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PHASE 2: GROUND INVESTIGATION REPORT

TELMAC DEVLOPMENTS LIMITED

FORMER WEST BOLDON PRIMARY SCHOOL

NORTH ROAD

WEST BOLDON

TYNE AND WEAR

NE36 0QE

Project No: 21-218

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The information and/or advice contained in this Phase 2: Ground Investigation Report is based solely on, and is limited to, the boundaries of the site, the immediate area around the site, and the historical use(s) unless otherwise stated. This 'Report' has been prepared in order to collate information relating to the physical, environmental and industrial setting of the site, and to highlight, where possible, the likely problems that might be encountered when considering the future development of this site for the proposed end use. All comments, opinions, diagrams, cross sections and/or sketches contained within the report, and/or any configuration of the findings is conjectural and given for guidance only and confirmation of the anticipated ground conditions should be considered before development proceeds. Agreement for the use or copying of this report by any Third Party must be obtained in writing from Arc Environmental Limited (ARC). If a change in the proposed land use is envisaged, then a reassessment of the site should be carried out.

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Appendices

Appendix I	Location Plan, Aerial Photograph, Existing Site Layout Plan, Proposed Development Layout Plan
Appendix II	Exploratory Hole Location Plan, Borehole Record Sheets, Concrete Core Record Sheets
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1.0 Introduction

April 2021

As requested by TELMAC Developments Limited, and in conjunction with the Phase 1: Desk Top Study Report (Ref. No. 21-218), Phase 2: Ground Investigation works have been carried out within the former West Boldon Primary School, located off North Road, West Boldon, where it is proposed to redevelop the site in the near future. The redevelopment works will comprise the demolition of the existing school building followed by the construction of residential properties with associated private gardens and access roads.

The intrusive investigation works comprised 8 no. windowless sampling boreholes (BH1 to BH8) incorporating the installation of 3 no. combined gas and groundwater monitoring wells (BH's 1, 4 & 6) and 3 no internal hand held cores through the existing school building floor slab (Cores 1 – 3). The positions of the borehole locations can be seen on the Exploratory Hole Location Plan, a copy of which can be seen in Appendix II. It should be noted that this plan should be used for orientating purposes only, as the positions shown are approximate, and the plan is not to a standard scale.

2.0 Site Details

Table 2.1 N = north, S = south, E = east, W = west

Site Name & Address:	West Boldon Primary School, North Road, West Boldon, Tyne and Wear, NE36 0QE.
OS Grid Reference:	436830, 513440 (representative for the central part of the site).
Description of Location:	The site is located off North Road, within the district of West Boldon, Tyne and Wear.
Site Boundaries:	N = Open land, E = Playing fields within former school grounds, W = North Road with open land beyond, S = Don Gardens and residential housing.

3.0 Scope of Works

Table 3.1

Client:	Gus Robinson Developments Ltd.
Project type:	Residential.
Site Location plan:	See Appendix I.
Layout plans (existing):	See Appendix I.
Layout plans (proposed):	See Appendix I.
Laboratory Testing:	Geotechnical & Ground Contamination.
Reporting:	Factual & Interpretative including Level 1 Risk Assessment. Works carried out in accordance with the British Standards as contained in the general references.

The information contained in this report is limited to the areas of the site, as indicated on the Existing and Proposed Site Layout Plans shown in Appendix I, and to those areas accessible during the ground investigation. The depths of strata on the record sheets are recorded from current ground levels. No topographical survey was requested or undertaken. When considering the full scope of the development any features and / or issues not specifically mentioned in this report cannot be assumed to have been covered.

4.0 Investigation Rationale

This ground investigation has been designed to provide information on the general ground and groundwater conditions around the proposed development areas and potential areas of geotechnical concern. The rationale behind the location of each exploratory hole is summarised in Table 4.1 on the following page.

4.0 Investigation Rationale (Cont'd)

Table 4.1

Potential issue	Exploratory hole
Geotechnical considerations around areas of proposed development	BH's 1 – 8
Determine thickness of existing building floor slab and underlying made ground	Cores 1 – 3
Shallow groundwater and ground gas monitoring	BH's 1, 4 & 6
Assessment of shallow ground conditions for use of sustainable infiltration drainage	BH's 1, 4 & 6
General site wide contamination assessment	BH's 1 – 8

4.1 Contamination Related Sampling & Site Protocols:-

All works associated with this ground contamination assessment and investigations have generally been completed in accordance with BS10175: British Standard Code of Practice for the Investigation of Potentially Contaminated Sites (2011) & CLR11, with the following precautions specific to this project.

4.1.1 Ground Contamination Sampling:-

Samples were recovered by a representative of ARC Environmental Ltd. during the intrusive investigation works. All samples were stored at approximately 4°C using cool boxes and ice packs prior to delivery to a UKAS/MCERTS accredited laboratory. Sampling was carried out in accordance with 'Technical Policy Statement 63: UKAS Policy on Deviating Samples'.

4.1.2 Avoiding Cross-Contamination between Sample Locations:-

To avoid cross-contamination of materials between soil horizons, drill casing was used to seal off the made ground. In addition, disposable plastic liners were used to collect samples from the windowless sampling boreholes carried out.

5.0 Ground Conditions

For an accurate description of the ground conditions encountered at each investigation position, reference should be made to the borehole and concrete core record sheets in Appendix II. It should be noted that there is always the possibility of variation in the ground conditions around and between the investigation locations.

5.1 Soil Profile:-

A summary of the soil profile for this site can be found in Table 5.1, below.

Table 5.1 bcgl = Below current ground levels.

Type of Strata	Depths Recorded (BGL)	Description & General Comments
MADE GROUND:	From 0.00m up to c.0.30m to c.2.20m.	Generally comprising initial site surfacing of either grass overlying dark brown sandy soil or bituminous surfacing. Underlying these deposits, disturbed natural strata with anthropogenic debris (i.e. brick, concrete, etc.) was recorded.
DRIFT GEOLOGY: (Pelaw Clay)	From c.0.30m to c.2.20m up to c.1.71m to c.3.00m	Generally comprising stiff (high strength) brown sandy gravelly CLAY. This is with the exception of BH7 where medium dense becoming dense brown initially claybound sandy GRAVEL was recorded.
SOLID GEOLOGY: (Upper Coal Measures/Basal Sands)	From c.2.00m to c.3.00m up to at least c.3.41m	Comprising reddish brown weathered MUDSTONE, recorded in BH's 2, 3 & 4 only.

5.0 Ground Conditions (Cont'd)

5.1 Soil Profile (Cont'd):-

A series of concrete cores were carried out within the former school building in order to determine the thickness of the floor slab and underlying made ground. A summary of the profile of the floor slab and underlying shallow soils can be found in Table 5.2, below.

Table 5.2

Position	Description & General Comments
Core 1	Generally comprising a floor tile overlying concrete, recorded to a depth of c.0.11m bgl. This was underlain by a concrete lintel to c.0.17m and brick, to a depth of c.0.40m bgl. The position was terminated at this depth due to encountering a void with services present.
Core 2	Generally comprising a wooden floor tile overlying concrete, recorded to a depth of c.0.21m bgl. This was underlain by bituminous material to a depth of c.0.27m bgl. In turn this was underlain by disturbed natural strata with anthropogenic debris (i.e. brick and ash), recorded to a depth of c.0.80m bgl before natural clays were recorded. The position was terminated within the natural clays at a depth of c.1.00m bgl.
Core 3	Generally comprising a wooden floor tile overlying concrete, recorded to a depth of c.0.23m bgl. This was underlain by bituminous material to a depth of c.0.30m bgl. In turn this was underlain by disturbed natural strata with anthropogenic debris (i.e. brick and ash), recorded to a depth of c.0.80m bgl before natural clays were recorded. The position was terminated within the natural clays at a depth of c.1.05m bgl.

There was no visual and / or olfactory evidence of significant ground contamination (i.e. fuel-derived contaminants, asbestos, etc) present at any of the exploratory positions undertaken across the site. However, occasional fragments of ash were noted within the made ground recorded at the location of WS07 and within the made ground underlying the existing school building.

5.2 Groundwater:-

Ingresses of water were recorded within BH's 3, 4 & 5 at depths of between c.0.30m to c.2.20m. These ingresses are likely to be associated with pockets / lenses of trapped surface infiltration rather than a continuous shallow groundwater surface (water table) below the site.

Combined ground gas & groundwater monitoring wells were installed at the locations of BH's 1, 4 & 6 in order to carry out a subsequent program of gas and groundwater monitoring. The results are discussed further in Section 6.3.

6.0 Insitu Testing

6.1 Insitu Hand Shear Vane Tests:-

Insitu hand vane tests were carried out using portable insitu hand vane tester on the natural clays encountered. The insitu hand vane tester takes direct readings of shear strength, three vane sizes allow for the direct determination of undrained shear strength of extremely low to high strength clays. The peak vane value is determined by a calibrated scale ring built into the head assembly.

The cross handle is used both to push the vane to the desired test depth and apply the shearing torque. The results are summarised in Table 6.1 on the following page and can also be found adjacent to the appropriate sample level, on the graphic borehole record sheets.

6.0 Insitu Testing (Cont'd)

6.1 Insitu Hand Shear Vane Tests (Cont'd):-

Table 6.1

Type of Strata	Range of Shear Strength Values	Result Details
NATURAL CLAY	88kN/m² up to 120kN/m²	High strength deposits

6.2 Insitu Standard Penetration Tests (SPT):-

Standard penetration tests (SPT's) were carried out with the use of a normal split spoon sampler on the made ground, natural drift and solid geological deposits encountered within the boreholes in order to determine the relative strength / density of the materials tested. The results are shown as 'N' values on the graphic borehole record sheets, adjacent to the appropriate sample level. A summary of the test results can be seen in Table 6.2 below;

Table 6.2

Type of Strata	Range of SPT 'N' Values	Result details
MADE GROUND	9 & 11	Firm strata.
NATURAL CLAY	12 & 25 and blows of 75 for limited penetration	Firm and stiff deposits.
NATURAL GRAVEL	30	Medium dense deposits
NATURAL MUDSTONE	Blows of 75 for limited penetration	Very stiff deposits

When considering the blows for limited penetration recorded towards the base of the natural clays, it is felt that these results have been influenced by the coarse nature of the materials tested and should be viewed with caution.

6.3 Insitu Gas & Groundwater Monitoring:-

When considering the infilled quarries to the east and south-east of the site, as highlighted within the Phase 1 Desk Top Study Report, soil gas/vapour & water monitoring standpipes were installed within BH's 01, 04 & 06 primarily to check for the possible presence of hazardous ground gas migration, as well as to monitor insitu groundwater levels.

A standard 50mm diameter HDPE standpipe, with gravel and/or geo-wrap surround, bentonite seal, gas valve cap and security cover, was installed to depths of c.2.30m (BH01), c.2.70m (BH04) & c.1.80m (BH06) below current ground levels, and the soil gas and water levels were allowed to reach equilibrium, prior to the first monitoring visit. Monitoring was undertaken using a GFM 435 series soil gas analyser, with integral flow meter, and a Geotechnical Instruments electronic dip-meter.

In accordance with CIRIA Report C665, November 2007, the current NHBC Document; Guidance on evaluation of development proposals on site where methane and carbon dioxide are present, Report Edition No. 04, March 2007 and BS8485:2007: Code of practice for the characterization and remediation from ground gas affected developments, it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- The Residential development has been considered as **high sensitivity** (Table 5.5 – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).
- The risk associated with the generation potential of a source is considered as **very low**, (based on observations noted during the fieldworks).

6.0 Insitu Testing (Cont'd)

6.3 Insitu Gas & Groundwater Monitoring (Cont'd):-

- Monitoring over a **minimum** of **three months** with **six recorded** readings (Table 5.5 – Typical /idealised frequency and period of monitoring after Wilson et al, 2005).
- **Negligible** flow rates have been recorded (Table 8.5 – Modified Wilson & Card classification).
- A targeted and phased program of gas monitoring should be completed which obtains gas monitoring readings during varying atmospheric conditions, which covers the 'worst case' scenario for ground gas emissions to occur, particularly during rapid falls in atmospheric pressure (i.e. from c.1020mb and c.1010mb).

Monitoring of the weather conditions and predicated atmospheric pressures (Met Office Surface Pressure Charts) are carried out up to 72 hours in advance of proposed monitoring visits, in order that a reasonable period of data is obtained to determine atmospheric trends, and also to target the 'worst case' scenario. Although, the gas monitoring visits completed to date have been carried out during periods of steady and rising atmospheric pressure trends, further assessment of predicated atmospheric pressures will be carried out prior the remaining visits being completed in order to obtain monitoring results during periods of low and falling pressures. A summary of the results for the 3 no. visits undertaken to date, compared with the 'inert' background gas levels are presented in Table 6.3 below with a copy of the monitoring certificate attached in Appendix III.

Table 6.3 Atmospheric trend taken from www.wunderground.com for Newcastle Airport.

Position	Date	Atmospheric Pressure (mbar)	Water (m bgl)	CH_4 (%v/v)	LEL (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	Flow Rate (l/hr)
Background		**~**	**~**	**0**	**0**	**0**	**21.0**	**0**
BH1	31/03/2016	996 (Rising trend 1001-1024)	2.30	0.0	0.0	0.6	19.7	<0.1
BH4			0.55	0.0	0.0	0.0	20.4	<0.1
BH6			0.95	0.0	0.0	0.0	20.4	<0.1
BH1	12/04/2016	1012 (Steady trend 1009-1015)	2.22	0.0	0.0	0.4	19.7	<0.1
BH4			0.50	0.0	0.0	0.0	20.2	<0.1
BH6			0.62	0.0	0.0	0.1	20.2	<0.1
BH1	27/04/2017	1006-1007 (Rising trend 1011-1022)	2.18	0.0	0.0	0.4	19.9	<0.1
BH4			0.50	0.0	0.0	0.0	20.4	<0.1
BH6			0.63	0.0	0.0	0.0	20.4	<0.1
3 no. outstanding visit to be completed – results and final to follow as Addendum Letter Report.								

As can be seen from the results undertaken to date, no concentrations of Methane (CH_4) were recorded within any of the boreholes. However, detectable levels of Carbon Dioxide (CO_2) were recorded within the boreholes, up to a maximum level of 0.6% *v/v*, with associated slightly depleted oxygen (O_2) concentrations (minimum 19.7% *v/v)*. In addition, negligible flow rates of <0.1l/hr have been recorded during the monitoring visits completed to date during periods of low and falling atmospheric pressures.

Based upon the results recorded, in accordance with CIRIA Report C665, the risk to the site from ground gases has been assessed by converting the CH_4 & CO_2 results in Table 6.3 to gas screening values (GSV's), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates (after Wilson & Card). As no levels of Methane have been recorded to date, the gas screening value (GSV) for CO_2 only has been calculated, using the maximum recorded value of 0.4% v/v, with a maximum flow rate of <0.1l/hr. The GSV can be calculated as follows:

Carbon Dioxide GSV = 0.004 (0.4%) x 0.1 = 0.0004 l/hr

6.0 Insitu Testing (Cont'd)

6.3 Insitu Gas & Groundwater Monitoring (Cont'd):-

When considering these results, in accordance with CIRIA C665, and considering the NHBC Traffic light system (low rise housing with ventilated underfloor void), it can be seen that the GSV value for CO_2 is below the assessment GSV of 0.78 l/hr (Green classification), indicating that no gas protection measures will be required. Alternatively, if the proposed development were to comprise a ground bearing floor slab within the structure, in accordance with CIRIA C665, the GSV for CO_2 would also fall below the lower target concentration of 0.07l/hr and would also equate to a Characteristic Situation 1 site classification, indicating no gas protective measures being required for the proposed development.

Following completion of the remaining 3 no. gas monitoring visits, a final assessment of these results and recommendations will follow as an addendum to this report.

When considering the results of the groundwater monitoring, it can be seen that standing levels were recorded at depths of between c.0.50m to c.2.30m during the monitoring visits undertaken. During the completion of the monitoring visits, the high water levels recorded (BH's 4 & 6) were purged of water to open up the response zone so that potential soil gases can be monitored in the well. If the water levels remain high on subsequent occasions these will continue to be purged.

