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SUPPLEMENTARY PHASE 2: GROUND INVESTIGATION REPORT

VISTRY GROUP

PROPOSED RESIDENTIAL DEVELOPMENT 'MAPPLEWELL 2'

LAND NORTH EAST OF WAKEFIELD ROAD

MAPPLEWELL

BARNSELEY

S75 6DL

Project No: 26-405

Prepared by:

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Date:



11/09/2026

Approved by:

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Date:



18/09/2026

The information and / or advice contained in this Supplementary 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 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	Site Location Plan, Existing Exploratory Hole Location Plan, Proposed Exploratory Hole Location Plan
Appendix II	Borehole Record Sheets, Trial Pit Record Sheets, LWD Record Sheets
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1.0 Introduction

September 2026

As requested by Vistry Group, supplementary Phase 2: Ground Investigation works have been carried out at a parcel of land north east of Wakefield Road, Mapplewell, Barnsley, S75 6DL, where the site is proposed for development of residential housing with associated private gardens, access roads, car parking and soft landscaping.

These supplementary intrusive investigation works carried out by Arc Environmental Ltd comprised 2 no. rotary open hole boreholes (RBH01 & RBH02), 18 no. windowless sampling boreholes (WS01 to WS18) with 6 no ground gas and groundwater monitoring wells (WS03, WS04, WS08, WS12, WS14 & WS16), 19 no. mechanically excavated trial pits (TP01 to TP12, TP13 to TP13E inclusive & TP14) and 4 no. manually excavated trial trenches (TT01 to TT04).

The positions of these investigation locations can be seen on the Existing and Proposed Exploratory Hole Location Plan, copies of which is attached in Appendix I. It should be noted that this plan is for orientating purposes only, as the plan is not to a standard scale.

2.0 Site Details

Table 2.1

N = north, E = east, S = south & W = west.

Site Name & Address:	Land North East of Wakefield Road, Mapplewell, Barnsley, S75 6DL.
National Grid Reference:	434020, 409950 (representative of the central part of the site).
Description of Location:	The site primarily comprises of a disused lane located north east of Wakefield Road. A large area of concrete hardstanding is located in the centre of the site, with the land surrounding to the north, east and west, heavily overgrown and vegetated. Overhead electrical powerlines are noted to run along the eastern boundary of the site. Multiple small concrete pads were identified in the south eastern corner of the site within the overgrown vegetation. A retaining wall runs along the southern boundary of the site, with a supermarket and associated car park located on the raised ground, directly located to the south of the site.

3.0 Scope of Works

Table 3.1

Client:	Vistry Group.
Project type:	Residential housing with associated private gardens, access roads, car parking and soft landscaping.
Investigation Works:	2 no. rotary open hole boreholes (RBH01 & RBH02), 18 no. windowless sampling boreholes (WS01 to WS18), 6 no ground gas and water monitoring wells (WS03, WS04, WS08, WS12, WS14 & WS16), 19 no. mechanically excavated trial pits (TP01 to TP12, TP13 to TP13E & TP14), 4 no. manually excavated trial trenches (TT01 to TT04).
Laboratory Testing:	Geotechnical and Ground Contamination
CLEA End-Use Classification:	Residential with Homegrown Produce
Summary of Historical Site Information:	Historical mapping suggests the site initially comprised agricultural fields until the 1960s, where the site was redeveloped into a 'Remoulded Rubber Works' with associated tanks and electrical sub-stations. This was demolished at some point between c.2009 to c.2015. A supermarket was constructed directly to the south of the site c.2019. There have been no apparent significant changes since.

4.0 Supplementary Investigation Rationale

The information contained in this supplemental report is limited to the areas of the site, as indicated on the Site Location Plan, and to those areas accessible during the ground investigation. The depths of strata on the record sheets are recorded in meters below current ground levels (m bcgl) and above ordnance datum (AOD).

Previous investigations have been completed within the site boundary and have been used as references in this report. These include:

- Geo-environmental Investigation Report,
Joynes Pike & Associates - Ref. NLM/DRS/120700197.20070986, August 2007.
- Preliminary Appraisal Report (Desk Study), Land off Wakefield Road, Mapplewell,
Sirius - Ref. C7481, June 2017.
- Geo-environmental Ground Investigation Report, Wakefield Road, Mapplewell,
Haigh Huddleston & Associates - Ref. E18/7124/R001, May 2018.
- Ground Gas Assessment, Wakefield Road, Mapplewell,
Haigh Huddleston & Associates - Ref. E18/7124/JM/001, August 2018.

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, although they may have been addressed in a previous report. This ground investigation has been designed to provide information on the general ground and groundwater conditions where access would allow, within the boundaries of the site.

The rationale behind the location of each exploratory location in this supplementary investigation is summarised in Table 4.1 below.

Table 4.1

Potential issue	Exploratory Location
Determine the nature of the underlying ground conditions, including shallow groundwater with a view to assess risks to Human Health and Controlled Waters.	TP01 to TP12, TP13 to TP13E & TP14, RBH01 & RBH02, WS01 to WS18.
Determine the geotechnical parameters of the underlying ground conditions to provide information for foundation design and earthworks cut and fill operations.	TP01 to TP12, TP13 to TP13E & TP14, TT01 to TT04, WS01 to WS18.
To delineate an area classified as 'Artificial Ground' on BGS Mapping.	TP01 to TP12, TP13 to TP13E & TP14, TT01 to TT04, WS01 to WS18.
To identify and locate inferred coal seams outcropping on-site.	TT01 to TT04.
To investigate the presence of any historic unknown shallow coal workings.	RBH01 & RBH02.
Undertake gas monitoring to determine the risk to the proposed development from the potential migration of gas.	WS03, WS04, WS08, WS12, WS14 & WS16.

4.1 Contamination Related Sampling & Site Protocols: -

All works associated with this ground contamination assessment and investigations have generally been completed in accordance with BS10175:2011+A2:2017: Investigation of potentially contaminated sites – Code of practice & Land Contamination Risk Management (LCRM: October 2020) with the following precautions specific to this project.

4.0 Supplementary Investigation Rationale (Cont'd)

4.1 Contamination Related Sampling & Site Protocols (Cont'd): -

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 c.2-8°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 Onsite Health & Safety Requirements: -

All site representatives wore relevant and appropriate PPE including (where appropriate) safety footwear, high visibility jacket / vest, hard hat, eye protection and overalls. In addition, disposable latex gloves were used when handling any potentially contaminated materials and when rinsing all sampling tools. Each site vehicle contained a suitable First Aid kit with hand wash station / cleansing products (i.e., sanitary wipes).

4.1.3 Avoiding Cross-Contamination between Sample Locations: -

To avoid cross-contamination of materials between soil horizons, drill casing was used in the boreholes to seal off the made ground. In addition, plastic liners were used to collect samples from the windowless sampling boreholes. With regards to the trial pits, the samples were recovered manually using dedicated disposable plastic gloves replaced between each sample recovery.

5.0 Ground Conditions

For an accurate description of the ground conditions encountered at each investigation position, reference should be made to the Trial Pit and Borehole Record Sheets attached in Appendix II. It should be noted that there is always the possibility of variation in the ground conditions around and between the exploratory hole locations.

5.1 Soil Profile: -

5.1.1 Made Ground / Topsoil: -

Made ground located generally in the centre and southern portions of the site initially comprises site surfacing of asphalt or concrete from ground levels up to 0.19m below current ground levels (bcgl) underlain by gravelly sand with suspected burnt shale fragments up to c.0.60m bcgl. In addition, within the north western corner of the site, made ground comprising sandy slightly gravelly clayey soil with anthropogenic fragments of plastic and glass was identified from ground level up to c.0.39m bcgl.

Within Trial Pits TP13, TP13C, TP13D and TP14, located in the south eastern portion of the site, suspected possible 'Landfill' materials were encountered, generally comprising a mixture of plastic, rubber, metal, wood, paper and other deleterious materials, proven to depths of up to c.2.12m bcgl. The full scope and extent of this feature was not identified, and only partially delineated, due to access issues relating to the overgrown vegetation across that portion of the site.

