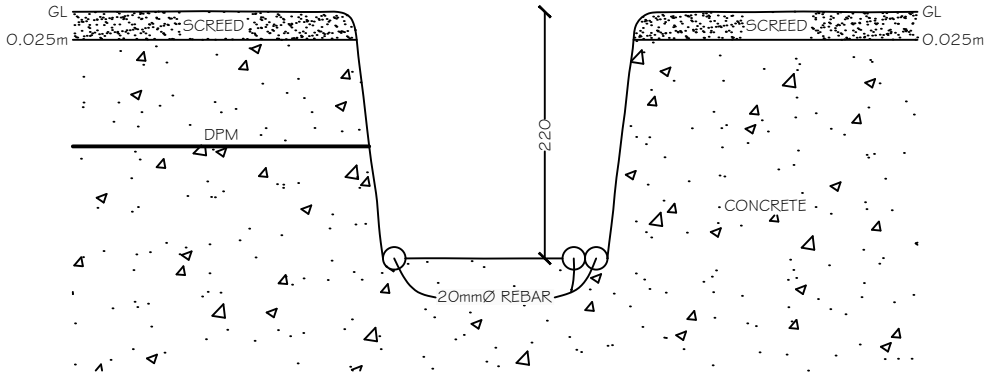
TRIAL PIT 1A PLAN



TRIAL PIT 1A SECTION



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Drawing. TP1A
scale NTS

date JUL 19	drawn D.Y	checked
drawing number 19.1170		revision

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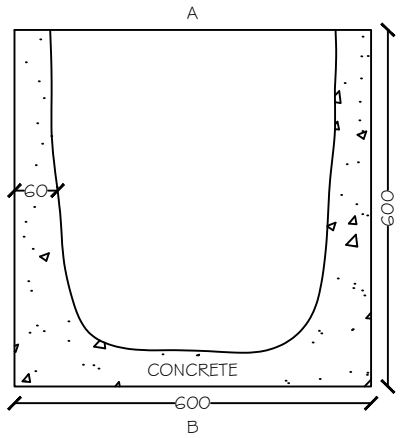
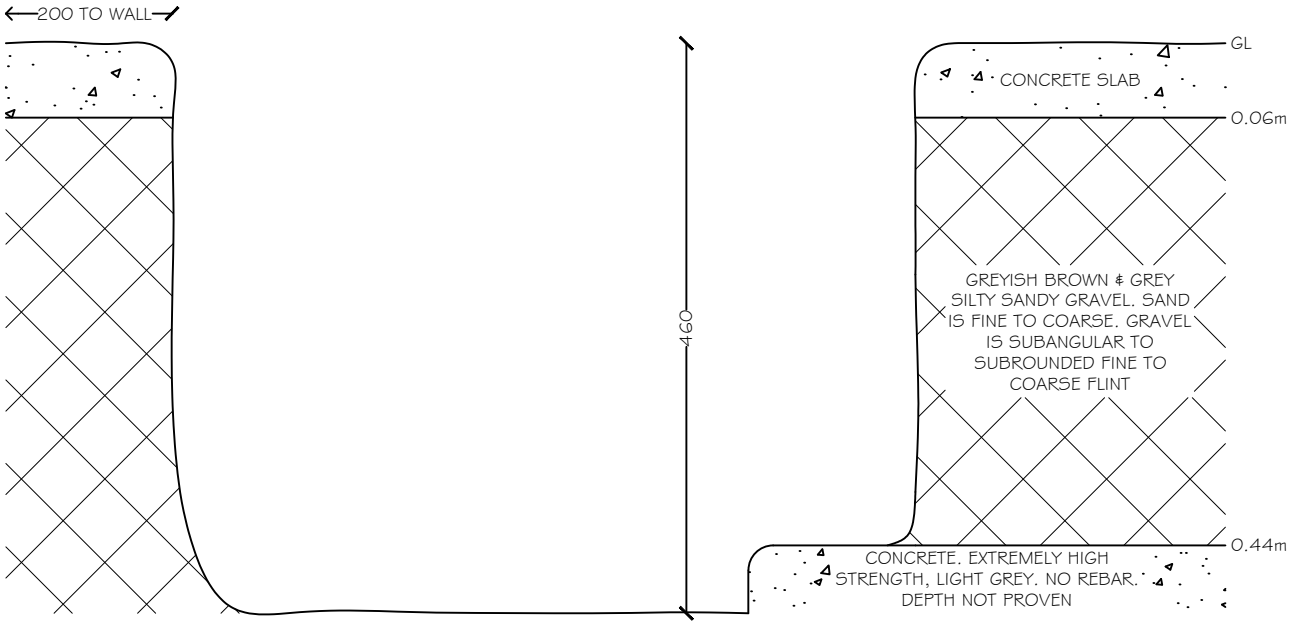
TRIAL PIT 2 PLAN