As can be seen from the results of the water monitoring undertaken and from the observations noted during the field works, shallow water ingress may be problematic with regards to future excavations. Therefore, it would be prudent to allow for the introduction of appropriate groundwater control measures, in order to take care of any localised ingresses of groundwater which may occur during the construction period, especially during the wetter periods of the year.

6.4 Insitu Variable Head (Falling) Permeability Tests:-

Variable head (falling) permeability tests were carried out within BH's 1, 4 & 6, in order to determine the coefficient of permeability (k) for the natural deposits present below the site and to assess the potential for utilising soakaways. At the test locations the water failed to drain away with only a drop in level of between c.0.20m to c.0.71m after a period of 1.50hrs. In addition, standing water levels were recorded at depths of between c.0.55m and c.2.30m prior to the tests being carried out. Therefore, the natural drift deposits are unlikely to be suitable for use as soakaways.

7.0 Laboratory Testing

All geotechnical testing was carried out in accordance with BS1377:1990:Parts 1-9 unless otherwise stated, at a UKAS accredited laboratory. Ground contamination screening was undertaken by a suitably experienced and qualified laboratory (UKAS and MCERTS accredited, unless otherwise stated).

7.1 Determination of pH & SO_4:-

Representative samples (8 no.) of the made ground and natural drift deposits recovered during the investigation, were tested in order to determine their acidic (pH) and soluble sulphate (SO_4) levels. The results are shown in Table 7.1 on the following page and are also contained within the Chemtech Environmental Limited Analytical Reports (Ref no: 63959), a copy of which can be seen in Appendix IV.

From these results it can be seen that the pH values for the samples of soil tested range from 7.4 up to 7.9 and the amount of soluble sulphate present ranges from 12mg/l to 2409mg/l. Therefore, in accordance with BRE Special Digest 1: 2005, the site can be given a classification of Class DS-3. When considering the nature of the materials tested and assuming mobile groundwater the assessment of the Aggressive Chemical Environment for Concrete (ACEC), is AC-3.

7.0 Laboratory Testing (Cont'd)

7.1 Determination of pH & SO_4 (Cont'd):-

Table 7.1 ACEC = Aggressive Chemical Environment for Concrete site classification

Position	Depth (m)	Strata	pH	SO_4(mg/l)	Design SO_4 Class	ACEC Class
BH1	0.70-1.00	Made Ground	7.6	45	DS-1	AC-1
BH2	0.70-1.00	Natural Strata	7.4	16	DS-1	AC-1
BH3	0.20-1.00	Made Ground	7.5	33	DS-1	AC-1
BH3	1.00-2.00	Natural Strata	7.7	23	DS-1	AC-1
BH4	0.40-1.00	Made Ground	7.8	38	DS-1	AC-1
BH6	0.30-0.80	Made Ground	7.9	126	DS-1	AC-1
BH6	0.80-1.00	Natural Strata	7.4	2409	DS-3	AC-3
BH7	0.50-1.00	Made Ground	7.6	12	DS-1	AC-1

7.2 Determination of Liquid & Plastic Limits:-

Six representative samples of the natural clay deposits recorded across the proposed development area were tested in order to determine their liquid and plastic limits, so these materials could be classified. The results can be seen in Table 7.2 below and also within the PSL analytical report ref no. PSL17/1384 in Appendix IV.

Table 7.2 M/C = Moisture Content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index

Position	Depth(m)	M/C (%)	LL	PL	PI	Class	% Passing 425µm Sieve
BH1	1.00-2.00	15	43	20	23	CI	89
BH2	1.00-2.00	18	39	19	20	CI	91
BH4	1.00-2.00	16	37	18	19	CI	86
BH5	1.00-1.70	15	40	19	21	CI	87
BH6	1.00-1.80	20	43	21	22	CI	94
BH8	1.00-2.00	18	42	21	21	CI	90

From these results it can be seen that the samples tested, when plotted on the plasticity chart, fall within the intermediate plasticity range, and from the resulting plasticity indices, are of a low and moderate shrinkability potential, when taking into account the amount passing the 425µm sieve.

Therefore, it can be seen that some of these materials may undergo some changes in volume, if large changes in their natural moisture content were to occur due to seasonal variations or the like and if new foundations were to be based within these materials, they would need to be taken down to a minimum depth of 0.90m below finished ground levels. However, an increase in founding depth may be required to reach competent strata and also if the proposed development is within close proximity to existing or envisaged vegetation, an increase in the minimum foundation depth may also be required, even if trees are to be removed, in order to ensure no additional future shrinkage and swelling of these materials occurs. Reference should be made to BS5837: 2012, Trees in Relation to Design, Demolition and Construction', along with the NHBC Standards, 'Building near trees'.

7.3 Contamination Screening/Screening Strategy:-

Representative samples of the made ground recovered from across the site were passed onto Chemtech Environmental of Consett, Co. Durham, so that soil contamination screening could be carried out. In total 5 no. representative samples were screened using a standard generic contamination suite (based on the current CLEA SGV listed analytes with historical additions), which is used to assess typical made ground (disturbed natural strata mixed with anthropogenic debris) of an unknown source.

7.0 Laboratory Testing (Cont'd)

7.4 Contamination Screening/Screening Strategy (Cont'd):-

Although no significant evidence of any fuel /oil type contamination, ash, etc., was noted within the exploratory positions carried out, for completeness and to aid in an assessment for off-site disposal classification, representative samples from across the proposed development area were tested for Speciated PAH, Speciated TPH and Asbestos. In addition, when considering the previous site use as an abattoir, although not considered to represent a significant risk, screening for common Pathogens and typical abattoir related Solvents have also been carried out.

When considering the environmental setting, no groundwater abstractions are recorded within c.500m of the site and although a Source Protection zone (Zone III) is recorded c.48m to the south-east and the River Don is located c.126m to the north-west, the site is underlain by relatively impermeable drift deposits. Therefore, no leachate screening was deemed necessary.

The catalogue of testing results can be found in the Chemtech Analytical Report (ref no. 63959), attached in Appendix IV, and the total analysis carried out to date is summarised below:

- 5 no. samples screened using a Generic Soils Suite - based on the current CLEA SGV listed analytes with historical additions and which is used to assess typical made ground, comprising disturbed natural strata mixed with anthropogenic debris, of an unknown source (suite comprises; Arsenic, Cadmium, Chromium III, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Zinc & Cyanide
- 5 no. samples screened for Speciated Polycyclic Aromatic Hydrocarbons (PAH's) – based on the current USEPA 16 PAH's
- 5 no. samples screened for Speciated Total Petroleum Hydrocarbons (TPH's) – Split into C5 – C7, C7 – C8, C8 – C10, C10 – C12, C12 – C16, C16 – C21, C21 – C35 & C35 – C44 Carbon Bands
- 5 no. samples screened for the presence of asbestos
- 2 no. samples screened for common Pathogens
- 2 no. samples screened for abattoir related Solvents (Kerosene and White Spirit)

8.0 Ground Contamination Risk Assessment

8.1 Methodology:-

Following completion of the contamination screening undertaken on various samples from this site, a Level 1 generic quantitative ground contamination risk assessments have been undertaken, generally in accordance with CLR11: Model Procedures for the Management of Land Contamination. A detailed description of the Assessment Framework and Methodology used for these risk assessments can be found in Appendix V.

This quantitative ground contamination risk assessment uses the current UK practice for assessing the risks from land contamination, which is based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part IIA, EPA 1990 - inserted through Section 57 EA 1995).

Based on the Revised Conceptual Site Model (CSM) for this site (described further in Section 8.2), a site specific screening strategy for the site has been developed (see Section 7.4) and the risks from potential contaminants have been assessed for human health.

The results of the risk assessment can be found in Section 8.3. Comments regarding off-site disposal can be found in Section 9.6.

8.0 Ground Contamination Risk Assessment (Cont'd)

8.2 Revised Conceptual Site Model (CSM):-

From the findings of the Phase 1: Desk Top Study report, combined with the results of the intrusive investigation works, a revised Conceptual Site Model (CSM) has been developed for this site. Table 8.1 below summarises the various contaminant *sources*, plausible migration *pathways* and potentially sensitive *receptors* identified for this site, assuming no remediation, additional protection measures and/or removal of the *sources* contamination takes place.

Table 8.1

	Sources (S)
S1	Made ground associated with the construction and demolition of buildings present within the site boundary including local infill to provide level playing areas and areas of "cut and fill"
S2	Possible ground gases from onsite and offsite sources – **No elevated levels recorded**
S3	Contaminants from the previous site uses including an abattoir – **No elevated levels recorded**

	Pathways (P)
P1	Ingestion
P2	Inhalation of indoor / outdoor air
P3	Plant Uptake and attached soil
P4	Migration through existing services
P5	Direct contact with building materials
P6	Surface run off and leachate Migration

	Receptors (R)
R1	Human health (End users and construction workforce)
R2	Groundwater within the Secondary Aquifer A and Principal Aquifer within the solid geological deposits
R3	Building materials*
R4	Adjacent sites
R5	Flora and fauna*

* = Not included in the Human Health & Controlled Waters Risk Assessment

8.2.1 Sources:-

The site is covered by a layer of made ground (up to c.2.20m in thickness) which represents the primary potential source of ground contamination for this site. The majority of the made ground contains some anthropogenic debris mixed with disturbed natural strata, and these materials have been assessed using a standard generic soil suite.

Although there was no significant visual, olfactory or analytical evidence of significant heavy or gross contamination, such as waste oils, fuels, ash, etc. For completeness, the potential for hydrocarbon based contamination (PAH's & TPH's) and Asbestos have also been assessed. In addition, when considering the previous site use as an abattoir, screening for common Pathogens and typical abattoir related Solvents have also been carried out.

8.2.2 Pathways:-

When considering the proposed end use, and without considering treatment, removal or protection measures, there are some potential plausible pathways available for direct contact, dermal contact, ingestion, inhalation, wind (dust / particulate), volatilization, and vertical and lateral transportation below the site, both within the existing structure and externally, where there is no hard cover or vapour barriers present. Within the CLEA Risk Assessment Model for Human Health, there are 3 exposure mediums considered for on site receptors, comprising ingestion of soil containing contaminants, inhalation of contaminated dust/vapours and dermal contact, with up to 10 no. exposure pathways considered, as shown below.

- *1. Ingestion of soil and indoor dust 2. Consumption of homegrown produce and attached soil 3. Dermal contact (indoor) 4. Dermal contact (outdoor) 5. Inhalation of dust (indoor) 6. Inhalation of dust (outdoor) 7. Inhalation of vapour (indoor) 8. Inhalation of vapour (outdoor) 9. Oral background intake 10. Inhalation background intake.*

8.0 Ground Contamination Risk Assessment (Cont'd)

8.2 Revised Conceptual Site Model (CSM) (Cont'd):-

8.2.2 Pathways (Cont'd):-

Where the future site has hard cover and below new structures, a number of these pathways may not be available. In addition, when considering the potential pathways for leachate migration, where either hard cover and/or future surface water drainage systems are present, the potential effects of surface infiltration or contaminated surface water runoff will be greatly reduced. Similarly, when considering the construction work force, exposure pathways through direct contact, ingestion and dust inhalation will be available during part of the construction process, and therefore adequate PPE should be provided to protect the work force during this period.

8.2.3 Receptors:-

Within the CLEA Risk Assessment Model for Human Health, the potential receptors are assessed initially on site end use, followed by a delineation of age category (i.e. child or adult), with default settings for *Residential, Allotment* and *Public Open Space (Park)* end uses based on a child aged 0 to 6 years, *Public Open Space (Residential)* based on a child aged 3 to 9 and *Commercial* end uses based upon a working exposure period of up to 49 years (i.e. 16 to 65).

Key generic assumptions for *Residential* and *Public Open Space (Residential)* are based upon a typical residential property, consisting of a two-storey small terraced house, with private garden, and a *Commercial* end use based upon a typical commercial or light industrial property, consisting of a three-storey office building (pre-1970). No buildings are anticipated for *Allotment* or *Public Open Space (Park)* end uses. Within the CLEA Risk Assessment Model for Human Health there are 6 no. generic end use categories presently in use, as follows;

1) Residential - with home grown produce, 2) Residential - without home grown produce, 3) Allotments, 4) Commercial
5) Public Open Space – Residential, 6) Public Open Space - Park

Therefore, for this Level 1 Risk Assessment, the best fit end use category for this site has been taken as:

1) Residential - with home grown produce

When considering the environmental setting, no testing has been carried out with regards to controlled waters risk assessment.

8.3 Level 1 Risk Assessment (Soils):-

8.3.1 Human Health - Generic Made Ground:-

The generic soil screening results have been subjected to statistical analysis utilising the contaminated land statistical analysis sheets developed by CL:AIRE, and a copy of the calculation sheets and the statistical methodology can be found in Appendix V. The results of the analysis and risk assessment have been summarised in Table 8.2 on the following page and have identified the following:-

- The maximum concentration (C_M) & upper confidence limit ($UCL_{0.95}$) values for all of the analytes screened for fall below the critical concentration values (C_C) for this site.
- The C_M values for Cadmium, Copper, Lead, Mercury & Zinc represents statistical outliers. However, since neither the C_M values nor the $UCL_{0.95}$ values exceed the chosen C_C values for this site, these analytes do not represent a potential risk to the end users.
- When considering these results, the made ground below the site does not represent a potential risk to the end users, and therefore no treatment, removal, protection measures and / or further detailed quantitative risk assessment will be required.

8.0 Ground Contamination Risk Assessment (Cont'd)

8.3 Level 1 Risk Assessment (Soils) (Cont'd):-

8.3.1 Human Health - Generic Made Ground (Cont'd):-

Table 8.2

Analyte	Critical Conc. (C_C) mg/kg	No. of Samples Screened	Max. Conc. (C_M) recorded mg/kg	Statistical Upper Bound Value (US_{95}) mg/kg	Has US_{95} exceeded C_C	No. of Samples > C_C	Is C_M an outlier (statistical hot spot)
Arsenic	37[1]	5	14	12.12	NO	0	NO
Cadmium	11[1]	5	4.8	5.13	NO	0	YES
Chromium III	910[1]	5	96	94.49	NO	0	NO
Chromium VI	6[1]	5	<1*	0.5	NO	0	NO
Copper	2400[1]	5	74	55.20	NO	0	YES
Lead	200[2]	5	87	91.61	NO	0	YES
Mercury	40[1]	5	0.7	0.73	NO	0	YES
Nickel	130[1]	5	37	33.36	NO	0	NO
Selenium	250[1]	5	1.6	1.36	NO	0	NO
Zinc	3700[1]	5	935	998.32	NO	0	YES
Cyanide	34[3]	5	<1*	0.5	NO	0	NO

[1] = LQM/CIEH S4UL's – Residential with home grown produce, [2] = CL:AIRE C4SLs – Residential with home grown produce, [3] = Atkins ATRISK SSV Residential with the consumption of home-grown produce (Mar 2011). * = Site Value (C_M) less than analytical detection limit

8.3.2 Human Health – Hydrocarbon Screening:-

Although no significant visual, olfactory or analytical evidence of significant heavy or gross contamination, such as waste oils, fuels, ash, etc. were recorded, for completeness representative samples of the made ground were recovered and screened for Speciated PAH's & Speciated TPH's. A summary of the results for the Level 1 Risk Assessment based on the results of the soil concentrations for the end users can be seen in Tables 8.3 & 8.4 below and on the following page and have identified the following;

Table 8.3 (Speciated PAH's)

Analyte	Critical Conc. (C_C) mg/kg	No. of samples tested	Max. Conc. (C_M) (mg/kg)	Has C_M exceeded C_C	No. of Samples > C_C
Acenaphthene	510[1]	4	0.02	NO	0
Acenaphthylene	420[1]	4	0.05	NO	0
Anthracene	5400[1]	4	0.37	NO	0
Benzo(a)anthracene	11[1]	4	1.28	NO	0
Benzo(a)pyrene	2.7[1]	4	1.10	NO	0
Benzo(b)fluoranthene	3.3[1]	4	1.29	NO	0
Benzo(ghi)perylene	340[1]	4	0.57	NO	0
Benzo(k)fluoranthene	93[1]	4	0.61	NO	0
Chrysene	22[1]	4	1.07	NO	0
Dibenz(ah)anthracene	0.28[1]	4	0.18	NO	0
Fluoranthene	560[1]	4	2.43	NO	0
Fluorene	400[1]	4	0.05	NO	0
Indeno(123cd)pyrene	36[1]	4	0.58	NO	0
Naphthalene	5.6[1]	4	0.11	NO	0
Phenanthrene	220[1]	4	0.62	NO	0
Pyrene	1200[1]	4	1.87	NO	0

[1] = LQM/CIEH S4UL's – Residential with home grown produce (2.5% SOM). * = Site Value (C_M) less than analytical detection limit.