There was no obvious visual or olfactory evidence of significant or gross contamination within the made ground materials such as Asbestos Containing Materials (ACM's), fuels, oils, solvents, etc.

5.0 Ground Conditions (Cont'd)

5.1 Soil Profile (Cont'd): -

5.1.2 Superficial / Residual Soil Deposits:

Underlying the made ground, the natural superficial deposits comprise localised areas of firm becoming stiff (medium becoming high strength) sandy clay (suspected Glacial Tills) identified to depths of up to c.1.90m bcgl underlain, site wide, by stiff becoming very stiff (high to very high strength) sandy gravelly clay (suspected residual soils).

5.1.3 Solid Geology:

Proven to underly the made ground and natural superficial deposits, solid geology initially comprised extremely weak completely weathered interbedded mudstones and siltstones from between c.0.77m bcgl to c.2.12m bcgl, becoming very weak partially weathered with depth, proven to at least c.30.00m bcgl, with noted intact coal encountered at depths of c.22.00m bcgl to c.25.00m bcgl with a thickness of c.1.00m. In addition, Coal was encountered within TP05 at a depth of c.1.89m bcgl.

5.2 Groundwater & Stability: -

No groundwater ingress was noted during the investigation. it should be noted that the rapid rate of advancement of the exploratory holes may mask minor seepages and consideration should be given fluctuating water levels due to seasonal variations, dewatering and pumping activities.

Most locations remained open and stable; however, instability was noted in some trial pits. A summary can be found in Table 5.1 below.

Table 5.1

<u>Location</u>	<u>Total Depth of position (m bcgl)</u>	<u>Stability</u>	<u>Comments</u>
TP13	3.00	Unstable	Instability within made ground 'Landfill' materials.
TP13C	2.20	Unstable	Instability within made ground 'Landfill' materials.
TP13D	1.50	Unstable	Instability within made ground 'Landfill' materials.
TP14	2.50	Unstable	Instability within made ground 'Landfill' materials.

5.3 Coal Mining Risk Assessment: -

It was identified that the site falls within a possible area of former shallow coal mining from both the Swinton Pottery Coal Seam, which subcrops across the north eastern corner of the site dipping north east, and the Newhill Coal Seam, which subcrops across the south western eastern corner of the site dipping north east under the site, where it is possible that there may be unrecording workings where the rock cover to extraction thickness ratio may be insufficient to meet the 10:1 safe conditions.

Past investigations have identified the intact Newhill Coal Seam under the site, as such, 2 no. confirmatory targeted cored / open hole rotary boreholes were sunk across the proposed development to check the depth and working status of the Newhill Coal Seam and measure the available rock cover.

Open hole rotary / probing is a crude method of drilling and the primary purpose of using this technique is to determine the presence or evidence of coal workings by 'feeling' the ground.

5.0 Ground Conditions (Cont'd)

5.3 Coal Mining Risk Assessment (Cont'd): -

During drilling operations cuttings are brought to the surface for identification purposes and drilling rates are observed to determine changes in the strength of the ground. A full water flush drilling medium (water recirculation tanks) was used to avoid the risk of spontaneous combustion and the movement of mine gases to adjacent structures which can occur when using a compressed air / air mist drilling medium.

Gas monitoring for Carbon Dioxide, Methane, Carbon Monoxide, Hydrogen Sulphide and Oxygen was regularly undertaken using a GFM 435 analyser and no elevated gas readings were observed. Similarly, the personal gas alarms were not activated by the drilling activities.

As can be seen from the borehole record sheets, c.1m to c.3m of superficial deposits overlie the Coal Measures. Intact Coal was encountered within the Coal Measures in both rotary boreholes, suspected to be the Newhill Coal Seam. Table 5.2 summarises the findings below.

Table 5.2

Position	Depth to Coal (mbgl) [Rock Cover (m)]	Thickness / Comments	Rock Cover Ratio (Rock Cover/thickness of workings)
RBH01	c.22.00m [20.90m]	c.1.00m of intact coal (Newhill Coal Seam)	20:1
RBH02	c.25.00m [22.00m]	c.1.00m of intact coal (Newhill Coal Seam)	22:1

The workings encountered verify that there is no evidence that the shallow coal (Newhill Coal Seam) has been worked below the development area at shallow depth. The relationship between the recorded extraction thickness and the available competent rock cover above the shallowest seam indicates rock cover is higher than the required 10:1 ratio normally acceptable for low rise developments (CIRIA Abandoned Mine Workings Manual, C758D, 2019).

In addition to the rotary boreholes, due to both seams inferred subcropping across the site, a series of trial pits and trial trenches were undertaken to locate areas where coal seams are present directly below the superficial deposits across the site. Table 5.3 summarises the findings below.

Table 5.3

Position	Depth to Coal (mbgl)	Targeted Subcropping Coal Seam	Comments
TT01	No coal encountered	Pottery Coal Seam	No coal was encountered within the slip trench.
TT02	No coal encountered	Pottery Coal Seam	No coal was encountered within the slip trench.
TT03	No coal encountered	Pottery Coal Seam	No coal was encountered within the slip trench.
TT04	No coal encountered	Newhill Coal Seam	No coal was encountered within the slip trench.
TP05	c.1.89m	Pottery Coal Seam	Solid geology encountered described as Extremely weak black highly weathered shaley MUDSTONE with coal fragments.

Due to the presence of subcropping coal seams on-site, additional foundation works will be required for any proposed developments where any coal is encountered during their construction process.

Therefore, when considering future development of the site, there does not appear to be a significant risk of future ground instability associated with past historic coal mining. Therefore, no further works are required to remediate the identified shallow workings in regard to the proposed development. Should the scope of the proposed development change, then the risks posed from the shallow workings may need to be re-assessed.

6.0 In-situ Testing

6.1 In-situ Standard Penetration Tests: -

Standard penetration tests (SPT's) were carried out with the use of a normal split spoon sampler on the made ground and natural drift deposits noted within the boreholes to determine the relative density / strength of the materials tested. The results are shown as uncorrected 'N' values on the borehole record sheets, adjacent to the appropriate sample level. A summary of the results of the tests undertaken can be seen in Table 6.1 below.

Where the full penetration depth, including seating blows (450mm), could not be achieved, the bottom sampling depth is indicated as less than 0.45m from the top (start of test), with the actual depth of penetration and number of blows undertaken also being recorded.

Table 6.1

<u>Type of Strata</u>	<u>Range of SPT 'N' Values</u>	<u>Result details</u>
Glacial Till	11 to 17	Indicative of firm becoming stiff (medium and high strength) deposits.
Residual Soil	21 to 50+ for limited penetration	Indicative stiff becoming very stiff (high and very high strength) deposits.
Mudstone	22 to 50+ for limited penetration	Indicative of extremely weak becoming very weak deposits.

6.2 In-situ Hand Shear Vane Tests: -

In-situ hand shear vane tests were carried out using a portable in-situ hand shear vane tester on the natural clays encountered in the exploratory locations. The in-situ 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 6.2 below and can also be found adjacent to the appropriate sample level, on the Trial Pit Sheet attached.

Table 6.2

<u>Type of Strata</u>	<u>Shear Strength (kPa)</u>	<u>Result details</u>
Glacial Till	76 - 110	High strength
Residual Soil	105 - 120+	High strength

6.3 In-situ LWD Tests: -

The Light Weight Deflectometer (LWD) is a portable device that measures the on-site dynamic modulus (Evd) of subgrade soils and pavements. It is suitable for cohesionless, cohesive and mixed types of soils with a maximum grain size of 63mm. It can be used on natural subgrade and subsoils, unbound base layers, granular layers, soil stabilised with lime or other additives.