TRIAL PIT 2 SECTION A-B



rev	date	amendment	check

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Drawing. TP2 scale NTS

date JUL 19	drawn D.Y	checked
drawing number 19.1170		revision

NOTES

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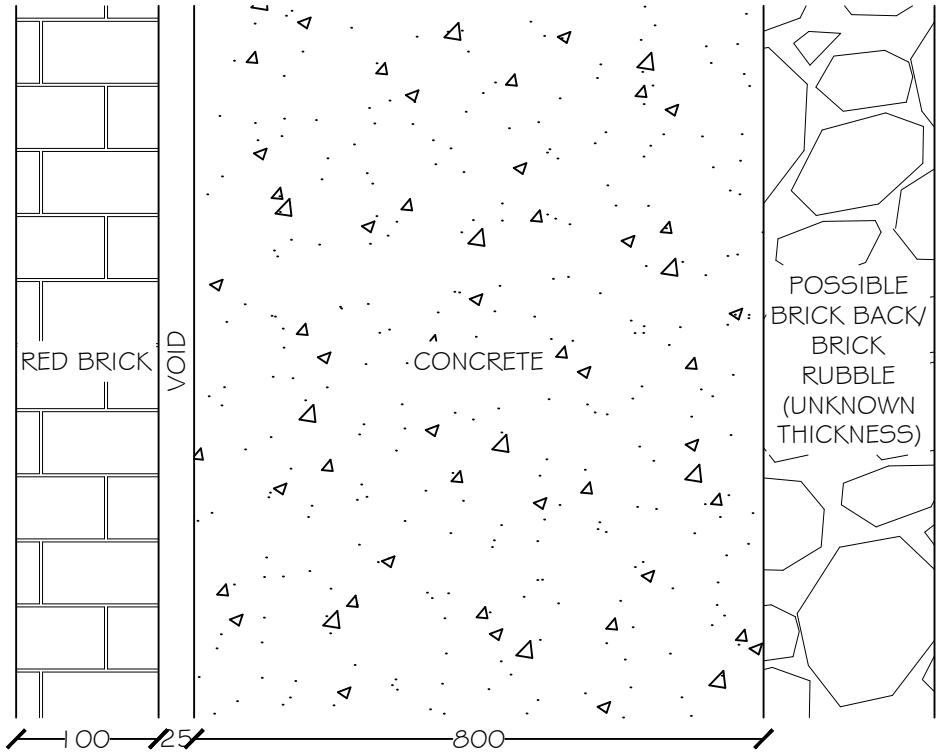
2. All dimensions must be checked on site prior to commencement of work.
3. Where applicable this drawing is to be read in conjunction with other consultants drawings.
4. This drawing is the copyright of Constructive Evaluation Ltd.

RETAINING WALL DETAIL



CORED TO 800mm (800mm THICK CONCRETE)
PROVEN TO 850mm WITH HILTI DRILL
POSSIBLE BREAKTHROUGH INTO SOFTER/LOOSE BACKFILL AT 850mm

rev	date	amendment	check

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Client.
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20-23 GREVILLE STREET

Drawing. RETAINING WALL DETAIL
scale NTS

date NOV 19	drawn D.Y	checked
drawing number 19.1170		revision

Appendix D – Geotechnical Laboratory Testing

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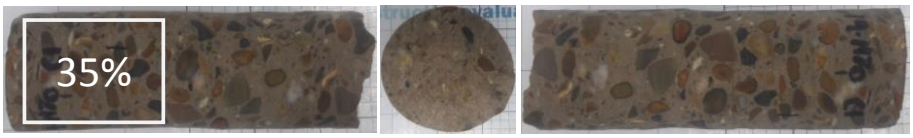
CORE COMPRESSION TEST REPORT

In accordance with BS EN 12390, BS EN 12504 and BS 1881

Project No	**19.1170**
Project Name	**20-23 Greville Street**
Client	**Avison Young**

Date of Coring	18/10/2019	***Operative***	G.B.L.
Floor Level/Position	**Retaining Wall**		

SPECIMEN DETAIL	***Core No./Ref***	**C1 - Retaining Wall**
Presence of Abnormalities	Minor ribbing throughout due to irregular coring	
Max Nominal Size of Aggregate (mm)	24	
Aggregate Details	Fairly well sorted, rounded-sub rounded, fairly well distributed	
Reinforcement (as received)	None	
Estimated Excess Voidage (%)	0.0%	
Max/Min Length as Received (mm)	247/223	
Mass of Sample as Received (including rebar where stated) (Kg)	2.2174	
Density as Received (including rebar where stated (kg / m³)	2452	
Method of End Preparation	**Diamond Saw**	
Mean Length after Preparation (mm)	70	
Mean Diameter after Preparation (mm)	70	
Tested Portion in relation to length recieved		
Length to Diameter Ratio	1.00	
Reinforcement present (after preparation)	None	
Mass of Tested Sample (including rebar where stated) (Kg)	0.6940	
Tested Density (kg / m³)	2576	