8.0 Ground Contamination Risk Assessment (Cont'd)

8.3 Level 1 Risk Assessment (Soils) (Cont'd):-

8.3.2 Human Health – Hydrocarbon Screening (Cont'd):-

Table 8.4 (Speciated TPH's)

Analyte	Critical Conc. (C_C) mg/kg	No. of samples tested	Max. Conc. (C_M) (mg/kg)	Has C_M exceeded C_C	No. of Samples > C_C
TPH C5-C7	78(1)	4	<0.1*	NO	0
TPH C7-C8	230(1)	4	<0.1*	NO	0
TPH C8-C10	65(1)	4	1.4	NO	0
TPH C10-C12	180(1)	4	<4*	NO	0
TPH C12-C16	330(1)	4	6	NO	0
TPH C16-C21	540(1)	4	19	NO	0
TPH C21-C35	1500(1)	4	69	NO	0
TPH C35 – C44	1500(1)	4	33	NO	0

(1) = LQM/CIEH S4UL's – Residential with home grown produce (2.5% SOM) most sensitive Aliphatic/Aromatic Fraction taken. * = Site Value (C_M) less than analytical detection limit.

- The C_M values for all of the analytes screened for fall below the C_C values for this site.
- When considering these results, the made ground below the site does not represent a potential risk to the end users, and therefore no treatment, removal, protection measures and / or further detailed quantitative risk assessment will be required.

8.3.3 Human Health – Asbestos fibres:-

Representative samples of the made ground recovered from below the proposed development area have been screened for Asbestos, to determine whether any unidentified asbestos was present within these materials. The results are summarised in Table 8.5 below and have identified the following:

Table 8.5 NAD = No Asbestos Detected.

Position	Depth (m)	Chrysotile (white)	Amosite (brown)	Crocidolite (blue)	Anthophyllite	Actinolite	Tremolite
BH1	0.70-1.00	NAD	NAD	NAD	NAD	NAD	NAD
BH3	0.20-1.00	NAD	NAD	NAD	NAD	NAD	NAD
BH4	0.40-1.00	NAD	NAD	NAD	NAD	NAD	NAD
BH6	0.30.-0.80	NAD	NAD	NAD	NAD	NAD	NAD
BH7	0.50-1.00	NAD	NAD	NAD	NAD	NAD	NAD

From these results, it can be seen no asbestos fibres have been detected and therefore the made ground below the proposed development area is not felt to represent a risk with regards to asbestos.

8.3.4 Human Health – Pathogens/Solvents:-

When considering the previous site use as an abattoir, although not considered to represent a significant risk, representative samples of the made ground recovered from below the proposed development area have been screened for common Pathogens and typical abattoir related Solvents.

From these results, no elevated levels of any of the analytes screened for have been recorded and therefore, the made ground below the site does not represent a potential risk to the end users with values below detection limits noted. Therefore, no treatment, removal, protection measures and / or further detailed quantitative risk assessment will be required.

9.0 Conclusions & Recommendations

9.1 Ground Conditions:-

From the information gained during these intrusive ground investigation works, made ground was recorded to depths of between c.0.30m to c.2.20m below current ground level (bcgl), generally comprising initial site surfacing of either grass overlying dark brown sandy soil or bituminous surfacing. Underlying these deposits, disturbed natural strata with anthropogenic debris (i.e. brick, concrete, etc.) was recorded.

The underlying natural drift deposits generally comprised, stiff (high strength) brown sandy gravelly clay, recorded to depths of between c.1.71m to c.3.00m bcgl. This is with the exception of BH7, where medium dense becoming dense brown initially claybound sandy gravel was recorded.

Underlying the natural drift deposits, reddish brown weathered mudstone was recorded in BH's 2, 3 & 4 only to a depth of at least c.3.41m bcgl.

When considering the internal cores carried out within the existing building on site, the floor slab appears to range in thickness from c.0.27m to c.0.30m generally comprising floor tiles overlying concrete, in turn underlain by a bituminous material. Underlying the floor slab, made ground was recorded to a depth of c.0.80m bcgl before natural clays were recorded. It should be noted that at the location of Core 1, this was terminated due to encountering a void with services present below the existing slab.

9.2 Groundwater:-

Ingresses of water were recorded within BH's 3, 4 & 5 at depths of between c.0.30m to c.2.20m. From the results of the groundwater monitoring, it can be seen that standing water levels were recorded at depths of between c.0.50m to c.2.30m during the monitoring visits undertaken.

As a result, shallow water ingress may occur within shallow construction related excavations. Therefore, it would be prudent to allow for the introduction of suitable groundwater control measures, in order to take care of ingresses of groundwater which may occur during the construction period, especially during the wetter periods of the year.

9.3 Foundation Options:-

When considering the proposed development and ground conditions recorded, it is felt that strip or pad foundations (utilising mass trench fill where required) should be acceptable for the proposed development, with foundations taken down through the made ground and based wholly within the natural clays / claybound gravel at a minimum depth of c.0.90m below finished ground levels where a maximum allowable bearing pressure of 150kN/m^2 is available. This will necessitate foundation depths of between c.0.90m to c.2.20m below current ground levels.

When considering the former school building occupying a large portion of the site, it would be prudent to undertake some further investigation works following demolition, within the footprint of the building, to determine the ground conditions are similar to those already encountered.

9.4 Gas Protection Measures:-

From the results of the gas monitoring undertaken to date, detectable levels of Carbon Dioxide (CO_2) have been recorded, up to a maximum level of 0.6% *v/v*, whilst slightly depleted oxygen (O_2) concentrations (minimum 19.7 *v/v)* have also been recorded. Flow rates of <0.1l/hr have been recorded during the monitoring visits completed to date.

When considering these results in accordance with CIRIA Report C665, the resulting GSV for this site would be 0.0006l/hr. Therefore, this result would suggest the site should be given either a Green or Characteristic Situation 1 classification (depending upon floor slab construction), resulting in no gas protective measures being required for the proposed development.

9.0 Conclusions & Recommendations (Cont'd)

9.4 Gas Protection Measures (Cont'd):-

Following completion of the remaining 3 no. gas monitoring visits, a final assessment of these results will follow as an addendum to this report.

9.5 Ground Contamination:-

From the results of the contamination screening carried out, it can be seen that the made ground below the site does not represent a significant risk to the end users, and will not require any removal, treatment or protection measures to be installed. However, where occasional fragments of ash were recorded in BH8 and a bituminous layer was recorded below the existing building floor slab, these materials will not be suitable for reuse in areas of proposed soft landscaping and should be either removed from site or if site levels allow, be placed below areas of hardstanding (i.e. buildings / access roads).

When considering the results of the contamination screening carried out, along with the environmental setting with no Potable Water Abstractions present within a plausible distance of the site and the presence of relatively impermeable drift deposits, the risks to controlled waters is deemed to be negligible.

When considering the risk to building materials, it is recommended that a concrete design class of DS-3 and ACEC class of AC-3 is used for all foundations and buried concrete. Recourse to the relevant utility suppliers should be made for their advice / comments regarding any service material precautions necessary.

When considering the risks to the construction workforce, standard PPE should prove adequate protection against the levels of potential contaminants recorded during these investigation works. Similarly, the results can also be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations. For further guidance reference should be made to the Health and Safety Executive (HSE) document EH40/2005 Workplace exposure limits.

9.6 Off-site Disposal Classification:-

When considering the removal of any materials from this site as a waste, to be disposed of at a landfill, it can be seen that where the uncontaminated natural strata (excluding any 'topsoil' or 'peat' materials) can be kept separate from any made ground or contaminated natural strata, then these materials can be considered as 'inert' and taken to an Inert Landfill Site.

Where made ground or contaminated natural strata is to be removed off site as a 'waste', a preliminary classification assessment, regarding off-site disposal, can be made utilising the contamination soils screening undertaken as part of the Level 1 Risk Assessment for Human Health. If there is sufficient screening to classify these materials as Non-Hazardous, then they can be disposed of at a Non-Hazardous Landfill. If insufficient preliminary screening has been undertaken to carry out the classification assessment, then further preliminary soils screening should be undertaken, where required.

When considering the results of the contamination screening completed, it may be the case that the made ground deposits could to be classified as Non-Hazardous for off-site disposal purposes. However, this is an approximation only as definitive waste disposal classifications can only be provided by individual landfill operators, in accordance with their site licences. Therefore, the test results attached to this report should be presented to, and discussions held with, appropriate licensed operators for confirmation of disposal classification and potential the costs involved with the removal of excess waste soils.

If possible, removal of materials from site as a 'waste' should be kept to a minimum, however, if materials have to be removed to accommodate finished ground levels etc., it is recommended that the volume to be disposed of is calculated, as the amount of additional screening required, including any full WAC screening, will be dependent upon the volume of material to be disposed of.

9.0 Conclusions & Recommendations (Cont'd)

9.7 General Comments:-

For future site works, adequate lateral trench support will be required for excavations, in order to prevent trench wall collapse or over excavations, as well as to create a safe working environment below a depth of 1.20m, and any excavations on this site should remain open for as short a period as possible, since some of these materials may be susceptible to deterioration, if left open to the natural elements for any significant period of time.

It is also recommended for any new developments, adequate surface drainage should be designed and installed by a competent contractor, in order to prevent surface water 'ponding' or collection, during and post construction, particularly where the existing surface drainage system is disrupted or damaged. From the results of the variable head (falling) permeability tests, the natural drift deposits are unlikely to be suitable for use as soakaways.

In addition, for deeper excavations, drainage, service runs or the like that may pass close to or beneath any proposed new foundations, these should be undertaken with care and completed prior to the preparation of any new foundations, so as not to allow any loose or granular material to move or 'flow', thus causing settlement to occur to any new foundations based at a higher level.

Following the results of the Phase 1: Desk Top Study the site is not considered to be at risk from shallow coal mining activities. In addition, the site is not located within an area that requires radon protective measures within proposed new developments.

An "observational technique" can be applied to the design and construction of this site, and where ground conditions seem to vary from that indicated from the conceptual ground model derived from works to date, then advice from a suitably qualified Engineering Geologist/Geotechnical Engineer should be sought.

END OF REPORT

GENERAL REFERENCES

- Phase 1: Desk Top Study Report, completed by Arc Environmental Ltd. (ref 17-179, April 2017).

- DoE, DEFRA & EA - Contaminated Land Reports

  CLR 1: A framework for assessing the impact of contaminated land on groundwater and surface water. Report by Aspinwall & Co. Volumes 1 & 2. DoE, 1994.
  CLR 2: Guidance on preliminary site inspection of contaminated land. Report by Applied Environmental Research Centre Ltd. Volume 1. DOE, 1994.
  CLR 3: Documentary research on industrial sites. Report by RPS Group plc. DoE, 1994.
  CLR 4: Sampling strategies for contaminated land. Report by The Centre for Research into the Built Environment, The Nottingham Trent University. DoE, 1994.
  CLR 5: Information systems for land contamination. Report by Meta Generics Ltd. DoE, 1994.
  CLR 6: Prioritisation & categorisation procedure for sites which may be contaminated. Report by M J Carter Associates. DoE, 1995.
  CLR11: Model Procedures for the Management of Land Contamination. DEFRA/EA, 2004.
  Science Report Final SC050021/SR2: Human Health Toxicological Assessment of Contaminants in Soils, 2009.
  Science Report Final SC50021/SR3: Updated Technical Background to the CLEA Model, 2009.
  Science Report SC050021/SR4: CLEA software (version 1.05) handbook, 2009.

- Guidance on Comparing Soil Contamination Data with Critical Concentrations, CL:AIRE/CIEH, May 2008
- BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution (BS 1377-9:1990 is partially superseded by BS EN 1997-2: 2007)
- BS 5930: 2015: Code of practice for site investigations. British Standards Institution
- BS EN 1997-1: 2004: Eurocode 7 - Geotechnical design. Part 1: General rules. British Standards Institution
- BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design. Part 2: Ground investigation and testing British Standards Institution
- BS EN ISO 9001: 2000: Quality Management Systems - requirements. British Standards Institution
- BS EN ISO 14688-1: 2002: Geotechnical investigation and testing. Identification and classification of soil. Identification and description.
- BS EN ISO 14688-2: 2004: Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification.
- BS EN ISO 14689-1: 2003: Geotechnical investigation and testing - Identification and classification of rock. Identification and description. British Standards Institution. Amended 2007 (Partially supersedes BS 5930:1999)
- BS EN ISO 22476-3: 2005: Geotechnical investigation and testing. Field testing. Standard penetration test. British Standards Institution
- BS5837: 2012: Trees in relation to design, demolition and construction - recommendations
- NHBC Standards 2007: Chapter 4.2 – Building near trees
- BRE Special Digest 1 2005: Concrete in Aggressive Ground 3rd Edition
- BS10175:2011 + A1:2013: Investigation of potentially contaminated sites – Code of practice
- Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D66, 2008 (NHBC, EA, CIEH)
- Asbestos in soil and made ground: a guide to understanding and managing risks, CIRIA C733, 2014
- Assessing Risks Posed by Hazardous Ground Gases to Buildings, CIRIA C665, 2007
- Methane and Associated Hazards to Construction - CIRIA Reports 149,150,151 & 152
- BS8485:2015 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
- BS8576:2013: Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds
- Category 4 Screening Levels (C4SL's) – DEFRA/CL:AIRE
- LQM CIEH Suitable 4 Use Levels (S4UL Nov 2014 (Revised August 2015))

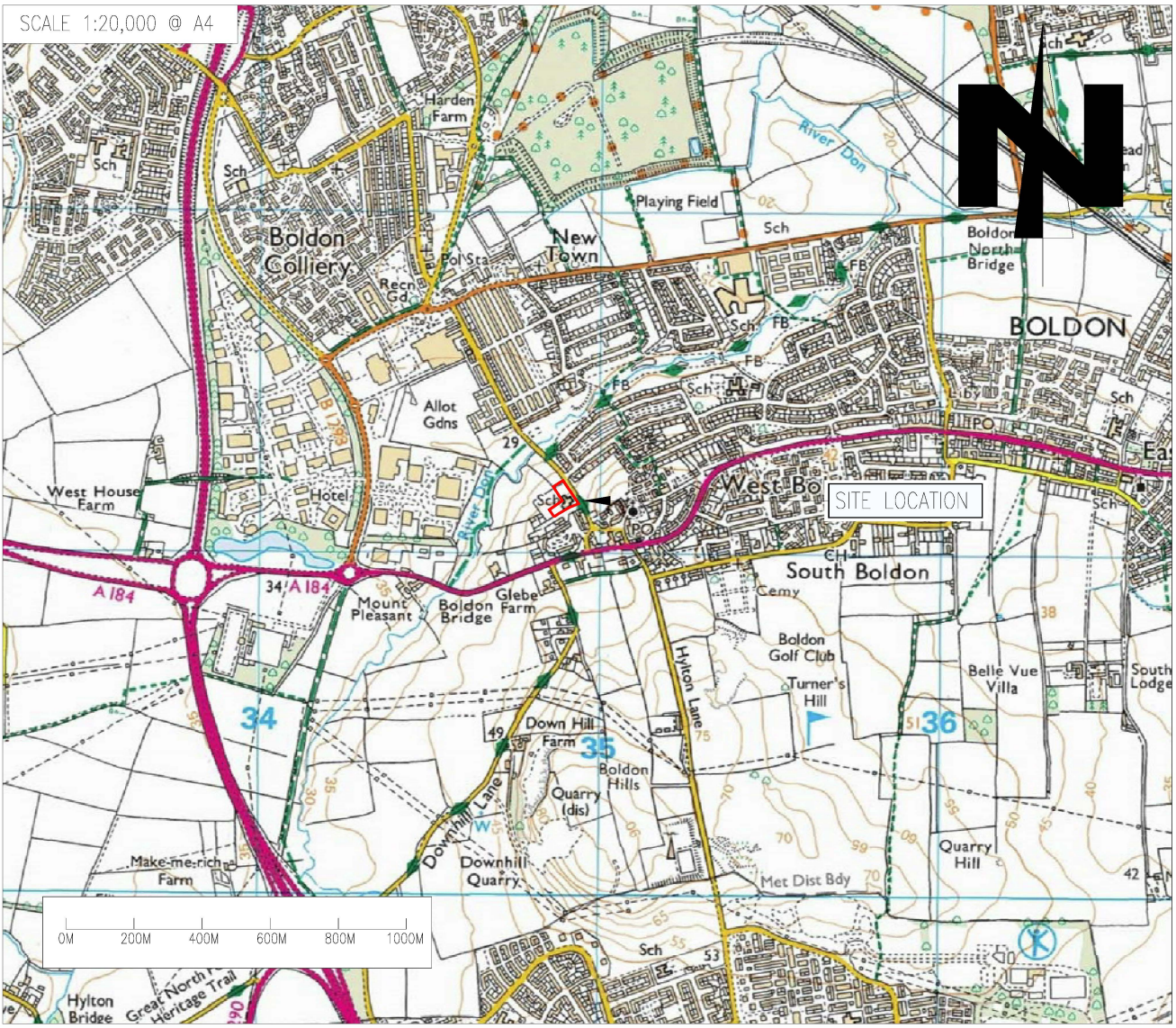
APPENDIX I

Location Plan

Aerial Photograph

Existing Site Layout Plan

Proposed Development Layout Plan



Client:

TELMAC DEVELOPMENTS LTD

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Former West Boldon Primary School North Road, West Boldon Tyne & Wear, NE36 0QE	Location Plan

rev.	date	amendments	drawn	chckd

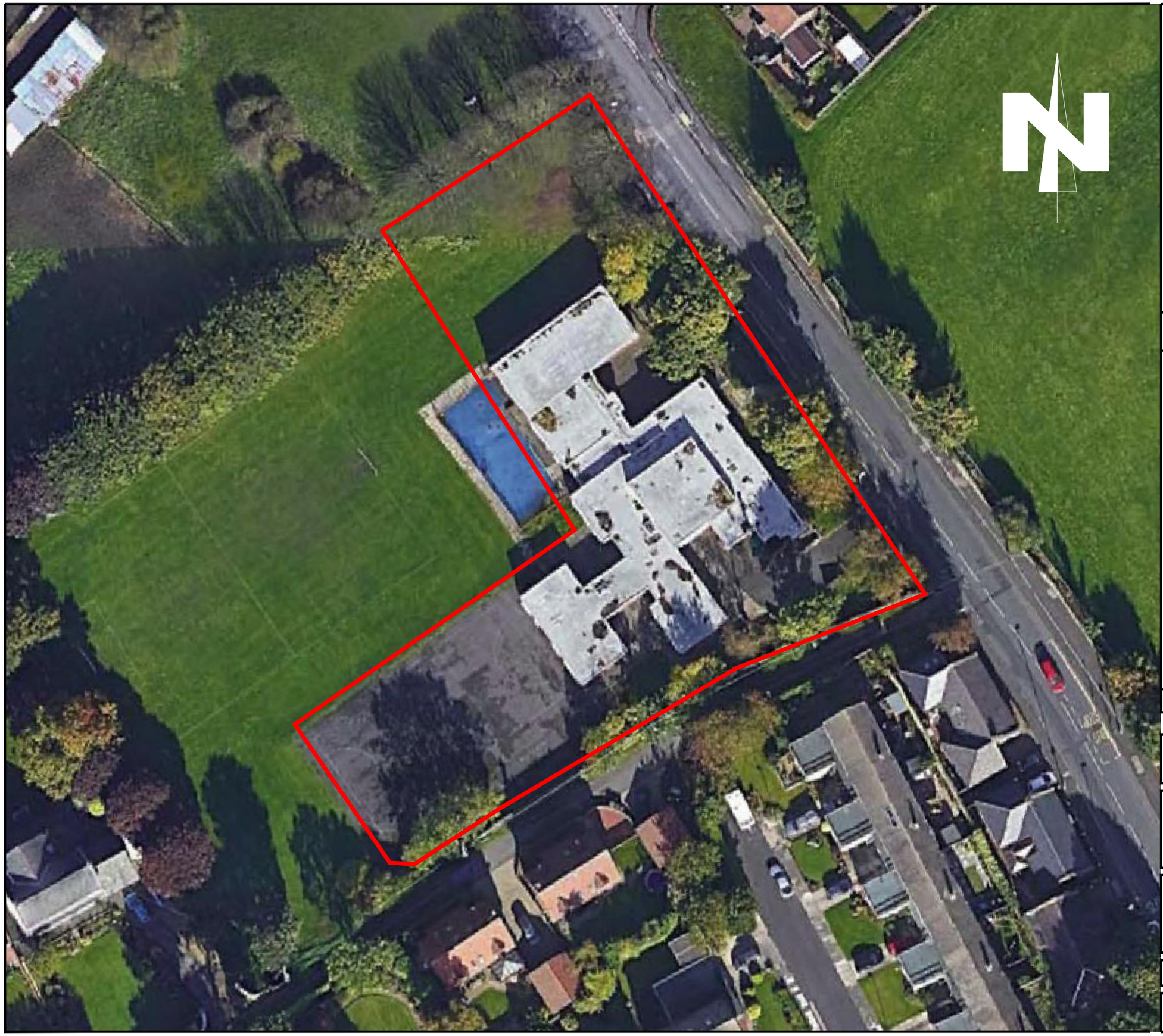
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21-218	_	_

Drawn by:	Date:	Scale at A4:
P.D	18.04.17	As Shown

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LEGEND	
	APPROXIMATE SITE BOUNDARY

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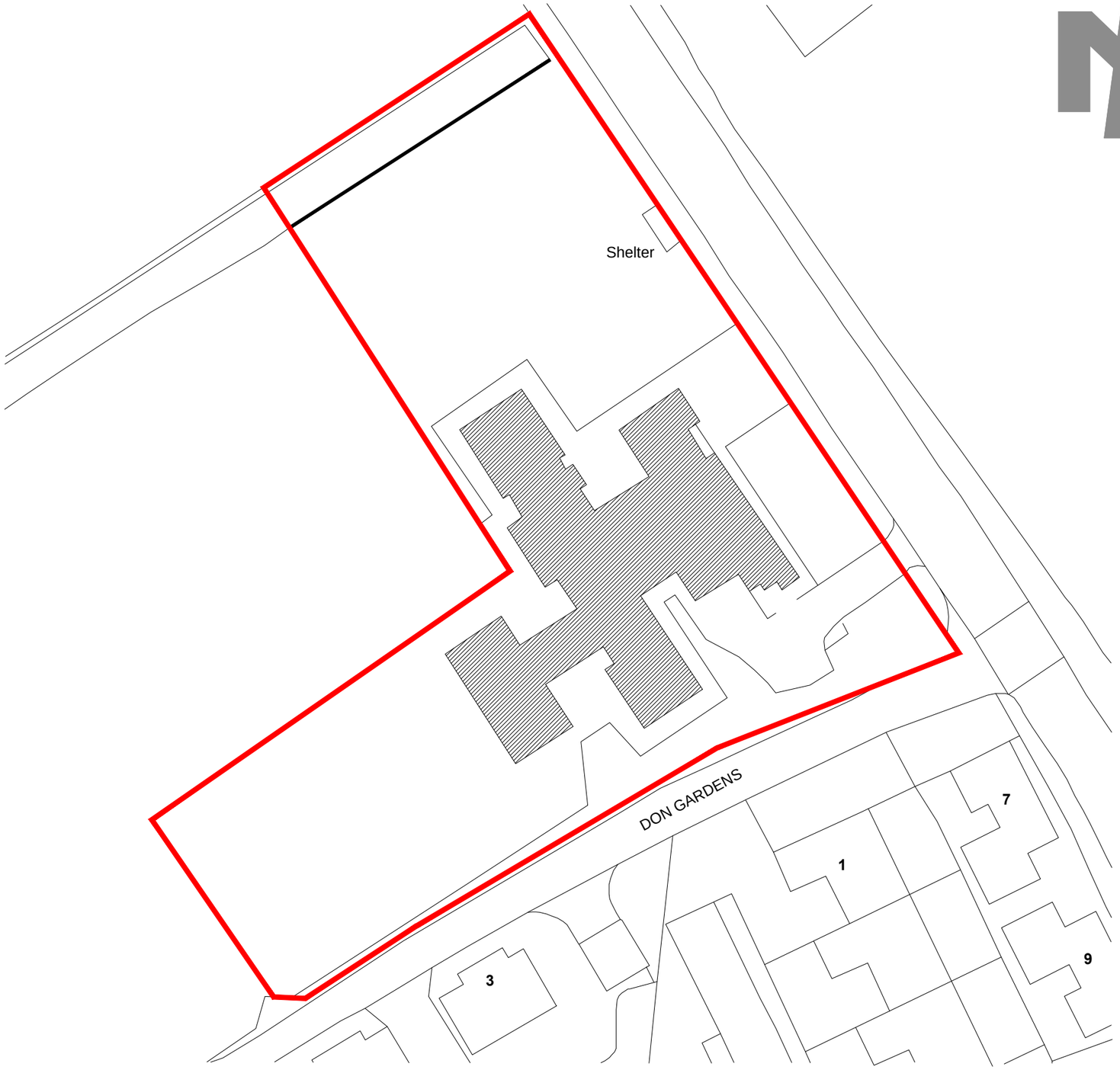
Client: **TELMAC DEVELOPMENTS LTD**

Project Title:
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North Road, West Boldon
Tyne & Wear, NE36 0QE

Drawing Title:
Aerial Photograph

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LEGEND

	APPROXIMATE SITE BOUNDARY

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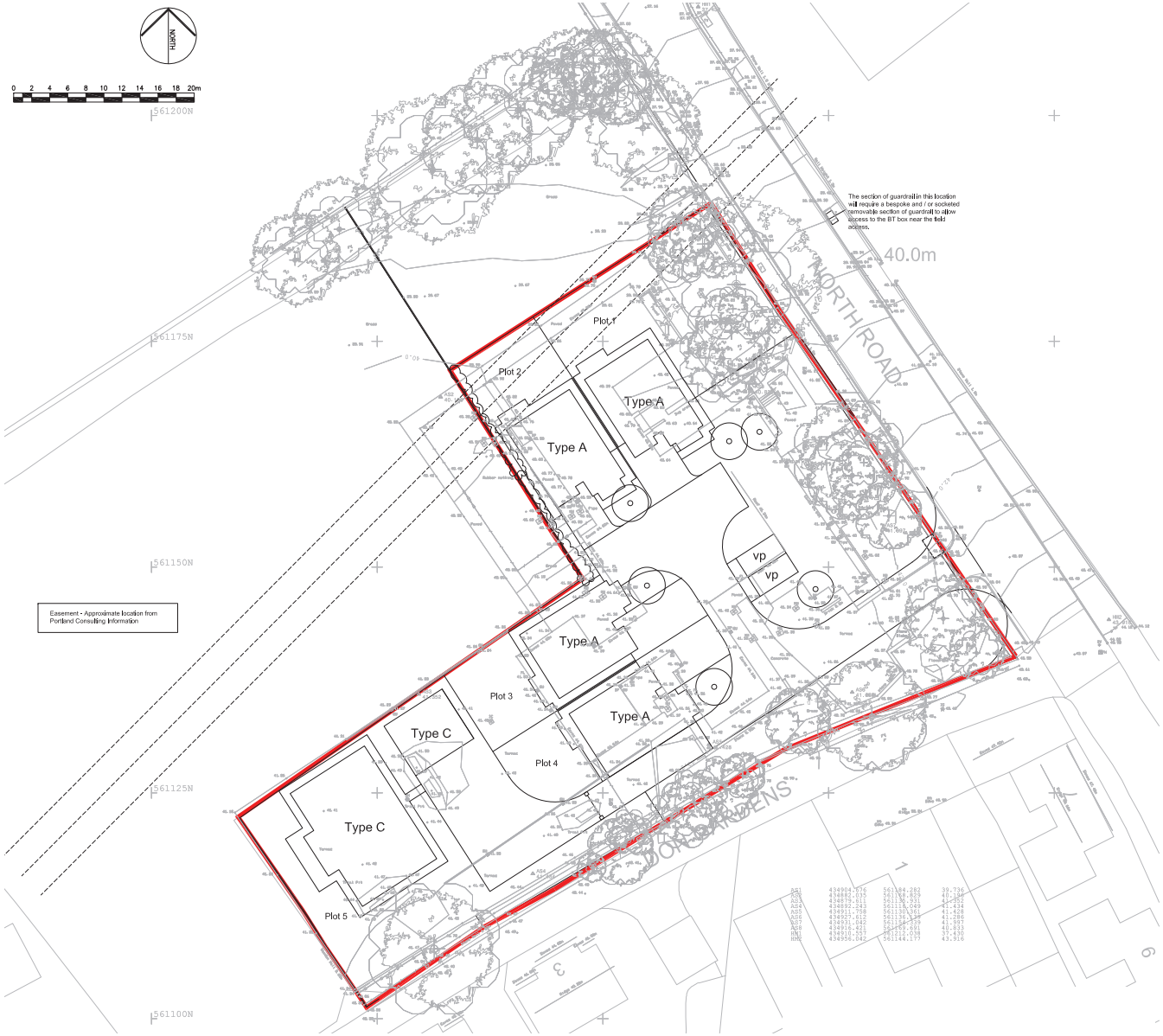
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Project Title:
Former West Boldon Primary School
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Tyne & Wear, NE36 0QE

Drawing Title:
Existing Site Layout Plan

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Project Title:
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Drawing Title:
Proposed Location Plan

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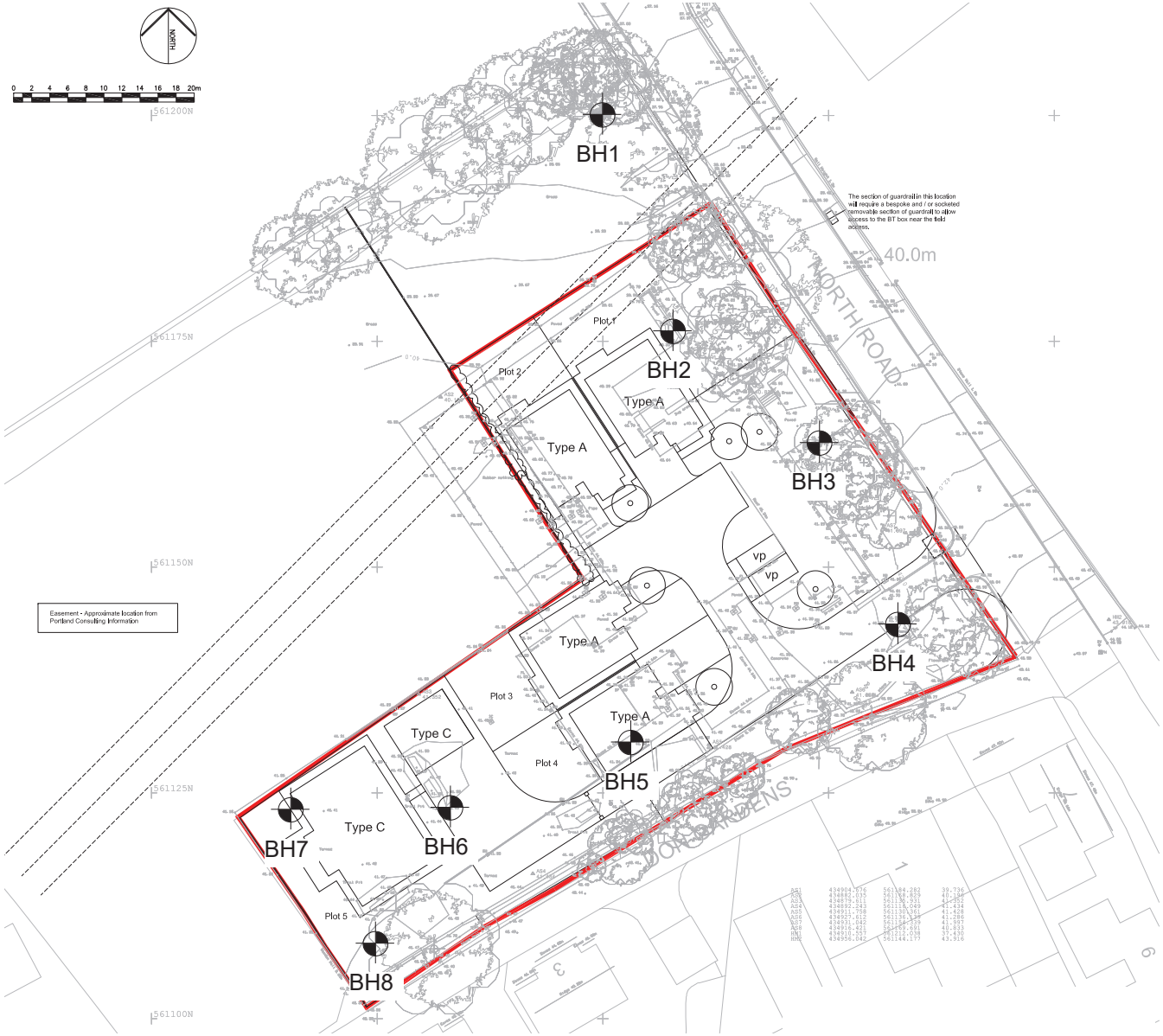
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APPENDIX II