The test method was originally designed to measure the dynamic modulus (Evd) of an in-situ material which indicates the material's stiffness. The test method is set out in BS 1924-2:2018, 9.2 "Hydraulically bound and stabilised materials for civil engineering purposes, Part 2, Sample preparation and testing of materials during and after treatment" but is also referenced in ASTM Standard E2583- 07: 2011 "Standard test method for measuring deflections with a light weight deflectometer (LWD)."

The test zone by the LWD is 300mm in diameter and up to 600mm in depth.

6.0 In-situ Testing (Cont'd)

6.3 In-situ LWD Tests (Cont'd): -

Numerous standards have been developed for the LWD and allow the characterisation of various materials based on Evd, including the estimation of the compaction degree of engineered fills, and bearing capacity. The principle of this test was developed in 1981 and simulates a truck with a 10-tonne axle weight travelling on a road at 80km per hour. A steel plate of 300mm diameter is placed on the soil to be tested.

A 10kg weight drops from a height of 0.72m onto the plate. The load pulse creates a soil pressure of 100kN/m² under the plate. The approximate duration of the load pulse is around 17ms (+/- 1.5ms) and it is created by means of engineered springs located above the plate. An acceleration sensor is arranged on the load plate and the velocity and the displacement (settlement) of the plate is calculated ranging from 0.1mm to 2mm (+/- 0.02mm).

LWD results can be used for determining dynamic soil modulus (Evd), spring stiffness (K₃₀₀), bearing capacity, degree of compaction and compaction quality control.

The LWD field results can be seen in Appendix II; the results were used to give estimates of static soil modulus (Ev1) and spring stiffness (K₃₀₀) to estimate a CBR value (%) summarised in Table 6.4 below using both typical correlations and the following equations:

Equation 1: $K_{300} = Ev1 / B * (1 - v^2)$,

where B = plate width (0.3m), v = poisson's ratio (0.35 typical for crushed rock or sub-base gravel and 0.4 for clay)

Equation 2: $K_{762} = 0.44 * K_{300}$,

where 0.44 is the conversion factor for smaller plate sizes

Equation 3: $CBR (\%) = 6.1 \times 10^{-8} * (K_{762})^{1.733}$

Table 6.4

Position	Depth (mbgl)	Strata	Δ mm	Evd MN/m ²	Ev1 MN/m ²	K ₃₀₀ kN/m ² /mm	K ₇₆₂ kN/m ² /mm	SC	CBR Equivalent %
TP01	0.27	RS	1.09	20.68	17.0	64.6	28.4	Very Soft	3.2
TP02	0.47	GT	0.78	28.85	22.5	85.5	37.6	Soft	5.2
TP03	0.39	MG	2.62	8.59	8.0	30.4	13.4	Very Soft	<1.0
TP04	0.15	GT	0.97	23.15	18.7	71.0	31.3	Soft	3.8
TP05	0.19	GT	0.89	25.25	23.5	89.3	39.3	Soft	5.6
TP06	0.56	GT	1.04	21.59	16.4	62.3	27.4	Very Soft	3.0
TP07	0.32	GT	1.23	18.35	15.9	60.4	26.6	Very Soft	2.8
TP08	0.42	GT	0.70	32.23	27.0	102.6	45.1	Firm	7.1
TP09	0.24	GT	1.22	18.50	15.3	58.1	25.6	Very Soft	2.7
TP10	0.37	GT	1.07	21.05	16.5	62.7	27.6	Very Soft	3.0
TP11	0.06	GT	1.27	17.79	14.0	53.2	23.4	Very Soft	2.3
TP12	0.54	MG	1.06	21.29	17.6	66.9	29.4	Very Soft	3.4

Evd = Dynamic Modulus, Ev1 = Static Soil Modulus (based on a correlation with Evd), SC = Soil Characterisation, K₃₀₀ / K₇₆₂ = Spring Stiffness / Modulus of Sub-grade Reaction (see equations 1 & 2), CBR = Californian Bearing Ratio (see equation 3), MG = Made Ground, RS = Residual Soil, GT = Glacial Till

6.0 In-situ Testing (Cont'd): -

6.4 In-situ Gas & Water Monitoring: -

Due to the potential risks (very low) identified in previous works, ground gas / vapor & water monitoring standpipes were installed within the windowless sampling boreholes (WS03, WS04, WS08, WS12, WS14 & WS16), primarily to check for the possible presence of hazardous ground gases (Landfill & Coal Mine Gasses), monitor any shallow water levels, and take samples of groundwater for testing if required.

A standard 50mm diameter HDPE standpipe, with gravel and geo-wrap surround, bentonite seal, gas valve cap and security cover, was installed within each borehole to depths of between c.1.00m bcgl to c.3.00m bcgl, and ground gas and water levels were allowed to reach equilibrium, prior to the first monitoring visit.

Monitoring was undertaken using a Gas Data GFM series soil gas analyser, with integral flow meter, and a Geotechnical Instruments electronic dip meter. The response zones were designed to target any ground gas from both on and off-site sources.

Based on the findings of the intrusive investigation works, in accordance with CIRIA Report C665, November 2007, Report Edition No. 04, March 2007 and BS8485:2015+A1 2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- The development has been considered as high sensitivity i.e., residential (Tables 5.5a & 5.5b – Typical / Idealised frequency and period of monitoring, after Wilson et al, 2005).
- The risk associated for future site use can be classified as very low. (Tables 5.5a & 5.5b – Typical / Idealised frequency and period of monitoring, after Wilson et al, 2005).
- Monitoring over a minimum of three months with a minimum of six recorded readings (Tables 5.5a & 5.5b – Typical / idealised frequency and period of monitoring after Wilson et al, 2005).
- Negligible flow rates are recorded during the monitoring period (Table 8.5 – Modified Wilson & Card classification).
- A targeted and phased programme of gas monitoring is being completed, which will obtain 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), and during low atmospheric pressure events (i.e. c.1000mb and below).

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 to target the ‘worst case’ scenario. The monitoring visits completed correlate with falling and steady atmospheric pressure trends and represent worst case conditions including falling atmospheric pressure trends, and atmospheric pressures below 1000mb.

A summary of the results for the visits undertaken to date, compared with the ‘inert’ background gas levels is presented in Table 6.5 on the next page, with the monitoring certificate attached in Appendix III.

6.0 In-situ Testing (Cont'd): -

6.4 In-situ Gas & Water Monitoring (Cont'd): -

Table 6.5

*Taken from (Skipton)

Table 0.2

Taken from (Skipton)

<u>Position</u>	<u>Date</u>	<u>Atmospheric Pressure (mbar)</u>	<u>Water (m bgl)</u>	<u>CH₄ (%v/v)</u>	<u>LEL (%v/v)</u>	<u>CO₂ (%v/v)</u>	<u>O₂ (%v/v)</u>	<u>Flow Rate (l/hr)</u>
Background		~	~	0	0	0	21.0	<0.1
WS03	04/08/2026	997 (Rising)*	Dry	0.0	0.0	0.7	20.2	<0.1
WS04			Dry	0.0	0.0	0.7	20.1	<0.1
WS08			Dry	0.0	0.0	0.8	16.1	<0.1
WS12			2.61	0.0	0.0	0.2	20.3	<0.1
WS14			Dry	0.0	0.0	0.8	19.5	<0.1
WS16			2.04	0.0	0.0	3.0	16.7	<0.1
WS03	18/08/2026	998 - 1000 (Steady)*	2.50	0.0	0.0	0.6	20.3	<0.1
WS04			Dry	0.0	0.0	0.2	20.5	<0.1
WS08			Dry	0.0	0.0	0.7	18.6	<0.1
WS12			2.10	0.0	0.0	0.3	20.3	<0.1
WS14			Dry	0.0	0.0	0.9	19.5	<0.1
WS16			Dry	0.0	0.0	3.3	16.6	<0.1
WS03	02/09/2026	1005 - 1006 (Rising)*	2.20	0.0	0.0	0.8	20.6	<0.1
WS04			Dry	0.0	0.0	0.4	20.1	<0.1
WS08			Dry	0.0	0.0	1.1	18.2	<0.1
WS12			2.00	0.0	0.0	0.5	20.5	<0.1
WS14			Dry	0.0	0.0	1.0	19.0	<0.1
WS16			1.80	0.0	0.0	3.2	14.4	<0.1
Minimum 3 no. outstanding visits to be completed – results to follow as Addendum Letter Report.								