Date Tested	29/10/2019	
Test Performed	**Compressive Strength Test**	
Surface Moisture Condition at Time of Test	Wet	
Maximum Failure Load (kN)	104	
Failure Mode *(diagrams taken from BS EN 12390-3:2001 [E], Fig.3 - Satisfactory failures of cylinder specimens)*	Hourglass	
Measured Compressive Strength (N/mm²)	**27.0**	
Estimated In-Situ Cube Strength (N/mm²)	**24.9**	
Remarks		

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Examination, Preparation and Test Procedure(s):	BS EN 12390: Testing Hardened Concrete: Parts 1-8: 2000			
	BS EN 12504: Testing Concrete In Structures: Parts 1-4: 2000			
	BS 1881: Testing Concrete: 1983			
Checked and Approved:	**B.R. (LabMngr)**	B. Rawlinson	**29/10/2019**	

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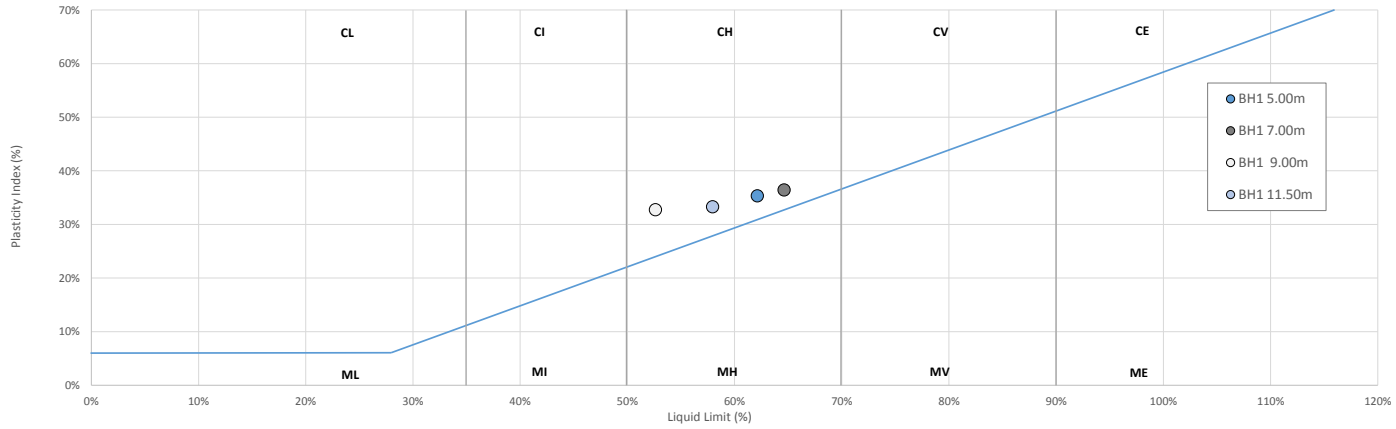
LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX

SUMMARY OF RESULTS

Project No	**19.1170**
Project Name	**20-23 Greville Street**
Client	**Avison Young**

Hole ID	Depth (m)	Moisture Content (W%)	Liquid Limit (WL%)	Plastic Limit (WP%)	Plasticity Index (IP%)	Portion retained on 425µm Sieve (%)	Modified PI (I'p%)	Soil Classification	Consistency Index (Ipc)	Sample description	Volume change potential			Remarks
											Low	Medium	High	
BH1	**5.00m**	32%	62%	27%	35%	3%	34%	**CH**	0.85	**Brown CLAY with occasional coarse gravel of claystone**	No	Yes	No	
BH1	**7.00m**	33%	65%	28%	36%	2%	36%	**CH**	0.87	**Dark grey CLAY with occasional fine gravel of claystone**	No	Yes	No	
BH1	**9.00m**	24%	53%	20%	33%	0%	33%	**CH**	0.88	**Grey silty CLAY**	No	Yes	No	
BH1	**11.50m**	26%	58%	25%	33%	0%	33%	**CH**	0.96	**Grey silty CLAY**	No	Yes	No	