Exploratory Hole Location Plan

Borehole Record Sheets

Concrete Core Record Sheets



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Drawing Title:
BH Location Plan

Scale at A3:	Date:	Drawn by:	Approved by:
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Job Ref:	Drg no:	Rev:
21-218		

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BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				**BH1**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.70	B					(0.70) 0.70	Grass overlying dark brownsandy soil. Some rootlets present (MADE GROUND).		
0.70-1.00	B					(0.30) 1.00	Brown slightly gravely sandy silty clay. Some rootlets present. Gravel is fine to coarse, angular to rounded brick and sandstone (MADE GROUND).		
1.00-2.00 1.00-1.45	B SPT	N=25				(1.31)	Stiff (high strength) dark brown sandy gravelly CLAY. Gravel is fine to medium subangular to rounded sandstone (PELAW CLAY).		
2.00-2.30 2.00	B V	96kN/m^2				2.31			
2.30-2.31	SPT	75 Blows					Borehole terminated due to refusal of sampling equipment.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	WATER : Borehole dry.

All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				BH2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.70	B					(0.70) 0.70	Grass overlying dark brown sandy soil. Some rootlets present (MADE GROUND).		
0.70-1.00	B					(0.90) 1.60	Firm dark brown slightly gravely sandy silty clay. Some rootlets present. Gravel is fine to coarse, angular to rounded brick, concrete, sandstone and limestone (MADE GROUND).		
1.00-2.00	B								
1.00-1.45	SPT	N=9							
						(0.40) 2.00	Stiff (high strength) dark brown sandy gravelly CLAY. Gravel is fine to medium subangular to rounded sandstone (PELAW CLAY).		
2.00-3.00	B					(1.03) 3.03	Reddish brown weathered MUDSTONE (BASAL SANDS).		
2.00	V	90kN/m^2							
3.00-3.03	SPT	75 Blows					Borehole terminated due to refusal of sampling equipment.		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

WATER : Borehole dry.

All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				BH3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.20	B					(0.20) 0.20	Grass overlying dark brown sandy soil. Some rootlets present (MADE GROUND).		
0.20-1.00	B						Firm dark brown slightly gravely sandy clay. Some rootlets present. Gravel is fine to coarse, angular to rounded brick, concrete, sandstone and limestone (MADE GROUND).		
1.00-2.00 1.00-1.45	B SPT	N=11				(2.00)			
2.00-2.20 2.00-2.45	B SPT	N=12	1			2.20			
2.20-3.00	B					(0.80) 3.00	Firm becoming stiff (high strength) dark brown sandy gravelly CLAY. Gravel is fine to medium subangular to rounded sandstone (PELAW CLAY).		
3.00-3.40 3.00	B V	94kN/m^2				(0.41) 3.41	Reddish brown weathered MUDSTONE (BASAL SANDS).		
3.40-3.41	SPT	75 Blows					Borehole terminated due to refusal of sampling equipment.		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

WATER : Ingress of water c.2.20m.

All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				**BH4**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.10	Bituminous surfacing (MADE GROUND).		
0.10-0.40	B					(0.30)	Yellowish brown limestone subbase (MADE GROUND).		
			1			0.40			
0.40-1.00	B						Stiff (high strength) dark brown sandy gravelly CLAY. Gravel is fine to medium subangular to rounded sandstone (PELAW CLAY).		
1.00-2.00	B								
1.00	V	88kN/m^2							
						(2.00)			
1.50	V	92kN/m^2							
2.00-2.40	B								
2.00	V	92kN/m^2							
						2.40			
2.40-2.70	B					(0.31)	Reddish brown weathered MUDSTONE (BASAL SANDS).		
						2.71			
2.70-2.71	SPT	75 Blows					Borehole terminated due to refusal of sampling equipment		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

WATER : Ingress of water c.0.40m.

All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				BH5
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.10	Bituminous surfacing (MADE GROUND).		
0.10-0.30	B					(0.20) 0.30	Yellowish brown limestone subbase (MADE GROUND).		
0.30-1.00	B		1				Stiff (high strength) dark brown sandy gravelly CLAY. Gravel is fine to medium subangular to rounded sandstone (PELAW CLAY).		
1.00-1.70	B					(1.41)			
1.00	V	110kN/m^2							
1.50	V	112kN/m^2							
						1.71			
1.70-1.71	SPT	75 Blows					Borehole terminated due to refusal of sampling equipment.		
1.70	V	120kN/m^2							

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

WATER : Ingress of water c.0.30m.

All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				**BH6**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.10	Bituminous surfacing (MADE GROUND).		
0.10-0.30	B					(0.20) 0.30	Yellowish brown limestone subbase (MADE GROUND).		
0.30-0.80	B					(0.50) 0.80	Dark brown slightly gravely sandy clay. Some rootlets present. Gravel is fine to coarse, angular to rounded brick, concrete, sandstone and limestone (MADE GROUND).		
0.80-1.00	B						Stiff (high strength) dark brown sandy gravelly CLAY. Gravel is fine to medium subangular to rounded sandstone (PELAW CLAY).		
1.00-1.80	B								
1.00	V	92kN/m^2				(1.01)			
1.50	V	112kN/m^2							
1.80-1.81	SPT	75 Blows				1.81	Borehole terminated due to refusal of sampling equipment.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	WATER : Borehole dry.

All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				BH7
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50	B					(0.50) 0.50	Grass overlying dark brown sandy soil. Some rootlets present (MADE GROUND).		
0.50-1.00	B						Medium dense becoming dense brown initially claybound sandy GRAVEL. Gravel is fine to medium subangular to rounded sandstone. Occasional sandstone cobbles noted (PELAW CLAY).		
1.00-2.00	B								
1.00-1.45	SPT	N=30				(1.52)			
2.00-2.02	SPT	75 Blows				2.02	Borehole erminated due to refusal of sampling equipment.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	WATER : Borehole dry.

All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project				BOREHOLE No
East Boldon C of E Primary School				**BH8**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.20	B					(0.20) 0.20	Grass overlying dark brown sandy soil. Some rootlets present (MADE GROUND).		
0.20-0.50	B					(0.30) 0.50	Black sandy gravelly soil with fragments of ash (MADE GROUND).		
0.50-0.90	B					(0.40) 0.90	Dark brown slightly gravely sandy clay. Some rootlets present. Gravel is fine to coarse, angular to rounded brick, concrete, sandstone and limestone (MADE GROUND.		
0.90-1.00	B					(1.92) 2.82	Stiff (high strength) dark brown sandy gravelly CLAY. Gravel is fine to medium subangular to rounded sandstone PELAW CLAY).		
1.00-2.00	B								
1.00	V	92kN/m^2							
1.50	V	104kN/m^2							
2.00-2.80	B								
2.00	V	110kN/m^2							
2.50	V	120kN/m^2							
2.80-2.82	SPT	75 Blows					Borehole terminated due to refusal.		

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Chiselling			Water Added	
From	To	Hours	From	To

GENERAL REMARKS

WATER : Borehole dry.

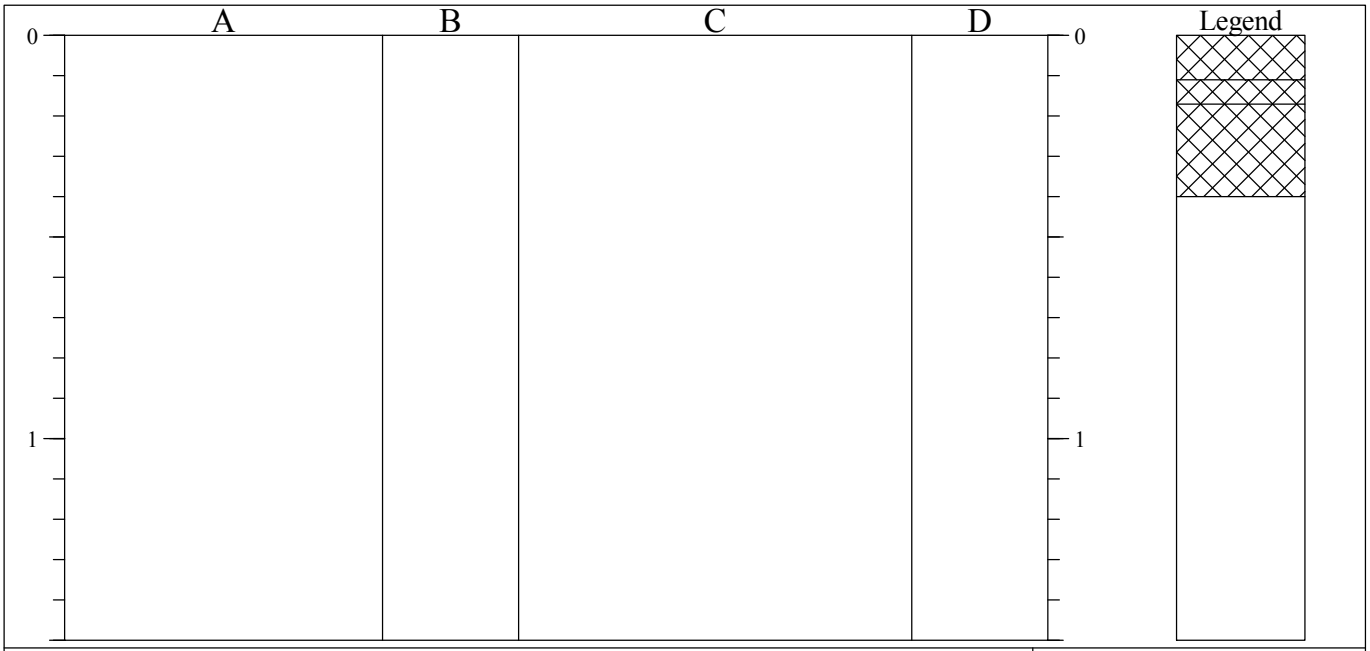
All dimensions in metres Scale 1:25	Client TELMAC Developments Ltd	Method/ Plant Used Windowless Sampling	Logged By DO

AGS3 UK BH BH LOGS.GPJ AGS3_ALL.GDT 2/5/17

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

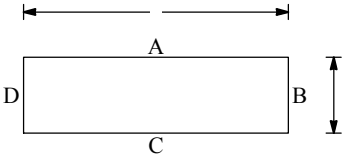
TRIAL PIT LOG

Project				TRIAL PIT No
East Boldon C of E Primary School				**Core 1**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.11		Floor tile covering concrete (MADE GROUND).			
0.11-0.17		Concrete / lintle (MADE GROUND).			
0.17-0.40		Brick (MADE GROUND).			
0.40		Core terminated due to finding void with services present			

Shoring/Support:
Stability:





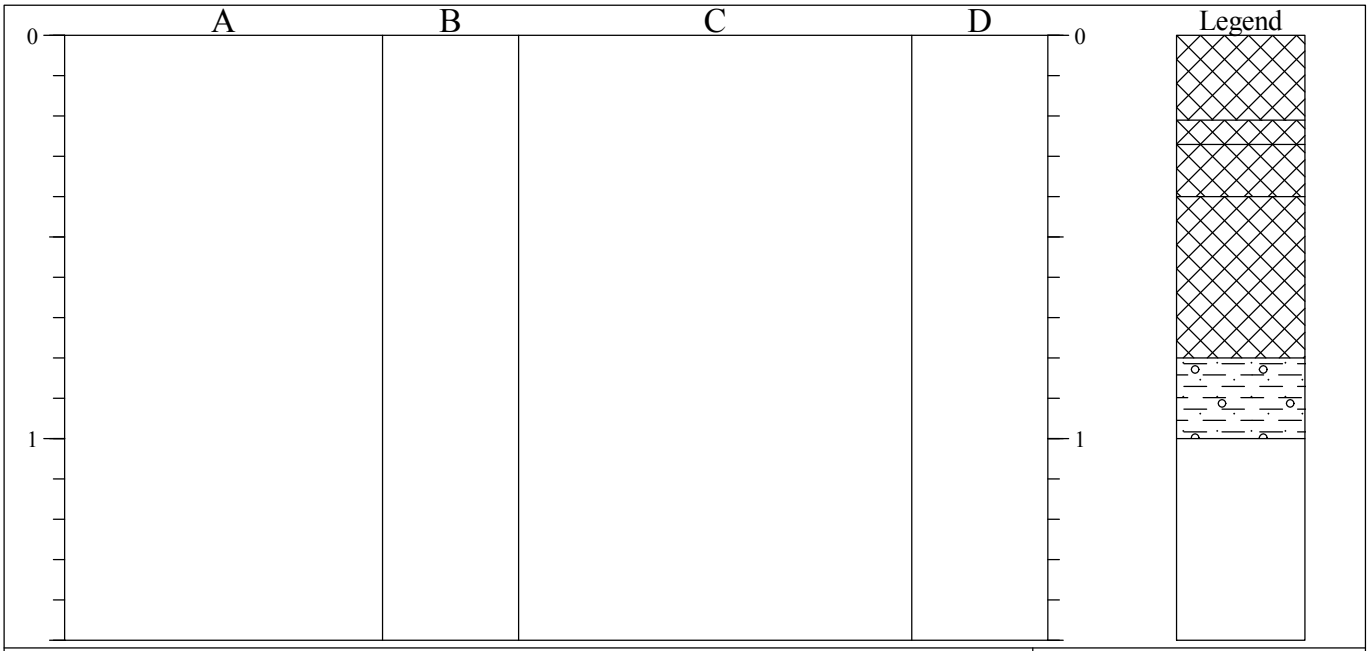
GENERAL REMARKS

All dimensions in metres Scale 1:18.75	Client TELMAC Developments Ltd	Method/ Plant Used Hand Core	Logged By MH

Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

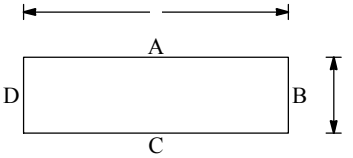
TRIAL PIT LOG

Project				TRIAL PIT No
East Boldon C of E Primary School				**Core 2**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.21		Wooden floor tile overlying concrete (MADE GROUND).			
0.21-0.27		Bituminous material (MADE GROUND).			
0.27-0.40		Black silty sand with fragments of brick and occasional ash (MADE GROUND).			
0.40-0.80		Brown slighty sandy gravelly silty. clay. Gravel is fine to coarse, angular to sub rounded including brick and concrete (MADE GROUND).			
0.80-1.00		Soft to firm slightly gravelly sandy CLAY. Gravel is fine to coarse, angular to rounded sandstone (PELAW CLAY).			