As can be seen from the results undertaken to date, detectable levels of Carbon Dioxide (CO₂) (up to 3.3%) have been recorded, with depleted Oxygen (O₂) concentrations (minimum 14.4% v/v). Detectable levels of CH₄ have not been recorded. Negligible flow rates of <0.1l/hr have been recorded.

Based on the results of the monitoring undertaken, in accordance with CIRIA Report C665, a risk assessment has been completed for this site, by converting the results in Table 6.2 above to a Gas Screening Value (GSV), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates (after Wilson & Card). The GSV for CO₂ have been calculated, using the maximum recorded values, with a maximum flow rate of <0.1l/hr. The GSV can be calculated as follows:

$$\text{Carbon Dioxide GSV} = 0.033 (3.3\%) \times 0.1 = 0.0033 \text{ l/hr}$$

When considering these results to date, in accordance with CIRIA C665, the GSV for CO₂ would fall below the lower target concentration of 0.07l/hr and would equate to a Characteristic Situation 1 (CS1) site classification.

However, consideration should be given to the depleted concentrations of O₂ identified to date, as this may may require an increase in the characteristic situation by an order of 1 (i.e., Characteristic Situation 2 Classification) resulting in additional gas protection measures being required.

When considering the results of the groundwater monitoring to date, water levels varied from Dry to c.1.80m bgl.

A further 3 no. visits are outstanding and following the completion of these visits, a final assessment will be carried out and the results issued as an addendum report.

7.0 Laboratory Testing

7.1 Determination of pH & SO₄: -

Representative samples of the made ground, topsoil, superficial deposits (Glacial Till & Residual Soil) and solid geology recovered from the boreholes and trial pits during the investigation were tested to determine their acidic (pH) and soluble sulphate (SO₄) levels. The results are shown in Table 7.1 below and contained within Chemtech Analytical Reports (Ref. 26-09274 & 26-09620), copies of which are contained in Appendix IV.

Table 7.1

Position	Depth (m bcd)	Strata	pH	SO₄ (mg/l)	Design SO₄ Class	ACEC Class
WS01	0.17 - 0.20	Glacial Till	5.2	72.9	DS-1	AC-3z
WS02	0.15 - 0.25	Topsoil	5.9	39.6	DS-1	AC-2z
WS02	2.50 - 2.60	Mudstone	8.4	104	DS-1	AC-1
WS03	0.00 - 0.10	Topsoil	5.5	37.7	DS-1	AC-2z
WS04	0.10 - 0.20	Topsoil	6.7	26.5	DS-1	AC-1
WS06	1.90 - 2.00	Residual Soil	4.8	227	DS-1	AC-3z
WS08	0.29 - 0.40	Made Ground	7.2	128	DS-1	AC-1
WS09	2.20 - 2.30	Mudstone	6.1	<10.0	DS-1	AC-2z
WS11	0.00 - 0.10	Topsoil	7.0	31.0	DS-1	AC-1
WS12	0.70 - 0.80	Made Ground	6.9	48.5	DS-1	AC-1
WS13	0.20 - 0.30	Made Ground	8.9	35.1	DS-1	AC-1
WS13	2.90 - 3.00	Mudstone	7.1	44.2	DS-1	AC-1
WS16	1.10 - 1.30	Made Ground	7.7	318	DS-1	AC-1
WS17	0.60 - 0.80	Made Ground	6.5	206	DS-1	AC-2z
WS17	2.60 - 2.80	Residual Soil	5.8	15.2	DS-1	AC-2z
TP01	0.15	Made Ground	8.0	21.1	DS-1	AC-1
TP03	2.40	Mudstone	7.5	221	DS-1	AC-1
TP04	0.10	Topsoil	5.7	33.6	DS-1	AC-2z
TP05	0.10	Topsoil	5.6	87.9	DS-1	AC-3z
TP06	0.40	Topsoil	6.2	22.6	DS-1	AC-2z
TP06	1.90	Mudstone	5.9	101	DS-1	AC-2z
TP07	0.35	Glacial Till	5.8	47.3	DS-1	AC-2z
TP08	0.30	Topsoil	6.7	36.8	DS-1	AC-1
TP08	1.70	Mudstone	5.7	106	DS-1	AC-2z
TP09	0.70	Glacial Till	5.2	99.2	DS-1	AC-3z
TP09	2.00	Mudstone	6.6	71.3	DS-1	AC-1
TP10	0.25	Made Ground	8.2	181	DS-1	AC-1
TP10	1.50	Mudstone	7.7	80.6	DS-1	AC-1
TP12	0.35	Made Ground	8.3	89.2	DS-1	AC-1
TP12	0.80	Made Ground	7.9	78.3	DS-1	AC-1
TP13	1.50	Made Ground	7.3	1230	DS-2	AC-2
TP14	0.50	Made Ground	7.7	207	DS-1	AC-1

ACEC = Aggressive Chemical Environment for Concrete site classification

From these results the pH values for the samples ranges from 4.8 to 8.9, and the amount of soluble sulphate present ranges from <10.0mg/l to 1230mg/l.

In addition to the above, as mudstone and residual soils were encountered within the windowless sampling boreholes and trial pits, 5 no. samples were tested for the BRE Suite D. The results are shown below in Table 7.2 on the following page and are also contained within the Chemtech Analytical Reports (Ref. 26-09274 & 26-09620), copies of which are contained in Appendix IV.

7.0 Laboratory Testing (Cont'd)

7.1 Determination of pH & SO₄ (Cont'd): -

Table 7.2

Position	Depth (m)	Strata	Mg (g/l)	S (%)	Cl- (g/l)	NO ₃ (g/l)	SO ₄ (%)	Design SO ₄ Class	ACEC Class
WS02	2.50 - 2.60	Mudstone	11.40	<0.0026	9.38	<1.00	0.05	DS-1	AC-1
WS06	1.90 - 2.00	Mudstone	<1.00	<0.0026	147	<1.00	0.04	DS-1	AC-2z
WS09	2.20 - 2.30	Mudstone	<1.00	<0.0026	103	<1.00	0.01	DS-1	AC-1
WS13	2.90 - 3.00	Mudstone	10.50	<0.0026	3.74	<1.00	<0.01	DS-1	AC-1
WS17	2.60 - 2.80	Mudstone	1.04	<0.0026	7.72	<1.00	<0.01	DS-1	AC-1

ACEC = Aggressive Chemical Environment for Concrete site classification

Therefore, in accordance with the BRE Special Digest 1:2005, where foundations and buried concrete come into contact with any made ground materials, a classification of DS-2, and assuming mobile groundwater, the assessment of the Chemical Environment is AC-2.

Where foundations and buried concrete come into contact with any topsoil materials, a classification of DS-1, and assuming mobile groundwater, the assessment of the Chemical Environment is AC-2z.

Where foundations and buried concrete come into contact with any superficial Glacial Till and Residual Soil materials, a classification of DS-1, and assuming mobile groundwater, the assessment of the Chemical Environment is AC-3z.

Where foundations and buried concrete come into contact with any mudstone deposits, a classification of DS-1, and assuming mobile groundwater, the assessment of the Chemical Environment is AC-2z.

7.2 Determination of Liquid & Plastic Limits: -

Representative samples of the cohesive deposits recorded across the proposed development area were tested to determine their liquid and plastic limits, so these materials could be classified. The results can be seen in Table 7.3 below and on the following page and within the PSL Analytical Reports (Ref. PSL26/6320 & PSL26/6661), copies of which are contained in Appendix IV.