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Test Procedure(s):	BS1377: Part 2: Clause 3.2: 1990: Determination of moisture content by the oven drying method	
	BS1377: Part 2: Clause 4.4: 1990: Determination of the liquid limit by the cone penetrometer method	
	BS1377: Part 2: Clause 5.0: 1990: Determination of the plastic limit and plasticity index	
Checked and Approved	**B.R. (LabMngr)**	B. Rawlinson ##

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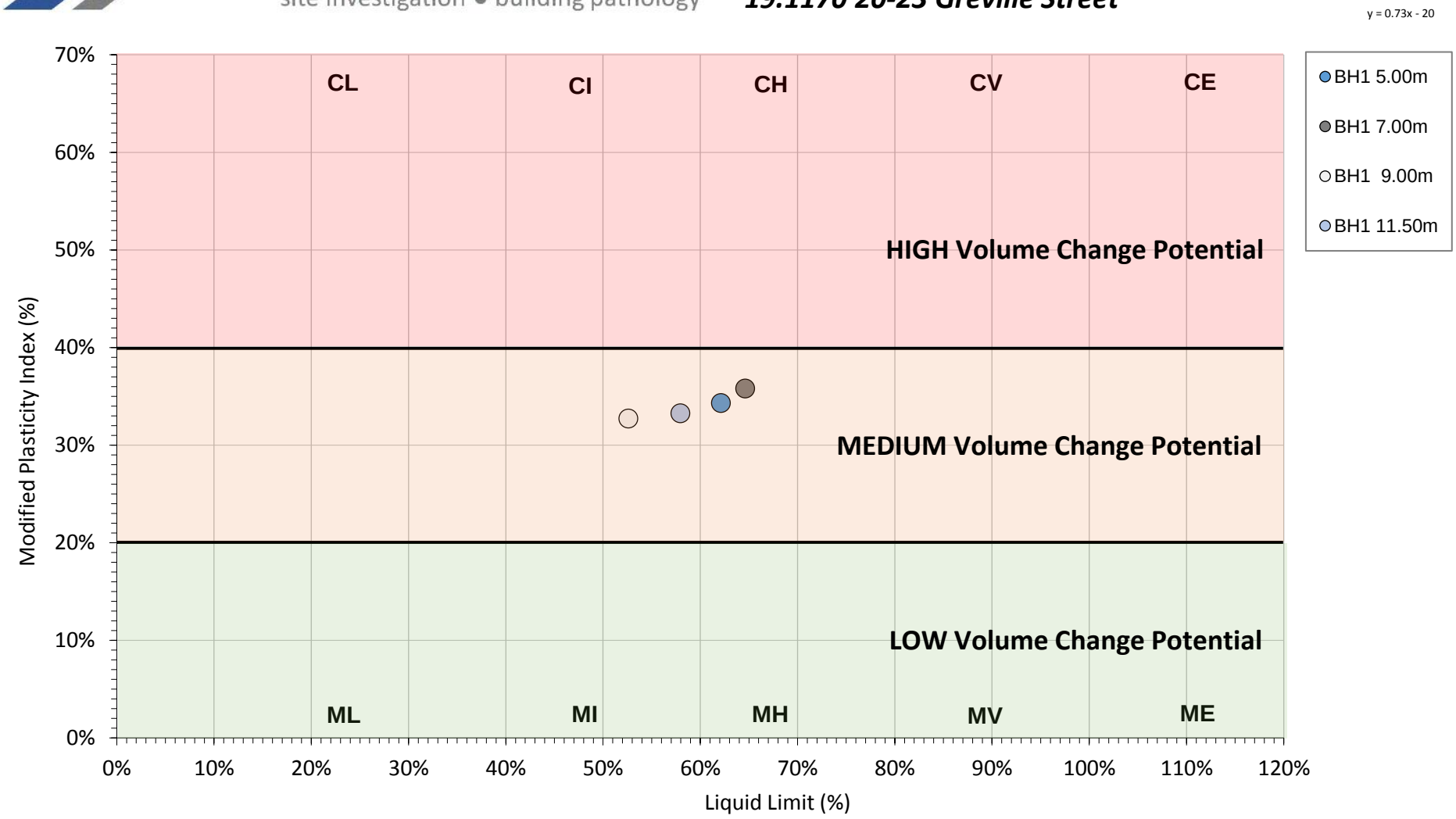
NHBC Volume Change Potential:

19.1170 20-23 Greville Street



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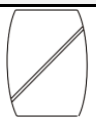
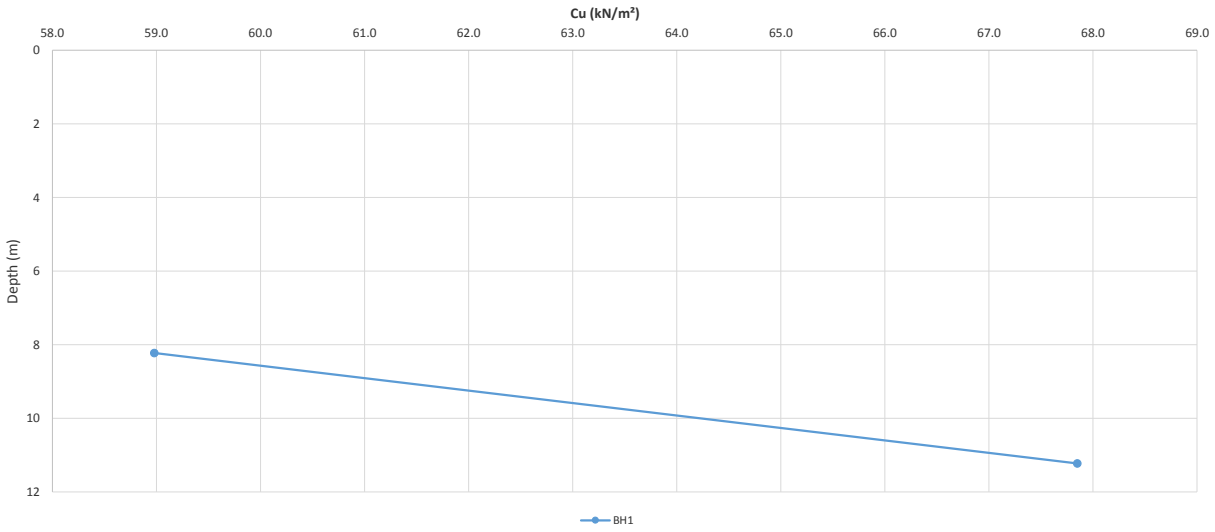
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION

SUMMARY OF RESULTS

Project No	**19.1170**
Project Name	**20-23 Greville Street**
Client	**Avison Young**

Hole ID	Depth (m)	Sample Description	Cell Test Pressure (kN/m²)	Bulk Density (Mg/m³)	BS 1377 Moisture Content (W%)	**Undrained Shear Strength (kN/m²)**	Strain at Failure	Strength Term	Failure Mode
BH1	8.00-8.45m	Firm to stiff closely fissured locally greyish brown locally sandy silty CLAY. Pockets of fine gravel-sized pyritisied wood. Occasional pockets of medium-sand sized selenite crystals.	160	2.02	32%	**59.0**	12.5%	Medium Strength	
BH1	11.00-11.45m	Firm to stiff locally very stiff closely fissured greyish brown locally gravelly locally sandy silty CLAY. Occasional Foraminifera. Pockets of fine gravel sized pyritised wood and nodular pyrite.	220	2.11	26%	**67.8**	6.0%	Medium Strength	



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Test Procedure(s):	BS1377: Part 2: Clause 3.2: 1990: Determination of moisture content by the oven drying method		
	BS1377: Part 7: Clause 8: 1990: Determination of undrained shear strength in triaxial compression without measurement of pore pressure (definitive method)		
Checked and Approved:	**B.R. (LabMngr)**	B. Rawlinson	**29/10/2019**

Appendix E – Environmental Laboratory Testing

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Rose Lane
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t: 01622 850410

4480

DETS Report No: 19-15190

Site Reference:	20 - 23 Greville Street
Project / Job Ref:	19.1170
Order No:	19.1170/DM
Sample Receipt Date:	28/10/2019
Sample Scheduled Date:	28/10/2019
Report Issue Number:	1
Reporting Date:	01/11/2019

Authorised by:

Dave Ashworth
Technical Manager

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate						
DETS Report No: 19-15190	**Date Sampled**	17/10/19	17/10/19	17/10/19		
Constructive Evaluation Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: 20 - 23 Greville Street	**TP / BH No**	BH1	BH1	BH1		
Project / Job Ref: 19.1170	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: 19.1170/DM	**Depth (m)**	0.35	0.70	2.00		
Reporting Date: 01/11/2019	**DETS Sample No**	443960	443961	443962		

Determinand	Unit	RL	Accreditation					
Asbestos Screen (S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	10.9	10.6	7.9		
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2		
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	338	130	1510		
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.34	0.13	1.51		
Organic Matter	%	< 0.1	MCERTS	1	1.1	2.7		
Arsenic (As)	mg/kg	< 2	MCERTS	13	12	13		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	0.4	0.3		
Chromium (Cr)	mg/kg	< 2	MCERTS	14	16	18		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	85	127	77		
Lead (Pb)	mg/kg	< 3	MCERTS	156	211	352		
Mercury (Hg)	mg/kg	< 1	NONE	2.1	2.1	1.9		
Nickel (Ni)	mg/kg	< 3	MCERTS	55	28	19		
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3		
Zinc (Zn)	mg/kg	< 3	MCERTS	81	89	71		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2		
TPH - Aliphatic >C35 - C40	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
TPH - Aromatic >C35 - C40	mg/kg	< 10	MCERTS	41	< 10	< 10		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C
Subcontracted analysis (S)