Shoring/Support:
Stability:





GENERAL REMARKS

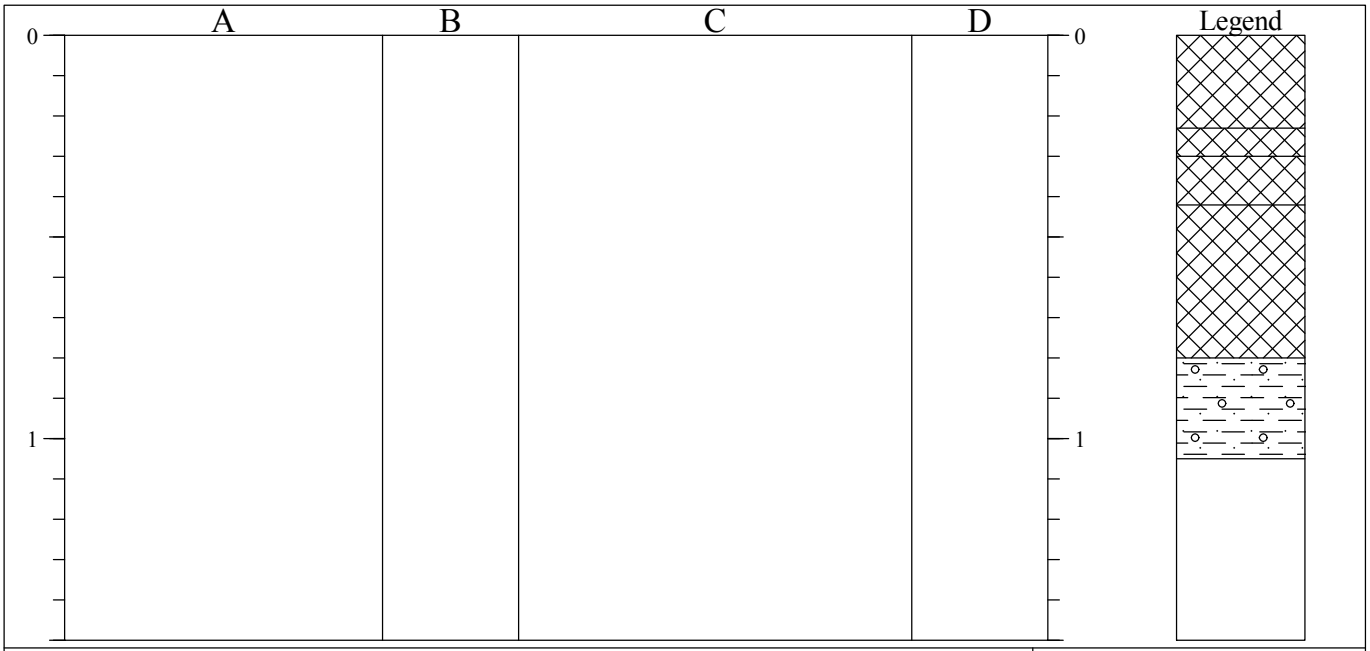
All dimensions in metres Scale 1:18.75	Client TELMAC Developments Ltd	Method/ Plant Used Hand Core	Logged By MH

AGS3 UK TP CORE LOGS.GPJ AGS3_ALL.GDT 2/5/17

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St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

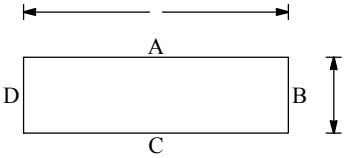
TRIAL PIT LOG

Project				TRIAL PIT No
East Boldon C of E Primary School				**Core 3**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
21-218	09-03-17			
Contractor				Sheet
				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.23		Wooden floor tile overlying concrete (MADE GROUND).			
0.23-0.30		Bituminous material (MADE GROUND).			
0.30-0.42		Black silty sand with fragments of brick and occasional ash (MADE GROUND).			
0.42-0.80		(MADE GROUND) Brown slighty sandy gravelly Silt. Gravel is fine to coarse, angular to sub rounded including brick fragments, brick waste and concrete			
0.80-1.05		Soft to firm slightly gravelly sandy CLAY. Gravel is fine to coarse, angular to rounded sandstone (PELAW CLAY).			

Shoring/Support:
Stability:





GENERAL REMARKS

All dimensions in metres Scale 1:18.75	Client TELMAC Developments Ltd	Method/ Plant Used Hand Core	Logged By MH

AGS3 UK TP CORE LOGS.GPJ AGS3_ALL.GDT 2/5/17

APPENDIX III

Gas Monitoring Certificate

Arc Environmental Ground Gas & Groundwater Monitoring Certificate

Site:	West Boldon School
Ref:	21-218

Visit	Date	Time	Equipment	Weather	Initials	Comments	Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Trend	Methane (% v/v)		Methane (% LEL)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Hydrocarbons (GFM 435 only)		Other Gases (PPM)			Depth to Water (m bgl)
											Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Hex %	PID Cf	PID (Isobutylene)	H_2S	CO	
1	31/03/2017	12:30pm	GFM435	Sunny spells and windy	IH	Atmospheric trend taken from www.wunderground.com for Newcastle Airport over three consecutive days.Bailed out BH's 4 & 6 prior to monitoring	1	<0.1	996	Rising (1001-1024)		0.0		0.0		0.6		19.7						2.30
							4	<0.1	996	Rising (1001-1024)		0.0		0.0		0.0		20.4						0.55
							6	<0.1	996	Rising (1001-1024)		0.0		0.0		0.0		20.4						0.95
2	12/04/2017	9.15am	GFM435	Sunny	IH	Atmospheric trend taken from www.wunderground.com for Newcastle Airport over three consecutive days.Bailed out BH's 4 & 6 prior to monitoring	1	<0.1	1012	Steady (1009-1015)		0.0		0.0		0.4		19.8						2.22
							4	<0.1	1012	Steady (1009-1015)		0.0		0.0		0.0		20.2						0.50
							6	<0.1	1012	Steady (1009-1015)		0.0		0.0		0.1		20.2						0.62
3	27/04/2017	2.45pm	GFM435	Overcast/showers	IH	Atmospheric trend taken from www.wunderground.com for Newcastle Airport over three consecutive days.Bailed out BH's 4 & 6 prior to monitoring	1	<0.1	1006	Rising (1011-1022)		0.0		0.0		0.4		19.9						2.18
							4	<0.1	1007	Rising (1011-1022)		0.0		0.0		0.0		20.4						0.50
							6	<0.1	1006	Rising (1011-1022)		0.0		0.0		0.0		20.4						0.63
4	05/05/2017	11:35am	GFM435	Sunny	IH	Atmospheric trend taken from www.wunderground.com for Newcastle Airport over three consecutive days.Bailed out BH's 4 & 6 prior to monitoring	1	<0.1	1022	Falling (1032-1018)		0.0		0.0		0.3		20.1						2.19
							4	<0.1	1022	Falling (1032-1018)		0.0		0.0		0.0		20.4						0.68
							6	<0.1	1022	Falling (1032-1018)		0.0		0.0		0.0		20.5						0.94
5	19/05/2017	11:30am	GFM435	Raining	IH	Atmospheric trend taken from www.wunderground.com for Newcastle Airport over three consecutive days.Bailed out BH's 4 & 6 prior to monitoring	1	<0.1	995	Steady (1009-1016)		0.0		0.0		0.1		20.3						2.17
							4	<0.1	996	Steady (1009-1016)		0.0		0.0		0.0		20.5						0.61
							6	<0.1	995	Steady (1009-1016)		0.0		0.0		0.0		20.3						0.92
6	05/06/2017	11.30am	GFM435	Overcast/showers	KC	Atmospheric trend taken from www.wunderground.com for Newcastle Airport over three consecutive days.Bailed out BH4 prior to monitoring	1	<0.1	995	Falling (1012-985)		0.0		0.0		0.0		20.3						2.12
							4	<0.1	994	Falling (1012-985)		0.0		0.0		0.0		20.1						0.68
							6	Borehole destroyed during demolition works																

Notes:

Detection limits - Methane = 0.0%, Carbon Dioxide = 0.0%, LEL = 0.0%, Oxygen = 0.0%, Flow = 0.1l/hr

Monitoring order is from **Left to Right** across table

Monitoring should be for **Not Less** than 3 minutes However, if high concentrations of gasses initially recorded, monitoring should be for up to 10 minutes

N/A = Not applicable = Off the scale

Cf = PID compensation Factor (1-10) - Must be used to multiply the PID reading to give an accuate measure of the total hydrocarbons in the borehole when methane is present

Hex = Hexane (Valid and in range up to 2.000%) - Recorded when abnormally high methane is present.

PID = Photo Ionisation Detector (Calibrated to Isobutylene)

APPENDIX IV

Laboratory Results

(Geotechnical & Ground Contamination)

LABORATORY REPORT

4043

Contract Number: PSL17/1384

Report Date: 30 March 2017

Client's Reference: 17-179

Client Name: Arc Environmental
Solum House
Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham
DH7 8PN

For the attention of: Michael Harmison

Contract Title: West Boldon Primary School

Date Received: 24/3/2017
Date Commenced: 24/3/2017
Date Completed: 30/3/2017

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)
A Watkins (Director)
R Berriman (Quality Manager)

[redacted]

L Knight (Senior Technician)
S Royle (Laboratory Manager)
A Fry (Senior Technician)

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e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH01		B	1.00	2.00	Brown slightly gravelly sandy CLAY.
BH02		B	1.00	2.00	Brown slightly gravelly sandy CLAY.
BH04		B	1.00	2.00	Brown slightly gravelly sandy CLAY.
BH05		B	1.00	1.70	Brown slightly gravelly sandy CLAY.
BH06		B	1.00	1.80	Brown slightly gravelly sandy CLAY.
BH08		B	1.00	2.00	Brown slightly gravelly sandy CLAY.

UKAS TESTING 4043

PSL Professional Soils Laboratory

West Boldon Primary School

Contract No:
PSL17/1384
Client Ref:
17-179

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH01		B	1.00	2.00	15			43	20	23	89	Intermediate plasticity CI.
BH02		B	1.00	2.00	18			39	19	20	91	Intermediate plasticity CI.
BH04		B	1.00	2.00	16			37	18	19	86	Intermediate plasticity CI.
BH05		B	1.00	1.70	15			40	19	21	87	Intermediate plasticity CI.
BH06		B	1.00	1.80	20			43	21	22	94	Intermediate plasticity CI.
BH08		B	1.00	2.00	18			42	21	21	90	Intermediate plasticity CI.

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

West Boldon Primary School

Contract No:

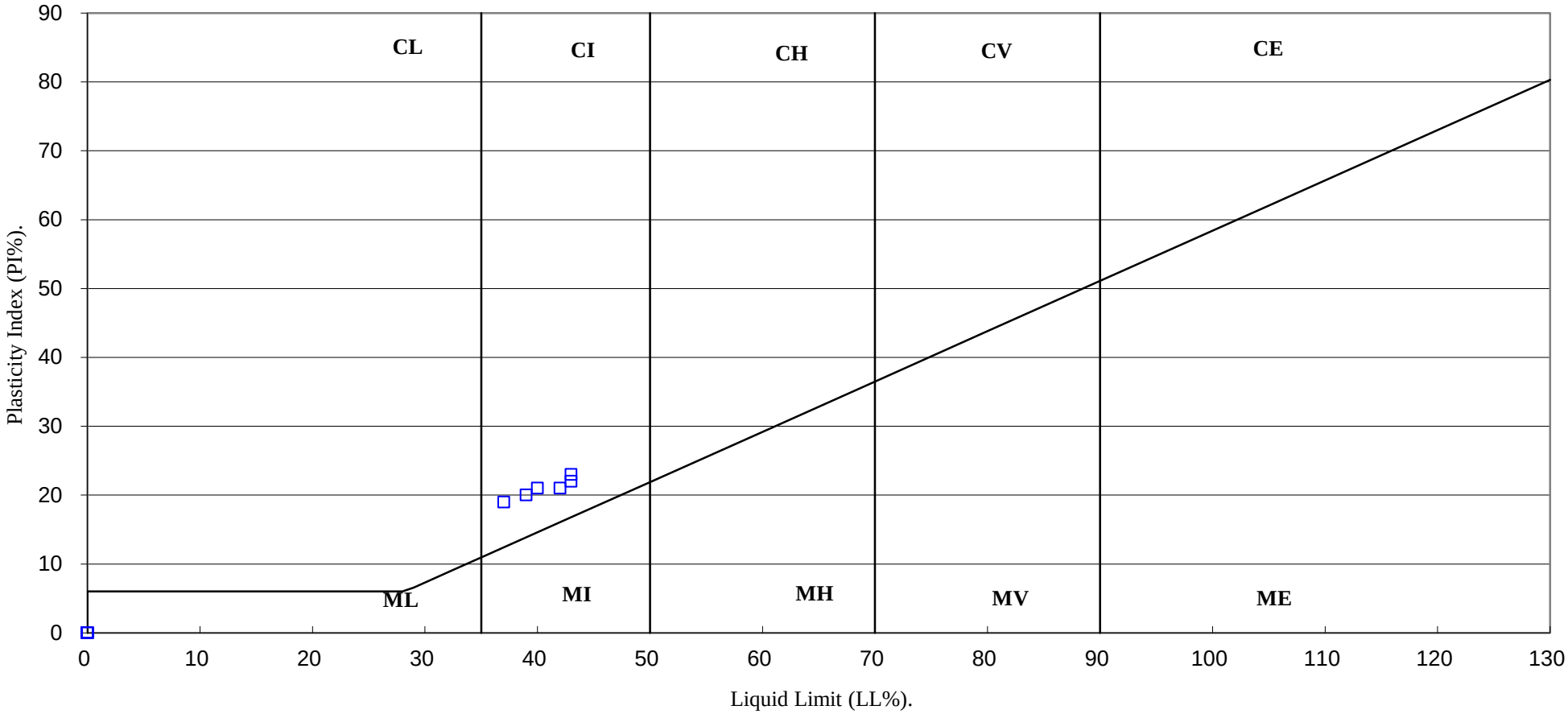
PSL17/1384

Client Ref:

17-179

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



UKAS TESTING 4043	PSL Professional Soils Laboratory	**West Boldon Primary School**	**Contract No:**
			PSL17/1384
			Client Ref:
			17-179

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ANALYTICAL TEST REPORT

Contract no: 63959

Contract name: West Boldon Primary School

Client reference: 17-179

Clients name: ARC Environmental

Clients address: Solum House, Unit 1 Elliott
St Johns Road
Meadowfield
DH7 8PN

Samples received: 22 March 2017

Analysis started: 22 March 2017

Analysis completed: 11 April 2017

Report issued: 11 April 2017

Notes:
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by: [redacted]
ames p e
Customer Services Team Leader

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
63959-1	BH1	0.70-1.00	Sandy Loam with Roots	-	-	11.9
63959-2	BH2	0.70-1.00	Sandy Clay	-	-	13.6
63959-3	BH3	0.20-1.00	Sandy Clay with Gravel	-	-	20.2
63959-4	BH3	1.00-2.00	Sandy Clay	-	-	17.7
63959-5	BH4	0.40-1.00	Clay	-	-	15.5
63959-6	BH5	0.30-1.00	Clay	-	-	15.5
63959-7	BH6	0.30-0.80	Sandy Clay with Gravel	-	-	24.3
63959-8	BH6	0.80-1.00	Sandy Clay	-	-	16.1
63959-9	BH7	0.50-1.00	Sand & Clay with Gravel	-	-	14.1