Table 7.3

Position	Depth (m bcd)	M/C (%)	LL	PL	PI	Class	% Passing 425µm Sieve
WS02	0.90 - 1.00	17.1	62	30	32	CIH	92
WS03	0.90 - 1.00	21.2	27	33	40	CIV	91
WS04	1.40 - 1.50	11.1	45	25	20	CIM	100
WS05	1.00 - 1.10	13.1	53	23	30	CIH	100
WS06	0.90 - 1.00	20.4	65	30	35	CIH	100
WS08	0.60 - 0.80	8.5	44	24	20	CIM	97
WS09	0.90 - 1.00	19.7	88	37	51	CIV	100
WS10	0.90 - 1.00	12.9	45	25	20	CIM	100
WS11	0.90 - 1.00	19.7	59	29	30	CIH	100
WS12	1.40 - 1.50	11.6	36	21	15	CIM	94
WS13	1.00 - 1.20	18.2	53	23	30	CIH	93
WS14	1.30 - 1.40	15.9	52	23	29	CIH	100
WS16	1.50 - 1.60	20.1	40	21	19	CIM	100
WS17	1.60 - 1.80	26.5	62	30	32	CIH	100
WS18	1.00 - 1.20	16.3	48	26	22	CIM	100

M/C = Moisture Content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, CIM = Clay Medium, CIH = Clay High, CIV = Clay Very High

7.0 Laboratory Testing (Cont'd)

7.2 Determination of Liquid & Plastic Limits (Cont'd): -

Table 7.3 (Cont'd)

Position	Depth (m)	M/C (%)	LL	PL	PI	Class	% Passing 425µm Sieve
TP01	0.90	18.0	59	28	31	CIH	90
TP02	1.20	14.2	42	20	22	CIM	100
TP02	1.90	13.7	49	23	26	CIM	100
TP03	1.50	16.4	43	20	23	CIM	100
TP04	1.00	12.2	58	28	30	CIH	91
TP05	1.40	24.1	75	30	45	CIV	90
TP06	1.20	16.2	46	22	24	CIM	91
TP07	1.30	12.5	43	21	22	CIM	100
TP08	1.00	20.0	68	29	37	CIH	100
TP09	1.20	15.2	49	23	26	CIM	92
TP10	0.60	16.5	40	20	20	CIM	100
TP11	1.00	13.5	49	23	26	CIM	100
TP12	1.50	22.1	55	24	31	CIH	100
TP12	2.50	14.5	41	20	21	CIM	80

M/C = Moisture Content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, CIM = Clay Medium, CIH = Clay High, CIV = Clay Very High

The twenty nine samples tested, when plotted on the plasticity chart, fall within the medium, high and very high plasticity ranges, and from the resulting plasticity indices, have a low, medium and high volume change potential, when considering the amount passing the 425µm sieve.

When comparing the natural moisture content to soil index properties there is a crude estimate to suggest that clays are desiccated if the water / moisture content (M/C) is less than 0.4x the Liquid Limit (LL). Similarly, a moisture content below the plastic limit strongly suggests that the clay is undergoing / has undergone desiccation.

Taking this into account and comparing the moisture content, 86% of the samples tested indicate that the clay has undergone desiccation.

Therefore, some of these materials may undergo significant changes in volume, if large changes in their natural moisture content were to occur due to seasonal variations or the like. As such, it is anticipated that a minimum founding depth of 1.00m bfgl (below finished ground levels) will be required within any cohesive deposits across the site.

7.3 Earthworks Relationship Testing: -

Representative samples of the sandy, occasionally silty, clay were subjected to a series of earthworks relationship tests to further assess the suitability of the natural soils for use in 'cut and fill' operations. The samples were tested for the following:

- Determination of dry density / moisture content (4.5kg rammer – standard compaction for fine soils - 5 points).
- Determination of California Bearing Ration (CBR) value at each point.
- Determination of Hand Shear Vane (HSV) value at each point.
- Determination of Moisture Condition Value (MCV).

7.0 Laboratory Testing (Cont'd)

7.3 Earthworks Relationship Testing (Cont'd): -

The graphic earthworks relationship testing summary sheets summarise the laboratory testing and show the relationships between the Moisture Contents and Dry Density. These can be seen in the PSL Analytical Reports (Ref. PSL26/6320 & PSL26/6661), copies of which are contained in Appendix IV.

Representative samples of the natural materials were subject to earthworks relationship testing to determine the performance criteria for achieving adequate compaction. Plots of the recorded relationship testing, comparing the various soil parameters, are attached along with the optimum moisture contents and maximum dry densities.

It is accepted that the laboratory theoretical maximum parameters (i.e. 100% compaction with no air voids) are impractical to achieve in the field, due mainly to heterogeneities in a large volume of material. It is therefore normal to adopt a field tolerance from this laboratory maximum. This is normally taken as between 90% and 95% of maximum compaction. In this case a conservative value $\geq 95\%$ has been adopted.

Although ultimately density is an important consideration in re-compacting earthworks materials, this must be taken in the context of workability and traffic-ability, which is assessed using MCV results.

Typically for fine soils to achieve a material that is both workable and trafficable then the MCV value should range from ≥ 8 to ≤ 16 , with values greater than 16 becoming more difficult to work and values less than 8 being unsuitable to traffic across.

The results have been summarised in Table 7.4 below.

Table 7.4

<u>Position</u>	<u>Depth (m bcgl)</u>	<u>Natural Moisture Content (%)</u>	<u>Optimum Moisture Content (%)</u>	<u>Moisture Content Range to achieve $\geq 95\%$ compaction & $\leq 5\%$ air voids (%)</u>	<u>MCV Range</u>	<u>Design Moisture Content Range (%)</u>	<u>Design CBR Range (%)</u>	<u>Design HSV Range (kPa)</u>
TP01	2.50	14.8	18.0	18.5 - 22.5	8.0 - 8.5	18.5 - 19.0	5.5 - 7.0	135 - 145
TP07	1.20	11.4	15.0	14.5 - 19.5	8.0 - 9.0	14.5 - 15.5	5.0 - 7.0	90 - 105
TP12	3.00	10.2	14.0	12.5 - 17.5	8.0 - 10.0	12.5 - 14.0	6.5 - 9.5	85 - 110

From these results, the following observations can be made:

- The relationship testing revealed Natural Moisture Contents ranged from 10.2% to 14.8%, with Optimum Moisture Contents ranging from 14.0% to 18.0%, with Natural Moisture Contents noted below associated Optimum Moisture Contents, and the general behaviour of the materials tested under standard compaction (4.5kg rammer) was not significantly different.
- The moisture content range to achieve $\geq 95\%$ compaction, $\leq 5\%$ air voids and workable material is range between c.12.5% to c.22.5%.
- From the materials where full relationship testing was completed, it was identified that the MCV Range was 8 to 10, with the Design Moisture Content Range between 12.5% to 19.0%, the Design CBR Range between 5.0% to 9.5% and the Design HSV Range between 85kPa to 145kPa

7.0 Laboratory Testing (Cont'd): -

7.3 Earthworks Relationship Testing (Cont'd): -

To achieve $\geq 95\%$ compaction and $\geq 5\%$ air voids, the natural in-situ moisture contents will require slight adjustments (i.e. drying or wetting) in order that the materials can be suitably compacted. To confirm the preferred compaction properties on-site controls will need to be adopted and any earthworks should be designed in accordance with the Code of Practice for Earthworks (BS6031:2009) and Series 600 Earthworks – Vol. 1 Specification for Highway Works February 2016.

It may be prudent to consider a method earthworks specification rather than a performance earthworks specification to achieve the preferred compaction, given the narrow margins of the performance parameters (i.e. moisture content, shear strength, MCV and CBR) and significant differences in design moisture contents.

7.4 Determination of Point Load Strength: -

Numerous selected samples of the intact bedrock recovered from the rotary cores, were dispatched to the laboratory for examination and subsequent testing.