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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 19-15190	**Date Sampled**	17/10/19	17/10/19	17/10/19		
Constructive Evaluation Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: 20 - 23 Greville Street	**TP / BH No**	BH1	BH1	BH1		
Project / Job Ref: 19.1170	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: 19.1170/DM	**Depth (m)**	0.35	0.70	2.00		
Reporting Date: 01/11/2019	**DETS Sample No**	443960	443961	443962		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	0.19	0.92	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	0.63	1.06	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	0.44	0.64	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	7.38	8.50	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	0.94	1.29	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	9.91	7.11	< 0.1		
Pyrene	mg/kg	< 0.1	MCERTS	8	5.65	< 0.1		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	3.75	1.91	< 0.1		
Chrysene	mg/kg	< 0.1	MCERTS	3.58	2	< 0.1		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	3.69	1.69	< 0.1		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	1.33	0.51	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	2.58	1.08	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	1.89	0.64	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	0.31	0.11	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	1.59	0.59	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	46.2	33.7	< 1.6		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

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Soil Analysis Certificate - TPH LQM Banded							
DETS Report No: 19-15190	**Date Sampled**	17/10/19	17/10/19	17/10/19		
Constructive Evaluation Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: 20 - 23 Greville Street	**TP / BH No**	BH1	BH1	BH1		
Project / Job Ref: 19.1170	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: 19.1170/DM	**Depth (m)**	0.35	0.70	2.00		
Reporting Date: 01/11/2019	**DETS Sample No**	443960	443961	443962		

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C16 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aliphatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10		
Aliphatic (C5 - C44)	mg/kg	< 30	NONE	< 30	< 30	< 30		
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	5	8	< 2		
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	39	39	< 3		
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	41	28	< 10		
Aromatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10		
Aromatic (>C5 - C44)	mg/kg	< 30	NONE	85	76	< 30		
Total >C5 - C44	mg/kg	< 60	NONE	85	76	< 60		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-15190	**Date Sampled**	17/10/19	17/10/19	17/10/19		
Constructive Evaluation Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied		
Site Reference: 20 - 23 Greville Street	**TP / BH No**	BH1	BH1	BH1		
Project / Job Ref: 19.1170	**Additional Refs**	None Supplied	None Supplied	None Supplied		
Order No: 19.1170/DM	**Depth (m)**	0.35	0.70	2.00		
Reporting Date: 01/11/2019	**DETS Sample No**	443960	443961	443962		

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5		
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2	5		
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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UKAS TESTING 4480

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

				Landfill Waste Acceptance Criteria Limits		
DETS Report No: 19-15190	**Date Sampled**	17/10/19		**Inert Waste Landfill**	**Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Constructive Evaluation Ltd	**Time Sampled**	None Supplied				
Site Reference: 20 - 23 Greville Street	**TP / BH No**	BH1				
Project / Job Ref: 19.1170	**Additional Refs**	None Supplied				
Order No: 19.1170/DM	**Depth (m)**	0.70				
Reporting Date: 01/11/2019	**DETS Sample No**	443961				
Determinand	**Unit**	**MDL**				
TOC[MU]	%	< 0.1	0.6	3%	5%	6%
Loss on Ignition	%	< 0.01	3.80	--	--	10%
BTEX[MU]	mg/kg	< 0.05	< 0.05	6	--	--
Sum of PCBs	mg/kg	< 0.1	< 0.1	1	--	--
Mineral Oil[MU]	mg/kg	< 10	< 10	500	--	--
Total PAH[MU]	mg/kg	< 1.7	33.7	100	--	--
pH[MU]	pH Units	N/a	10.6	--	>6	--
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	3.3	--	To be evaluated	To be evaluated