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SOILS

Lab number			63959-1	63959-2	63959-3	63959-4	63959-5	63959-6
Sample id			BH1	BH2	BH3	BH3	BH4	BH5
Depth (m)			0.70-1.00	0.70-1.00	0.20-1.00	1.00-2.00	0.40-1.00	0.30-1.00
Date sampled			09/03/2017	09/03/2017	09/03/2017	09/03/2017	09/03/2017	09/03/2017
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	4.3	-	14	-	5.5	-
Cadmium (total)	CE127 M	mg/kg Cd	0.2	-	4.8	-	<0.2	-
Chromium (total)	CE127 M	mg/kg Cr	90	-	67	-	70	-
Chromium (III)	-	mg/kg CrIII	90	-	67	-	70	-
Chromium (VI)	CE146	mg/kg CrVI	<1	-	<1	-	<1	-
Copper (total)	CE127 M	mg/kg Cu	13	-	74	-	20	-
Lead (total)	CE127 M	mg/kg Pb	29	-	27	-	26	-
Mercury (total)	CE127 M	mg/kg Hg	<0.5	-	0.7	-	<0.5	-
Nickel (total)	CE127 M	mg/kg Ni	18	-	26	-	37	-
Selenium (total)	CE127 M	mg/kg Se	0.5	-	1.0	-	1.6	-
Zinc (total)	CE127 M	mg/kg Zn	67	-	935	-	74	-
pH	CE004 M	units	7.6	7.4	7.5	7.7	7.8	-
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	45	16	33	23	38	-
Cyanide (free)	CE077	mg/kg CN	<1	-	<1	-	<1	-
Total Organic Carbon (TOC)	CE072 M	% w/w C	0.63	-	4.95	-	1.34	-
PAH								
Naphthalene	CE087 M	mg/kg	<0.01	-	0.11	-	0.03	-
Acenaphthylene	CE087 M	mg/kg	<0.01	-	0.05	-	<0.01	-
Acenaphthene	CE087 M	mg/kg	<0.01	-	<0.01	-	0.02	-
Fluorene	CE087 U	mg/kg	<0.01	-	0.05	-	0.02	-
Phenanthrene	CE087 M	mg/kg	0.02	-	0.62	-	0.22	-
Anthracene	CE087 U	mg/kg	<0.02	-	0.37	-	0.02	-
Fluoranthene	CE087 M	mg/kg	<0.02	-	2.43	-	0.11	-
Pyrene	CE087 M	mg/kg	<0.02	-	1.87	-	0.09	-
Benzo(a)anthracene	CE087 U	mg/kg	<0.02	-	1.28	-	0.04	-
Chrysene	CE087 M	mg/kg	<0.01	-	1.07	-	0.06	-
Benzo(b)fluoranthene	CE087 M	mg/kg	<0.02	-	1.29	-	0.05	-
Benzo(k)fluoranthene	CE087 M	mg/kg	<0.02	-	0.61	-	<0.02	-
Benzo(a)pyrene	CE087 U	mg/kg	<0.02	-	1.10	-	0.03	-
Indeno(123cd)pyrene	CE087 M	mg/kg	<0.02	-	0.58	-	<0.02	-
Dibenz(ah)anthracene	CE087 M	mg/kg	<0.02	-	0.18	-	<0.02	-
Benzo(ghi)perylene	CE087 M	mg/kg	<0.02	-	0.57	-	0.03	-
PAH (total of USEPA 16)	CE087	mg/kg	<0.27	-	12.17	-	0.73	-
Benzo(j)fluoranthene	CE087	mg/kg	<0.02	-	0.17	-	<0.02	-
PAH (total of OIL 8)	CE087	mg/kg	<0.15	-	6.27	-	0.18	-
TPH								
VPH (>C5-C7)	CE067	mg/kg	<0.1	-	<0.1	-	<0.1	-
VPH (>C7-C8)	CE067	mg/kg	<0.1	-	<0.1	-	<0.1	-

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SOILS

Lab number			63959-1	63959-2	63959-3	63959-4	63959-5	63959-6
Sample id			BH1	BH2	BH3	BH3	BH4	BH5
Depth (m)			0.70-1.00	0.70-1.00	0.20-1.00	1.00-2.00	0.40-1.00	0.30-1.00
Date sampled			09/03/2017	09/03/2017	09/03/2017	09/03/2017	09/03/2017	09/03/2017
Test	**Method**	**Units**						
VPH (>C8-C10)	CE067	mg/kg	<0.1	-	<0.1	-	1.4	-
EPH (>C10-C12)	CE033 [M]	mg/kg	<4	-	<4	-	<4	-
EPH (>C12-C16)	CE033 [M]	mg/kg	6	-	4	-	<4	-
EPH (>C16-C21)	CE033 [M]	mg/kg	8	-	19	-	7	-
EPH (>C21-C35)	CE033 [M]	mg/kg	14	-	69	-	22	-
EPH (>C35-C44)	CE033 [M]	mg/kg	<10	-	33	-	12	-
Volatiles								
Kerosene (>C8-C16)	CE033	mg/kg	-	-	-	-	-	<10
White Spirits (>C9-C12)	CE033	mg/kg	-	-	-	-	-	<10
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	-	NAD	-	NAD	-
E. coli	$	cfu/g	-	-	-	-	-	<10
Salmonella	$	in 25g	-	-	-	-	-	ND
Enterobacteriaceae	$	cfu/g	-	-	-	-	-	<10

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SOILS

Lab number			63959-7	63959-8	63959-9
Sample id			BH6	BH6	BH7
Depth (m)			0.30-0.80	0.80-1.00	0.50-1.00
Date sampled			09/03/2017	09/03/2017	09/03/2017
Test	**Method**	**Units**			
Arsenic (total)	CE127 M	mg/kg As	8.5	-	10
Cadmium (total)	CE127 M	mg/kg Cd	0.3	-	0.4
Chromium (total)	CE127 M	mg/kg Cr	96	-	88
Chromium (III)	-	mg/kg CrIII	96	-	88
Chromium (VI)	CE146	mg/kg CrVI	<1	-	<1
Copper (total)	CE127 M	mg/kg Cu	34	-	12
Lead (total)	CE127 M	mg/kg Pb	87	-	22
Mercury (total)	CE127 M	mg/kg Hg	<0.5	-	<0.5
Nickel (total)	CE127 M	mg/kg Ni	29	-	23
Selenium (total)	CE127 M	mg/kg Se	1.0	-	0.8
Zinc (total)	CE127 M	mg/kg Zn	113	-	44
pH	CE004 M	units	7.9	7.4	7.6
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	126	2409	12
Cyanide (free)	CE077	mg/kg CN	<1	-	<1
Total Organic Carbon (TOC)	CE072 M	% w/w C	3.59	-	0.22
PAH					
Naphthalene	CE087 M	mg/kg	0.06	-	0.06
Acenaphthylene	CE087 M	mg/kg	<0.01	-	<0.01
Acenaphthene	CE087 M	mg/kg	<0.01	-	<0.01
Fluorene	CE087 U	mg/kg	<0.01	-	<0.01
Phenanthrene	CE087 M	mg/kg	0.15	-	0.14
Anthracene	CE087 U	mg/kg	0.02	-	<0.02
Fluoranthene	CE087 M	mg/kg	0.19	-	0.17
Pyrene	CE087 M	mg/kg	0.16	-	0.14
Benzo(a)anthracene	CE087 U	mg/kg	0.11	-	0.09
Chrysene	CE087 M	mg/kg	0.11	-	0.10
Benzo(b)fluoranthene	CE087 M	mg/kg	0.12	-	0.10
Benzo(k)fluoranthene	CE087 M	mg/kg	0.06	-	0.05
Benzo(a)pyrene	CE087 U	mg/kg	0.09	-	0.08
Indeno(123cd)pyrene	CE087 M	mg/kg	0.06	-	0.05
Dibenz(ah)anthracene	CE087 M	mg/kg	<0.02	-	<0.02
Benzo(ghi)perylene	CE087 M	mg/kg	0.07	-	0.06
PAH (total of USEPA 16)	CE087	mg/kg	1.20	-	1.04
Benzo(j)fluoranthene	CE087	mg/kg	<0.02	-	<0.02
PAH (total of OIL 8)	CE087	mg/kg	0.54	-	0.43
TPH					
VPH (>C5-C7)	CE067	mg/kg	<0.1	-	<0.1
VPH (>C7-C8)	CE067	mg/kg	<0.1	-	<0.1

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SOILS

Lab number			63959-7	63959-8	63959-9
Sample id			BH6	BH6	BH7
Depth (m)			0.30-0.80	0.80-1.00	0.50-1.00
Date sampled			09/03/2017	09/03/2017	09/03/2017
Test	**Method**	**Units**			
VPH (>C8-C10)	CE067	mg/kg	<0.1	-	<0.1
EPH (>C10-C12)	CE033 M	mg/kg	<4	-	<4
EPH (>C12-C16)	CE033 M	mg/kg	<4	-	<4
EPH (>C16-C21)	CE033 M	mg/kg	9	-	<4
EPH (>C21-C35)	CE033 M	mg/kg	39	-	8
EPH (>C35-C44)	CE033 M	mg/kg	17	-	<10
Volatiles					
Kerosene (>C8-C16)	CE033	mg/kg	-	<10	-
White Spirits (>C9-C12)	CE033	mg/kg	-	<10	-
Subcontracted analysis					
Asbestos (qualitative)	$	-	NAD	-	NAD
E. coli	$	cfu/g	-	<10	-
Salmonella	$	in 25g	-	ND	-
Enterobacteriaceae	$	cfu/g	-	<10	-

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		1	mg/kg CN
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE087	Naphthalene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	Wet	U	0.01	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	Wet		0.27	mg/kg
CE087	Benzo(j)fluoranthene	Solvent extraction, GC-MS	Wet		0.02	mg/kg
CE087	PAH (total of OIL 8)	Solvent extraction, GC-MS	Wet		0.15	mg/kg
CE067	VPH (>C5-C7)	Headspace GC-FID	Wet		0.1	mg/kg
CE067	VPH (>C7-C8)	Headspace GC-FID	Wet		0.1	mg/kg
CE067	VPH (>C8-C10)	Headspace GC-FID	Wet		0.1	mg/kg
CE033	EPH (>C10-C12)	Solvent extraction, GC-FID	Wet	M	4	mg/kg
CE033	EPH (>C12-C16)	Solvent extraction, GC-FID	Wet	M	4	mg/kg
CE033	EPH (>C16-C21)	Solvent extraction, GC-FID	Wet	M	4	mg/kg
CE033	EPH (>C21-C35)	Solvent extraction, GC-FID	Wet	M	6	mg/kg
CE033	EPH (>C35-C44)	Solvent extraction, GC-FID	Wet	M	10	mg/kg
CE033	Kerosene (>C8-C16)	Solvent extraction, GC-FID	Wet		10	mg/kg
CE033	White Spirits (>C9-C12)	Solvent extraction, GC-FID	Wet		10	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-
$	β-Glucoronidase Positive Escherichia coli	Microbiology (details on request)	Wet		10	cfu/g
$	Faecal Enterococci	Microbiology (details on request)	Wet		50	cfu/g
$	Salmonella	Microbiology (details on request)	Wet		-	-
$	TVC @ 30°C 48h	Microbiology (details on request)	Wet		10	cfu/g

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DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
IT	Sample not cooled
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
63959-1	BH1	0.70-1.00	N	
63959-2	BH2	0.70-1.00	N	
63959-3	BH3	0.20-1.00	N	
63959-4	BH3	1.00-2.00	N	
63959-5	BH4	0.40-1.00	N	
63959-6	BH5	0.30-1.00	N	
63959-7	BH6	0.30-0.80	N	
63959-8	BH6	0.80-1.00	N	
63959-9	BH7	0.50-1.00	N	

APPENDIX V

Ground Contamination Risk Assessment Data: Methodology

CL:AIRE Statistical Analysis Sheet

Revised Conceptual Site Model (CSM)

Ground Contamination Risk Assessment

Assessment Framework:-

Ground contamination risk assessments are undertaken to identify potential risks from historical and recent land contamination on a given site and enable appropriate risk management actions to be undertaken in accordance with the regulatory context of the site and any future development. There are a range of technical approaches to the assessment of chemical contaminants in the UK, all of which broadly fit within a tiered/phased approach and the current UK approach is set out in the Defra and Environment Agency Publication: CLR 11: Model Procedures for the Management of Land Contamination (*Defra/EA 2004*).

ARC's approach to undertaking ground contamination risk assessments is based on the tiered/phased framework in accordance with CLR11, and for Human Health, the recently updated CLEA (Contaminated Land Exposure Assessment) framework and model for assessing potentially contaminated land in the UK. This framework and model is based primarily on the following publications and software: Science Reports SC050021/SR2 (EA 2008b Human Health toxicological assessment of contaminants in soil) and SC050021/SR3 (Updated technical background to CLEA model – replaces the previous guidance documents CLR9, CLR10 and Briefing notes 1 – 4); Science Report SC050021/SR4 (CLEA Software (version 1.06 beta) handbook) and the new CLEA software (replaces Science Report SC050021/H CLEA UK Handbook (draft) and the CLEA UK Software version 1.0 beta), along with the publication of a review of body weight and height data used within the Contaminated Land Exposure Assessment model (CLEA), Project no. SC050021/Technical Review 1.

All SGV's (Soil Guidance Values) published as part of the CLEA UK Handbook (draft) and software (version 1.0 beta), have been withdrawn along with guidance documents CLR7 and CLR8, and replacement of the SGV values to provide new Generic Assessment Criteria values (GAC's), using the updated model and software (version 1.071) has been derived by a combination of regulatory and non-governmental organisations (Defra, CL:AIRE and LQM). The newly published GAC's are known as Suitable 4 Use Levels (S4UL's) & Category 4 Screening Levels (C4SL's), and where assessment values for certain contaminants are not available the most appropriate alternative values from other sources will be utilised.

When considering ground contamination risk assessments for Controlled Waters (groundwater & Surface waters), ARC follows the EA guidance on Remedial Targets Methodology, Hydrogeological Risk Assessment for Land Contamination, 2006.

Methodology:-

ARC consider that the most appropriate methodology for completing a ground contamination risk assessment for soils on this site is to utilise the recently published GAC values (S4UL's – Arsenic, Cadmium, Chromium III & VI, Copper, Mercury Nickel Selenium, Zinc, Benzene, Toluene, Ethylbenzene, Xylenes, Phenol, speciated PAH's, speciated TPH's and other organic compounds, C4SL's – Lead), combined with other published and recognised GAC's (generic assessment criteria) for the remaining analytes. It is widely recognised by ground contamination risk assessment practitioners that the new CLEA model will generally result in higher SGV and GAC (generic assessment criteria) values for the standard end uses, and consequently continued use of the former CLEA model will result in a slightly more conservative assessment.

For general soil surface contamination, the new S4UL value for inorganic Mercury can be compared with chemical analysis for total mercury content, as the concentrations of elemental and methylmercury compounds are likely to be very low, in accordance with Science Report SC050021 / Mercury SGV. In addition, the updated C4SL values are based upon a Soil Organic Matter (SOM) content of 6%, in line with the most recent Defra and EA guidance. Once all the relevant data is available, a reassessment of the ground contamination present on this site can be carried out, if felt necessary, as this may result in a reduction in the scope of remediation works (if required). It should be noted that guidance document CLR11: Model Procedures for the Management of Land Contamination has not been withdrawn.

Ground Contamination Risk Assessment (Cont'd)

Methodology (Cont'd):-

ARC ground contamination risk assessments, in accordance with CLR11, are based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part IIA, EPA 1990 - inserted through Section 57 EA 1995), and adopts the tiered/phased approach beginning with a preliminary assessment (also referred to a desk top study). If potential pollutant linkages are identified from the preliminary assessment, for both Human Health and/or Controlled Waters, then Level 1 Quantitative Risk Assessments are appropriate guideline values. For soils these typically comprise Generic Assessment Criteria values (GAC's) or site specific assessment criteria (SSAC) and for Controlled Waters, Environmental Quality Standards (EQS) or UK Drinking Water Standards.

Where any Level 1 criteria have been exceeded, various courses of action are available for recommendation, in order to try and 'break' the pollutant linkage by designing into the proposed development works and/or by recommending appropriate remediation works, i.e. removal of source, treatment of contaminants, installation of permanent barriers, etc. and/or by carrying out more detailed site specific quantitative risk assessment (DQRA, i.e. Level 2 or above). Completing further DQRA for any contaminants present, can take into account factors such as the introduction of physical barrier and the actual availability of plausible contaminant migration pathways, as well as site specific data such as the type, properties and characteristics (permeability, porosity, density, etc.) of the soil present on site, groundwater depth and flow, site specific exposure criteria and values, and contaminant retardation, attenuation, dilution and degradation. Similarly, when considering potential risks to off-site receptors, these are considered by assessing the potential risks to on-site receptors, as well as the potential mobility of any contaminants present within either the soils or water/groundwater below this site.