The samples were loaded between two 60° steel points with a tip radius of 5mm, to determine their tensile point load strength (I_s), so that they might be classified.

The point load test is ideal for the rapid testing of rock samples, as multiple tests can be undertaken on irregular rock lumps, generally obtained from zones of high weathering (i.e., non-intact zones), as well as intact sections.

The results obtained are shown in Table 7.5 below and are also contained in the PSL Analytical Reports (PSL26/6662), a copy of which is contained in Appendix IV.

Table 7.5

Position	Depth (m)	Rock Type	Type of Test	Point Load Index ($I_{s(50)}$) (MPa)	Equivalent UCS Values (MPa)	Strength Term
RBH01	2.30	Mudstone	Axial	1.22	25.62	Medium Strong
RBH01	3.00	Mudstone	Axial	0.61	12.81	Moderately Weak
RBH01	3.80	Mudstone	Axial	0.87	18.27	Moderately Weak
RBH01	4.10	Mudstone	Axial	0.22	4.62	Weak
RBH01	4.80	Mudstone	Axial	0.64	13.44	Moderately Weak
RBH01	5.40	Mudstone	Axial	0.71	14.91	Moderately Weak
RBH01	6.90	Mudstone	Axial	1.01	21.21	Moderately Weak

To calculate the equivalent UCS value from the $I_{s(50)}$, a conservative value for coal measure deposits (Carter and Sneddon, 1977) of 21 was used. The results obtained indicate the approximate equivalent UCS values range from 4.62MPa up to 25.62MPa.

7.5 Contamination Screening / Screening Strategy: -

Representative samples of the made ground and topsoil were passed onto Chemtech Environmental of Stanley so that soil contamination screening could be carried out to assess any potential risk to human health, controlled waters, and assist with off-site disposal.

7.0 Laboratory Testing (Cont'd): -

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

The samples were screened using a standard generic contamination suite as detailed below (based on the historic CLEA SGV listed analytes with additions), which is used to assess typical made ground (disturbed natural strata mixed with anthropogenic debris) of an unknown source. Although visual/olfactory evidence of significant contamination (i.e. fuels / oils, ash, asbestos etc.) was not observed, representative samples were also tested for Speciated PAH (Polycyclic Aromatic Hydrocarbons), Speciated TPH (Total Petroleum Hydrocarbons) & Asbestos. The catalogue of testing results can be found in the Chemtech Analytical Reports (Ref. 26-09274 & 26-09620), copies of which are contained in Appendix IV, and the total analysis carried out is summarised below.

- 20 no. samples tested for A generic (metals and non-organics) soil suite including Arsenic, Cadmium, Chromium (III & VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide and Total Organic Carbon (TOC)
- 20 no. samples tested for Speciated Polycyclic Aromatic Hydrocarbons (PAH's)
- 20 no. samples tested for Speciated Total Petroleum Hydrocarbons (based on a full Aliphatic / Aromatic Split & BTEX)
- 20 no. samples tested for presence of asbestos and 1 no. sample for quantification testing

In addition, 4 no. samples were also tested for full UKWIR screening, to determine what type of pipe materials can be used for the proposed development.

8.0 Ground Contamination Risk Assessment

8.1 Methodology: -

Following completion of the contamination screening undertaken on various samples from this site, a supplementary Level 1 quantitative ground contamination risk assessments have been undertaken, generally in accordance with BS10175: British Standard Code of Practice for the Investigation of Potentially Contaminated Sites (2011+A2:2017) & Land Contamination Risk Management (LCRM: October 2020).

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 results of the contamination screening completed for this site, the risks from potential contaminants have been assessed for Human Health and Controlled Waters. The results of the risk assessments can be found in Sections 8.2 (Human Health) and 8.3 (Controlled Waters), with a summary of the potential contamination sources, migration pathways and sensitive receptors for this site described within the revised CSM in Section 8.4.

8.2 Level 1 Risk Assessment (Human Health): -

The soil screening results from across the site have been assessed by comparing the Maximum Concentration values (C_M) recorded for each analyte to the Critical Concentration (C_C) values chosen for this site (taken as *Residential with Home Grown Produce*). The results of the testing are contained in Appendix IV and are summarised in Table 8.1 below and on the following page. The average TOC percentage across the 20 no. samples tested is 2.56%, which when converted to SOM using a conversion factor of 1.72 is 4.40%. As such it is deemed suitable to adopt Critical Concentrations for the site based on an SOM of 2.5%.

8.0 Ground Contamination Risk Assessment (Cont'd)

8.2 Level 1 Risk Assessment (Human Health) (Cont'd): -

Table 8.1

Bold = Elevated concentrations

Analyte	Critical Conc. (C _c)	No. of Samples Screened	Max. Conc. (C _M) Recorded	No. of Samples >C _c
Metals & Non-Metals				
Arsenic	37 ⁽¹⁾	20	14.6	0
Cadmium	11 ⁽¹⁾	20	2.8	0
Chromium III	910 ⁽¹⁾	20	28.7	0
Chromium VI	6 ⁽¹⁾	20	<0.040	0
Copper	2400 ⁽¹⁾	20	39.6	0
Lead	200 ⁽²⁾	20	87.7	0
Mercury	40 ⁽¹⁾	20	1.1	0
Nickel	130 ⁽¹⁾	20	37.1	0
Selenium	250 ⁽¹⁾	20	<3.0	0
Zinc	3700 ⁽¹⁾	20	2090	0
Cyanide	1.49 ⁽³⁾	20	<1.0	0
PAHs				
Acenaphthene	510 ⁽¹⁾	20	0.097	0
Acenaphthylene	420 ⁽¹⁾	20	0.186	0
Anthracene	5400 ⁽¹⁾	20	0.417	0
Benzo(a)anthracene	11 ⁽¹⁾	20	5.33	0
Benzo(a)pyrene	2.7 ⁽¹⁾	20	8.00	2 (TP10 & TP12)
Benzo(b)fluoranthene	3.3 ⁽¹⁾	20	9.64	2 (TP10 & TP12)
Benzo(ghi)perylene	340 ⁽¹⁾	20	5.67	0
Benzo(k)fluoranthene	93 ⁽¹⁾	20	4.04	0
Chrysene	22 ⁽¹⁾	20	5.75	0
Dibenz(ah)anthracene	0.28 ⁽¹⁾	20	1.23	2 (TP10 & TP12)
Fluoranthene	560 ⁽¹⁾	20	7.03	0
Fluorene	400 ⁽¹⁾	20	0.142	0
Indeno(123cd)pyrene	36 ⁽¹⁾	20	6.88	0
Naphthalene	5.6 ⁽¹⁾	20	1.25	0
Phenanthrene	220 ⁽¹⁾	20	1.57	0
Pyrene	1200 ⁽¹⁾	20	7.74	0
BTEX & MTBEs				
Benzene	0.17 ⁽¹⁾	20	<0.001	0
Toluene	290 ⁽¹⁾	20	<0.001	0
Ethylbenzene	110 ⁽¹⁾	20	<0.001	0
m & p-Xylene	130 ⁽¹⁾	20	<0.002	0
o-Xylene	140 ⁽¹⁾	20	<0.002	0
TPHs				
VPH Aliphatic (>C5-C6)	78 ⁽¹⁾	20	<0.10	0
VPH Aliphatic (>C6-C8)	230 ⁽¹⁾	20	<0.10	0
VPH Aliphatic (>C8-C10)	65 ⁽¹⁾	20	0.11	0
EPH Aliphatic (>C10-C12)	330 ⁽¹⁾	20	3.5	0
EPH Aliphatic (>C12-C16)	2400 ⁽¹⁾	20	6.5	0
EPH Aliphatic (>C16-C35)	92000 ⁽¹⁾	20	128	0
EPH Aliphatic (>C35-C44)	92000 ⁽¹⁾	20	22.4	0

⁽¹⁾ = LQM CIEH Suitable 4 Use Levels (S4UL Nov 2014 (Revised August 2015) – Residential with Home Grown Produce – 6.0% SOM), ⁽²⁾ = C4SL Values (Residential with Homegrown Produce), ⁽³⁾ = ATRISK^{SOIL} SSV.