Eluate Analysis	**2:1 mg/l**	**8:1 mg/l**		**Cumulative 10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic[U]	< 0.01	< 0.01		< 0.2	0.5	2	25
Barium[U]	< 0.02	< 0.02		< 0.1	20	100	300
Cadmium[U]	< 0.0005	< 0.0005		< 0.02	0.04	1	5
Chromium[U]	0.022	0.007		< 0.20	0.5	10	70
Copper[U]	0.11	0.03		< 0.5	2	50	100
Mercury[U]	< 0.005	< 0.005		< 0.01	0.01	0.2	2
Molybdenum[U]	0.025	0.005		< 0.1	0.5	10	30
Nickel[U]	< 0.007	< 0.007		< 0.2	0.4	10	40
Lead[U]	< 0.005	< 0.005		< 0.2	0.5	10	50
Antimony[U]	< 0.006	< 0.006		< 0.06	0.06	0.7	5
Selenium[U]	< 0.005	< 0.005		< 0.1	0.1	0.5	7
Zinc[U]	< 0.005	< 0.005		< 0.2	4	50	200
Chloride[U]	8	2		26	800	15000	25000
Fluoride[U]	< 0.5	< 0.5		< 1	10	150	500
Sulphate[U]	367	50		938	1000	20000	50000
TDS	414	186		2173	4000	60000	100000
Phenol Index	0.01	< 0.01		< 0.5	1	-	-
DOC	15.4	16		159	500	800	1000
Leach Test Information							
Sample Mass (kg)	0.19						
Dry Matter (%)	90						
Moisture (%)	11.2						
Stage 1							
Volume Eluate L2 (litres)	0.33						
Filtered Eluate VE1 (litres)	0.24						

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepencies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test

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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 19-15190	
Constructive Evaluation Ltd	
Site Reference: 20 - 23 Greville Street	
Project / Job Ref: 19.1170	
Order No: 19.1170/DM	
Reporting Date: 01/11/2019	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 443960	BH1	None Supplied	0.35	11.5	Brown gravelly clay with stones and brick
$ 443961	BH1	None Supplied	0.70	10	Brown gravelly clay with stones
$ 443962	BH1	None Supplied	2.00	19.9	Brown clayey gravel with stones

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

$ samples exceeded recommended holding times

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Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 19-15190
Constructive Evaluation Ltd
Site Reference: 20 - 23 Greville Street
Project / Job Ref: 19.1170
Order No: 19.1170/DM
Reporting Date: 01/11/2019

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Appendix F – SPT Hammer Calibration Certificate

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Stuart Simmonds
Southern Testing Laboratories
Unit 11
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref:	IM2
Test Date:	08/02/2019
Report Date:	08/02/2019
File Name:	IM2.spt
Test Operator:	NPB

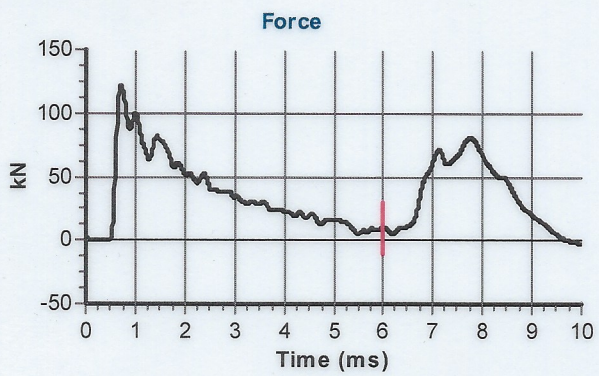
Instrumented Rod Data

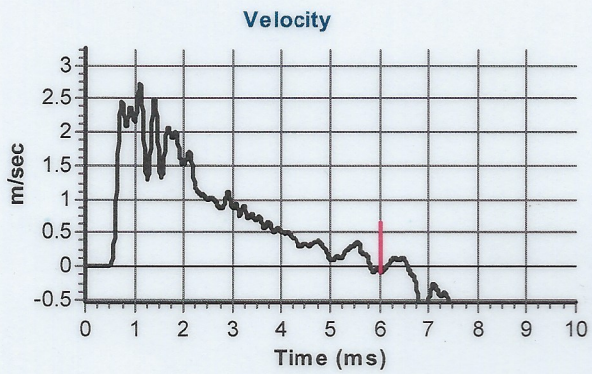
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

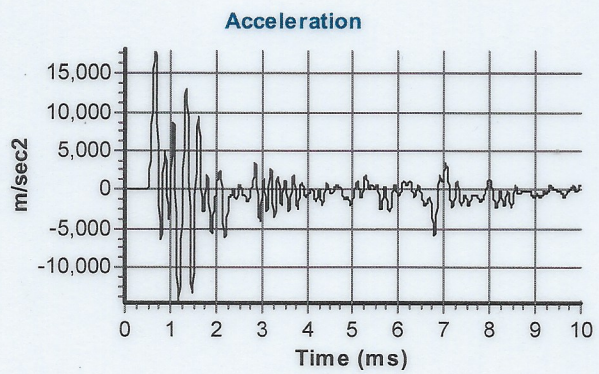
SPT Hammer Information

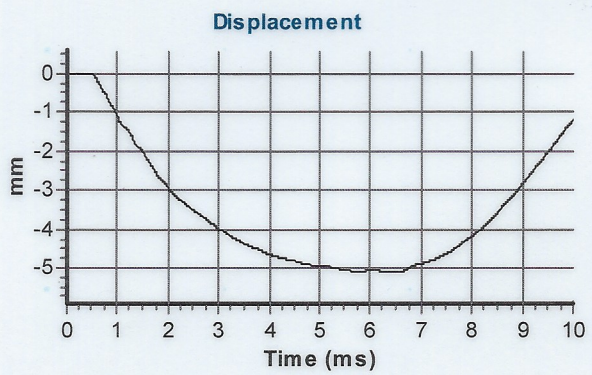
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	14.5