For the purpose of this report, the preliminary and level 1 risk assessment considers one main category of receptor as follows:

- On site Human Health – (CLEA Model).

When considering the environmental setting and results of the contamination screening, no Level 1 Controlled Waters Risk Assessment has been carried out.

When considering the risk to construction workforce, the results of the screening can be used by the Main Contractor/Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations, and when assessing the level of PPE required on site. Similarly, when considering the risks to building materials, again the results of the contamination screening can be used to determine the level of protection that may be required, and reference should be made to the utilities suppliers for their comments.

Level 1 - Human Health:-

Level 1 human health related assessments are based upon the current CLEA Model, with site values assessed against published Soil Guidance Values (SGV's), and where these values are not available against the published CIEM (Chartered Institute of Environmental Health)/LQM Generic Assessment Criteria (GAC), Atkins ATRISKsoil© SSV values and USEPA Region 9 Screening Values (2009). For statistical analysis, the site is assessed to delineate any potentially differing areas of contamination (averaging areas), based on the results of the preliminary investigation as well as the result of any visual, olfactory or analytical evidence following completion of the intrusive investigation works. Following this geographical delineation of the site, where generic or pervasive contaminants are anticipated, for each 'averaging area' under consideration, the results are assessed using the established methods of statistical analysis given in the CL:AIRE Guidance on Comparing Soil Contamination Data with a Critical Concentration (C_C), May 2008. In this case, the results of the sample population are assessed to determine whether they represent a normal or non-normal distribution and the statistical upper confidence limit is (95% percentile – $UCL_{0.95}$) is calculated and then compared with the chosen Level 1 Critical Concentration (C_C) value for the site (i.e. the appropriate SGV, GAC or SSV).

In addition, further statistical analysis is undertaken to determine whether the maximum concentration(s) recorded represent statistical outliers, i.e. potential 'hot spots', and where necessary these are removed from the sampling populations and a reassessment of the averaging areas/potential hot spot areas identified.

Ground Contamination Risk Assessment (Cont'd)

Methodology (Cont'd):-

ARC ground contamination risk assessments, in accordance with CLR11, are based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part IIA, EPA 1990 - inserted through Section 57 EA 1995), and adopts the tiered/phased approach beginning with a preliminary assessment (also referred to a desk top study). If potential pollutant linkages are identified from the preliminary assessment, for both Human Health and/or Controlled Waters, then Level 1 Quantitative Risk Assessments are appropriate guideline values. For soils these typically comprise Generic Assessment Criteria values (GAC's) or site specific assessment criteria (SSAC) and for Controlled Waters, Environmental Quality Standards (EQS) or UK Drinking Water Standards.

Where any Level 1 criteria have been exceeded, various courses of action are available for recommendation, in order to try and 'break' the pollutant linkage by designing into the proposed development works and/or by recommending appropriate remediation works, i.e. removal of source, treatment of contaminants, installation of permanent barriers, etc. and/or by carrying out more detailed site specific quantitative risk assessment (DQRA, i.e. Level 2 or above). Completing further DQRA for any contaminants present, can take into account factors such as the introduction of physical barrier and the actual availability of plausible contaminant migration pathways, as well as site specific data such as the type, properties and characteristics (permeability, porosity, density, etc.) of the soil present on site, groundwater depth and flow, site specific exposure criteria and values, and contaminant retardation, attenuation, dilution and degradation. Similarly, when considering potential risks to off-site receptors, these are considered by assessing the potential risks to on-site receptors, as well as the potential mobility of any contaminants present within either the soils or water/groundwater below this site.

For the purpose of this report, the preliminary and level 1 risk assessment considers one main category of receptor as follows:

- On site Human Health – (CLEA Model).

When considering the environmental setting and results of the contamination screening, no Level 1 Controlled Waters Risk Assessment has been carried out.

When considering the risk to construction workforce, the results of the screening can be used by the Main Contractor/Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations, and when assessing the level of PPE required on site. Similarly, when considering the risks to building materials, again the results of the contamination screening can be used to determine the level of protection that may be required, and reference should be made to the utilities suppliers for their comments.

Level 1 - Human Health:-

Level 1 human health related assessments are based upon the current CLEA Model, with site values assessed against published Soil Guidance Values (SGV's), and where these values are not available against the published CIEM (Chartered Institute of Environmental Health)/LQM Generic Assessment Criteria (GAC), Atkins ATRISKsoil© SSV values and USEPA Region 9 Screening Values (2009). For statistical analysis, the site is assessed to delineate any potentially differing areas of contamination (averaging areas), based on the results of the preliminary investigation as well as the result of any visual, olfactory or analytical evidence following completion of the intrusive investigation works. Following this geographical delineation of the site, where generic or pervasive contaminants are anticipated, for each 'averaging area' under consideration, the results are assessed using the established methods of statistical analysis given in the CL:AIRE Guidance on Comparing Soil Contamination Data with a Critical Concentration (C_C), May 2008. In this case, the results of the sample population are assessed to determine whether they represent a normal or non-normal distribution and the statistical upper confidence limit is (95% percentile – $UCL_{0.95}$) is calculated and then compared with the chosen Level 1 Critical Concentration (C_C) value for the site (i.e. the appropriate SGV, GAC or SSV).

In addition, further statistical analysis is undertaken to determine whether the maximum concentration(s) recorded represent statistical outliers, i.e. potential 'hot spots', and where necessary these are removed from the sampling populations and a reassessment of the averaging areas/potential hot spot areas identified.

CL:AIRE Statistical Analysis Calculation Sheet - Level 1 GQRA for Generic Contaminants

Client/client ref: Gus Robinson Developments Ltd
Project ref: Former West Boldon Primary School
Site ref: 21-218
Data description: Contamination Results
Contaminant(s): Generic
Test scenario: Planning

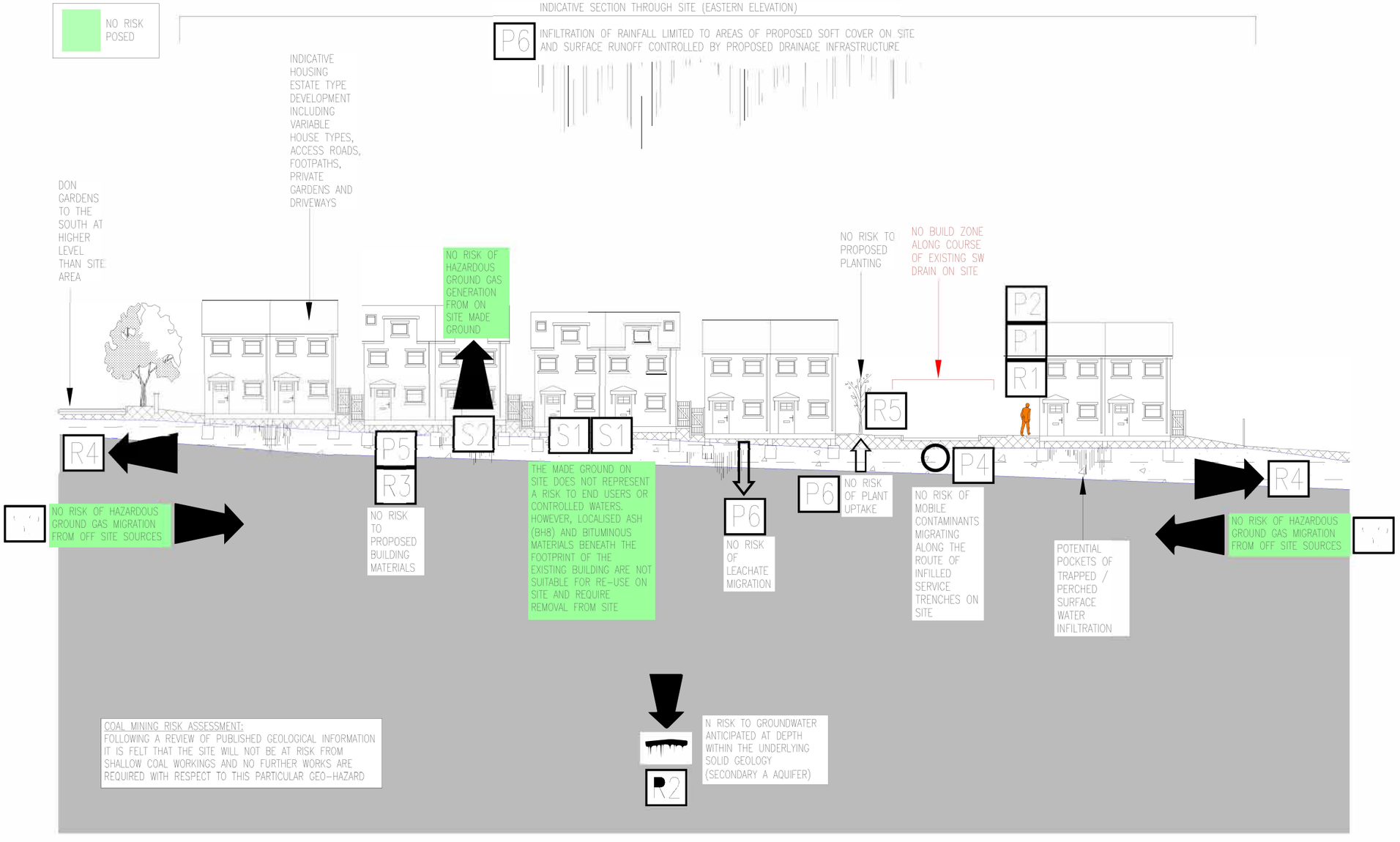
	Arsenic (total) (mg/kg)	Cadmium (total) (mg/kg)	Chromium (III) (mg/kg)	Chromium (VI) (mg/kg)	Copper (total) (mg/kg)	Lead (total) (mg/kg)	Mercury (total) (mg/kg)	Nickel (total) (mg/kg)	Selenium (total) (mg/kg)	Zinc (total) (mg/kg)	Cyanide (free) (mg/kg)
Critical concentration, C_c	**37**	**11**	**910**	**6**	**2400**	**200**	**40**	**180**	**250**	**3700**	**34**
Notes	S4UL - Residential with home-grown produce - LQM, 2014	S4UL - Residential with home-grown produce - LQM, 2014	S4UL - Residential with home-grown produce - LQM, 2014	S4UL - Residential with home-grown produce - LQM, 2014	S4UL - Residential with home-grown produce - LQM, 2014	C4SL - Residential with home-grown produce	S4UL - Residential with home-grown produce - LQM, 2014	S4UL - Residential with home-grown produce - LQM, 2014	S4UL - Residential with home-grown produce - LQM, 2014	S4UL - Residential with home-grown produce - LQM, 2014	ATRISK(SOIL) SSV - 2011
Sample size, n	5	5	5	5	5	5	5	5	5	5	5
Sample mean, $\overline{x}$	8.46	1.16	82.2	0.5	30.6	38.2	0.34	26.6	0.98	246.6	0.5
Standard deviation, s	3.84486671	2.03789107	12.8918579	0	25.8031006	27.3989051	0.20124612	7.09224929	0.40249224	385.628448	0
Number of non-detects	0	**1**	0	**5**	0	0	**4**	0	0	0	**5**
Set non-detect values to:	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit	Half detection limit
Outliers?	No	Yes	No	No	Yes	Yes	Yes	No	No	Yes	No
Distribution	Normal	Non-normal	Normal	Single value	Normal	Non-normal	Non-normal	Normal	Normal	Non-normal	Single value
Statistical approach	Auto: One-sample t	Auto: Chebychev	Auto: One-sample t	Auto: Chebychev	Auto: One-sample t	Auto: Chebychev	Auto: Chebychev	Auto: One-sample t	Auto: One-sample t	Auto: Chebychev	Auto: Chebychev
Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?				**Evidence level required:**		**95%**	Use Normal distribution to test for outliers			
t statistic, t_0 (or k_0)	-16.59807347	-10.79690139	-143.5803192	N/A	-205.3295668	-13.2047539	-440.6666667	-48.36446291	-1383.444444	-20.02455263	N/A
Upper confidence limit (on true mean concentration, μ)	12.1256608	5.13258102	94.4909796	0.5	55.2004404	91.6102986	0.7323009	33.3616857	1.36373242	998.328235	0.5
Evidence level	**100%**	**99%**	**100%**	**100%**	**100%**	**99%**	**100%**	**100%**	**100%**	**100%**	**100%**
Base decision on:	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level	evidence level
Result	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**	**μ < Cc**
Select dataset	○ Y	○ Y	○ Y	○ Y	○ Y	◉ Y	○ Y	○ Y	○ Y	○ Y	○ Y

CRITICAL POLLUTANT LINKAGES

SOURCE		PATHWAY		RECEPTOR	
S	1. MADE GROUND ASSOCIATED WITH THE CONSTRUCTION AND DEMOLITION OF BUILDINGS PRESENT WITHIN THE SITE BOUNDARY INCLUDING LOCAL INFILL TO PROVIDE LEVEL PLAYING AREAS AND AREAS OF "CUT AND FILL" 2. POSSIBLE GROUND GASES FROM ONSITE AND OFFSITE SOURCES – NO ELEVATED LEVELS RECORDED 3. CONTAMINANTS FROM THE PREVIOUS SITE USES INCLUDING AN ABATTOIR – NO ELEVATED LEVELS RECORDED	P	1. INGESTION AND DERMAL CONTACT 2. INHALATION OF INDOOR / OUTDOOR AIR 3. PLANT UPTAKE AND ATTACHED SOIL 4. MIGRATION THROUGH EXISTING SERVICES 5. DIRECT CONTACT WITH BUILDING MATERIALS 6. SURFACE RUN OFF AND LEACHATE MIGRATION	R	1. HUMAN HEALTH (END USERS AND CONSTRUCTION WORKFORCE) 2. GROUNDWATER WITHIN THE SECONDARY AQUIFER A WITHIN THE SOLID GEOLOGICAL DEPOSITS 3. BUILDING MATERIALS* 4. ADJACENT SITES 5. FLORA AND FAUNA*

NO RISK POSED

INDICATIVE SECTION THROUGH SITE (EASTERN ELEVATION)



STRATA DETAILS

MADE GROUND:
FROM 0.00M UP TO C.0.30M TO C.2.20M.
GENERALLY COMPRISING INITIAL SITE SURFACING OF EITHER GRASS OVERLYING DARK BROWN SANDY SOIL OR BITUMINOUS SURFACING. UNDERLYING THESE DEPOSITS, DISTURBED NATURAL STRATA WITH ANTHROPOGENIC DEBRIS (I.E. BRICK, CONCRETE, ETC.) WAS RECORDED

DRIFT DEPOSITS (PELAW CLAY):
FROM C.0.30M TO C.2.20M UP TO C.1.71M TO C.3.00M
GENERALLY COMPRISING STIFF (HIGH STRENGTH) BROWN SANDY GRAVELLY CLAY. THIS IS WITH THE EXCEPTION OF BH7 WHERE MEDIUM DENSE BECOMING DENSE BROWN INITIALLY CLAYBOUND SANDY GRAVEL WAS RECORDED

SOLID GEOLOGY (UPPER COAL MEASURES / BASAL SANDS):
FROM C.2.00M TO C.3.00M UP TO AT LEAST C.3.41M
COMPRISING REDDISH BROWN WEATHERED MUDSTONE, RECORDED IN BH'S 2, 3 & 4 ONLY

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The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
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rev.	date	amendments	drawn	chckd

Client:
TELMAC DEVELOPMENTS LTD

Project Title:
Former West Boldon Primary School
North Road, West Boldon
Tyne & Wear, WE36 0QE

Drawing Title:
Revised Conceptual Site Mode

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	13.04.17	P.D	M.H

Job Ref:	Drg no:	Rev:
21-218	—	—