8.0 Ground Contamination Risk Assessment (Cont'd): -

8.2 Level 1 Risk Assessment (Human Health) (Cont'd): -

Table 8.1 (Cont'd)

Bold = Elevated concentrations

Analyte TPHs	Critical Conc. (C _C)	No. of Samples Screened	Max. Conc. (C _M) Recorded	No. of Samples >C _C
VPH Aromatic (>EC5-EC7)	140 ⁽¹⁾	20	<0.010	0
VPH Aromatic (>EC7-EC8)	290 ⁽¹⁾	20	<0.010	0
VPH Aromatic (>EC8-EC10)	83 ⁽¹⁾	20	<0.010	0
EPH Aromatic (>EC10-EC12)	180 ⁽¹⁾	20	<5.0	0
EPH Aromatic (>EC12-EC16)	330 ⁽¹⁾	20	9.2	0
EPH Aromatic (>EC16-EC21)	540 ⁽¹⁾	20	21.8	0
EPH Aromatic (>EC21-EC35)	1500 ⁽¹⁾	20	210	0
EPH Aromatic (>EC35-EC44)	1500 ⁽¹⁾	20	51.6	0
Asbestos	Presence	20	<0.001	1 (WS02)

⁽¹⁾ = LQM CIEH Suitable 4 Use Levels (S4UL Nov 2014 (Revised August 2015) – Residential with Home Grown Produce – 2.5% SOM), NAD = No asbestos detected

The results have identified the following:

- The Maximum Concentration C_M values for Benzo(a)pyrene exceeded the Critical Concentration C_C values in TP10 & TP12.
- The C_M values for Benzo(b)fluoranthene exceeded the C_C values in TP10 & TP12.
- The C_M values for Dibenz(ah)anthracene exceeded the C_C values in TP10 & TP12.
- The C_M values for Asbestos exceeded the C_C values in 1 of 20 samples in TP02.
 - The asbestos was identified as Chrysotile at a content of <0.001% and therefore is not considered to be a significant risk.
- No C_M values for any other analytes screened for exceed the C_C values for this site.
- No other asbestos fibres have been recorded during the investigation period.

The results of the contamination screening and analysis have confirmed that some topsoil and made ground encountered on-site does pose a possible risk to Human Health where exposure pathways are available which will require appropriate remediation This is described in detail in Section 9.4.

8.3 Level 1 Risk Assessment (Controlled Waters): -

The following hydrogeological and hydrological issues have been taken into consideration when assessing the risks towards Controlled Waters:

- There was no 'free product' recorded during the investigation.
- The site is not situated in or within c.1km of a Source Protection Zone.
- There are no Water Abstractions recorded within c.1km of the site.
- The superficial Glacial Till deposits are classified as Secondary Aquifer - Undifferentiated.
- The solid geology (Pennine Lower Coal Measures) is classified as a Secondary Aquifer - A.
- The nearest surface water feature (Unnamed Water Feature) is located 240m to the west of the site.
- The proposed development will include several areas of hardcover therefore reducing surface infiltration.

8.0 Ground Contamination Risk Assessment (Cont'd): -

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

From the results of these intrusive investigation works, the made ground identified does not contain any free product or mobile contamination such as waste oils, fuels, solvents, etc., that could migrate vertically or laterally from the site significantly and impact Controlled Waters.

Consequently, the risk to Controlled Waters from on-site contamination is considered to be low. Although there are some potential pathways and sensitive receptors, there is considered to be a negligible risk from on-site contamination and no further screening is considered necessary.

8.4 Conceptual Site Model (CSM): -

From the results of the intrusive investigation and contamination testing, a Conceptual Site Model (CSM) has been developed for the site and is illustrated in Table 8.2 below.

Table 8.2

	<i>Sources (S)</i>		<i>Pathways (P)</i>		<i>Receptors (R)</i>
S1	Made ground associated with historical industrial land use and adjacent construction. Raised levels of 3 no. analytes identified above C _c levels. Asbestos (Chrysotile) detected in 1 no. samples analysed at <0.001% not considered to pose a significant risk.	P1	Ingestion & Dermal Contact.	R1	<u>Human Health End Users:</u> Residential with Home Grown Produce & Construction Workforce
		P2	Air – Inhalation of vapours (indoor & outdoors) and contact with dust.		
		P3	Plant uptake and attached soils.		
		P4	Migration through existing services.	R2	<u>Controlled Waters:</u> Superficial Deposits: Secondary Aquifer - Undifferentiated Solid Geology: Secondary Aquifer - A Surface Water: Unnamed Surface Water Feature 240m west of the site
S2	Hazardous ground gas associated with the above made ground. Monitoring to date suggests Characteristic Situation 2 (CS-2)	P5	Direct contact with building materials.		
		P6	Surface run off & Infiltration.	R3	Adjacent sites
				R4*	Building materials and protection of water supply pipes.
				R5*	Flora and fauna*

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

8.4.1 Sources: -

The centre of the site comprises the relict remains of the historical industrial land use, comprising hardstanding and associated access, underlain made ground deposits containing anthropogenic debris of brick, concrete, tile and suspected burnt shale which, when assessed using a standard generic soil suite, have returned with raised levels of 3 no. PAH's when compared to their Critical Concentration Limits. As such, these made ground materials can be considered as a single averaging area for these analytes.

8.0 Ground Contamination Risk Assessment (Cont'd): -

8.4 Conceptual Site Model (CSM) (Cont'd): -

8.4.1 Sources (Cont'd): -

The remainder of the site generally comprises topsoil with occasional anthropogenic fragments of brick and tile overlying Glacial Till and Residual Soils which, when assessed using a standard generic soil suite, have returned with a raised level of asbestos (chrysotile) when compared to their Critical Concentration Limits. As such, these made ground materials can be considered an additional averaging area for these analytes.

In addition, within TP13, TP13C, TP13D and TP14, located in the south eastern portion of the site, suspected possible 'Landfill' materials were encountered, generally comprising a mixture of plastic, rubber, metal, wood, paper and other deleterious materials, proven to depths of up to c.2.12m bcgl. These materials, , have returned no raised levels analytes when compared to their Critical Concentration Limits. However, the full extents of these materials were not delineated, and consideration should be given to the nature and possible presents of additional sources of contamination not identified during these works.

Due to the potential made ground present on and adjacent to site, there is the potential for hazardous ground gases to migrate upwards and pose a risk to the proposed development, though current monitoring to date indicates no need for additional gas protection measures.

8.4.2 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, where there is no hardcover 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.

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 workforce during this period.

8.4.3 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).

8.0 Ground Contamination Risk Assessment (Cont'd): -

8.4 Conceptual Site Model (CSM) (Cont'd): -

8.4.3 Receptors (Cont'd): -

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 on the next page:

- 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*

For this Level 1 Risk Assessment when considering the sensitivity of the site the most appropriate end use category for this site has been taken as:

- 1) *Residential with Home Grown Produce*

With regards to Controlled Waters, the primary receptors considered for this site are the Solid Secondary Aquifer - A and Superficial Secondary Aquifer - Undifferentiated.

9.0 Conclusions & Recommendations

9.1 Ground Conditions: -

9.1.1 Made Ground and Topsoil: -

Made ground located generally in the centre and southern portions of the site from ground level up to c.1.50m bcgl with noted reinforced concrete and asphalt surfacing and anthropogenic fragments of brick, concrete, tile and burnt shale. Within Trial Pits TP13, TP13C, TP13D and TP14 located in the south eastern portion of the site, suspected possible 'Landfill' materials were encountered, generally comprising a mixture of plastic, rubber, metal, wood, paper and other deleterious materials, proven to depths of up to c.2.12m bcgl. The full scope and extent of this feature was not identified, and only partially delineated, due to access issues relating to the overgrown vegetation across that portion of the site.