Comments / Location
CHARLWOODS









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	307

Energy Ratio E_r (%): **65**

Signed: S M Simmonds
Title: Field Operations Technician

The recommended calibration interval is 12 months

Appendix G - Report Terms and Conditions

Trading Terms

Unless specifically stated within the tender/quotation or unless identified within the introduction to this report it is confirmed that this report has been compiled wholly in accord with Constructive Evaluation Limited's terms of engagement. This report is provided for sole use by the Client and is confidential to them. No responsibility whatsoever for the contents of the report will be accepted to anyone other than the Client.

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Context

This report is written in the context of an agreed scope of work between Constructive Evaluation Limited and the Client and should not be used in a different context. In light of additional information becoming available, improved practices and changes in legislation amendment or re-interpretation of the report in whole or part may be necessary after its original submission.

Professional Interpretation

The recommendations made and opinions expressed in the report are based on the conditions revealed by the site works together with an assessment of the data from the insitu and laboratory testing or in respect of the desktop reports. No responsibility can be accepted for conditions that have not been revealed by the research, site works and testing.

The Client is advised that the conditions observed on site by Constructive Evaluation Limited at the time of any site survey may be subject to change. Certain indicators of the presence of hazardous substances may have been latent at the time of the most recent site reconnaissance and they may subsequently have become evident. It is not possible to assess areas which are inaccessible or where access is not granted and CE accept no liability for risks subsequently identified therein.

The conceptual model, Risk assessment and sampling regime has been formulated in accordance with current UK guidance at time of production based upon the relevant information gained from Phase 1 and Phase 2 investigations. While the model and assessment offer opinions and interpretations of these guidelines, the comments made are for guidance only and no liability can be accepted for their accuracy. It is possible that aspects of desktop study may need to be altered to conform to the requirements of the statutory regulatory bodies.

Intrusive Field Operations

The data collected through direct operations in the production of this report has been so obtained, unless directly otherwise stated, in accordance with current UK guidance, law or accepted industry practice, including but not limited to: BS.5930: 1990 Code of Practice for Site Investigations (Amendment 2: 2010), BS 10175:2011+A1:2013 Investigations into Potentially Contaminated Sites, and BS.8576:2013 Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds. Exact exploratory locations will depend upon access conditions, site use and plant capability, CE do not accept liability for issues arising from material identified between or outside of the area of exploratory locations.

Laboratory Testing

Unless stated otherwise within the text, all geotechnical and material laboratory tests have been performed in accordance with the relevant British Standard Documents. Laboratory testing for contaminated land assessment is completed under the UKAS / MCERTS accreditation schemes, unless identified as otherwise in the report.

Human Health Risk Assessment Criteria

The Environment Agency has recently undertaken revision of the Soil Guideline Values (SGVs) which are partially complete. Where standards are available using the "new" approach, these have been utilised for correlative purposes. Where standards have not yet been revised, guidance following the "old" approach has been utilised. Please note that upon release of the remaining guidelines, the standards contained within this report may be subject to change. In addition, the second edition of the LQM CIEH guidance has now been released and will be utilised in favour of previously published guideline values.

Third Parties

The findings and opinions conveyed in this report are based on information obtained from a variety of sources, including that from previous Site investigations and chemical testing laboratories. Constructive Evaluation Limited has assumed that such information is correct. Constructive Evaluation Limited cannot and does not guarantee the authenticity or reliability of the information it has relied upon and can accept no responsibility for inaccuracies with the data supplied by other parties.

The accuracy of the historical map extracts supplied cannot be guaranteed and it should be noted that different conditions may have existed between mapping sheet editions. Therefore, there can be no certainty that all areas of contamination have been identified during the Phase 1 investigation.

Definitions

Reference to the word “contamination” in this report does not relate to the statutory definition of contaminated land under 1990 Environmental Protection Act unless otherwise stated. The definition used in this report is: “Land that contains substances that, when present in sufficient quantities or concentrations, are likely to cause harm, directly or indirectly, to man, to the environment, or on occasion to other targets” (NATO CCMS, 1985). CE Ltd 2014