There was no obvious visual or olfactory evidence of significant or gross contamination within the made ground materials such as Asbestos Containing Materials (ACM's), fuels, oils, solvents, etc.

9.1.2 Superficial / Residual Soil Deposits:

Underlying the made ground, the natural superficial deposits comprised of localised areas of firm becoming stiff (medium becoming high strength) sandy clay (suspected Glacial Till's identified to depths of up to c.1.90m bcgl underlain site wide by stiff becoming very stiff (high to very high strength) sandy gravelly clay (suspected residual soils)

9.0 Conclusions & Recommendations (Cont'd)

9.1 Ground Conditions (Cont'd): -

9.1.3 Solid Geology:

Proven to underly the made ground and natural superficial deposits, solid geology initially comprised extremely weak completely weathered interbedded mudstones and siltstones from between c.0.77m bcgl to c.2.12m bcgl, becoming very weak partially weathered with depth, proven to at least c.30.00m bcgl, with noted intact coal encountered at depths of c.22.00m bcgl to c.25.00m bcgl with a thickness of c.1.00m. In addition, Coal was encountered within TP05 at a depth of c.1.89m bcgl.

9.2 Groundwater & Stability: -

No groundwater ingress was noted during the investigation. It should be noted that the rapid rate of advancement of the exploratory holes may mask minor seepages and consideration should be given fluctuating water levels due to seasonal variations, dewatering and pumping activities.

As such, consideration should be given to shallow water ingress during future construction related excavations. It is therefore recommended that allowance is made for 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.

Most locations remained open and stable; however, instability was noted in some trial pits. A detailed summary can be found in Table 5.1.

9.3 Foundation Options: -

When considering the ground conditions encountered and the proposed development, it is considered that a combination of conventional strip footings and mass trench fill could be adopted across the site, with foundations taken down through the topsoil and any made ground deposits, founded wholly within the natural stiff to very stiff Glacial Till and Residual Soils or wholly within the completely to highly weathered Mudstone at a depth of at least 1.00 meters below finished ground levels, where a maximum allowable bearing pressure of 125kN/m² & 200kN/m² respectively, is available to ensure that all settlements remain within serviceable limits.

Within the area of Trial Pits TP13, TP13C, TP13D and TP14 located in the south eastern portion of the site, where the suspected landfill materials were encountered, should a mass trench fill solution be unviable, a piled solution may be required. This report should be forwarded onto a competent piling contractor for their comments and recommendations.

If any shallow coal strata are encountered within any foundation excavations, the foundations must be extended below the coal seam and any seatearth / soft deposits and founded wholly within the underling mudstone bedrock. The coal seam surrounding the foundations must be immediately sealed to prevent the risks of any possible spontaneous combustion events. The seam must be sealed within any foundation excavations, and firebreaks provided to the external perimeters of the plots where the seam abuts any foundation construction.

9.0 Conclusions & Recommendations (Cont'd)

9.3 Foundation Options (Cont'd): -

In addition, where any services are to be run over shallow coal strata, at least 1.00m thickness of clean cover must be emplaced surrounding the services to prevent the risks of any possible combustion events.

When considering the results of the pH and soluble sulphate testing, and assuming mobile groundwater:

- Where foundations and buried concrete come into contact with any made ground materials, the classification of DS-2 and the assessment of the Chemical Environment of AC-2 should be used.
- Where foundations and buried concrete come into contact with any topsoil materials, the classification of DS-1 and the assessment of the Chemical Environment of AC-2z should be used.
- Where foundations and buried concrete come into contact with any superficial Glacial Till and Residual Soil materials, the classification of DS-1 and the assessment of the Chemical Environment of AC-3z should be used.
- Where foundations and buried concrete come into contact with any mudstone deposits, the classification of DS-1 and the assessment of the Chemical Environment of AC-2z should be used.

Based on modified plasticity indices, the natural cohesive deposits present beneath the site have a low, medium and high volume change potential. As such, significant volume changes may occur if large changes in their natural moisture content were to occur due to seasonal variations or the like. In areas of cohesive deposits, a minimum founding depth of c.1.00m below finished ground levels.

In addition, an increase in founding depth may be required to reach competent strata if the proposed development is within close proximity to existing or envisaged vegetation.

When considering c.86% of the cohesive samples tested indicated they are undergoing / have undergone desiccation, an increase in the minimum foundation depth may be required in combination with the addition of heave protection measures, even if trees are to be removed, to ensure no additional future shrinkage and swelling of these materials occurs and influences the proposed development. Reference should be made to BS5837: 2012, 'Trees in Relation to Design, Demolition and Construction' along with the NHBC Standards, 'Building near trees'. A plan showing the areas where samples were identified as desiccated can be found in Appendix VI.

Due to some CBR values being below 1%, localised additional sub-grade improvement may be required, typically by adding an increased thickness of stone sub-base and geogrid reinforcements followed by rolling until the desired CBR value is met. It would be beneficial to confirm CBR values following compaction using Plate Load Testing. Any 'soft / loose' zones identified during development should be treated in the same manner. It should be considered that depending on cut and fill operations, any emplaced fill may be suitability engineered to reduce the scope of the required sub-base and subgrade.

9.0 Conclusions & Recommendations (Cont'd)

9.4 Classification of Waste: -

The made ground material and topsoil materials across site which may have to be discarded as a waste to landfill, have been assessed using Technical Guidance WM3 'Guidance on the classification and assessment of Waste', in conjunction with the on-line waste classification software tool HazWasteOnline™.

Each sample has been assessed separately to determine whether all the soils can be considered as a single waste stream or whether the different sources represent separate waste streams.

Based on the physical (visual and olfactory) inspection of the samples recovered from the boreholes and trial pits, representative samples have been assessed as either 17 05 03 (waste soil and stones containing hazardous substances) or 17 05 04 (waste soil and stones other than those mentioned in 17 05 03) from the WM3 List of Waste (LoW).

In order to determine which waste code applies to each sample, the results of the laboratory testing have been assessed using the HazWasteOnline™ software. The results are summarised in Table 9.1 below, and the full Waste Classification Report can be found attached in Appendix V.

Table 9.1

Position	Depth (m)	Classification	Waste Code
WS01	0.17 - 0.20	Non-Hazardous	17 05 04
WS02	0.15 - 0.25	Non-Hazardous	17 05 04
WS03	0.00 - 0.10	Non-Hazardous	17 05 04
WS04	0.10 - 0.20	Non-Hazardous	17 05 04
WS08	0.29 - 0.40	Non-Hazardous	17 05 04
WS11	0.00 - 0.10	Non-Hazardous	17 05 04
WS12	0.70 - 0.80	Non-Hazardous	17 05 04
WS13	0.20 - 0.30	Non-Hazardous	17 05 04
WS16	1.10 - 1.30	Non-Hazardous	17 05 04
WS17	0.60 - 0.80	Non-Hazardous	17 05 04
TP01	0.15	Non-Hazardous	17 05 04
TP04	0.10	Non-Hazardous	17 05 04
TP05	0.10	Non-Hazardous	17 05 04
TP06	0.40	Non-Hazardous	17 05 04
TP07	0.35	Non-Hazardous	17 05 04
TP08	0.30	Non-Hazardous	17 05 04
TP10	0.25	Non-Hazardous	17 05 04
TP12	0.35	Non-Hazardous	17 05 04
TP13	1.50	Non-Hazardous	17 05 04
TP14	0.50	Hazardous	17 05 03

The results of this assessment have identified that 19 no. of the soil samples tested are classified as Non-Hazardous Waste, whilst 1 no. sample tested was classified as Hazardous.

The material from TP14 that was classified as Hazardous comprised the suspected Landfill Material, as such, this material, as well as any other similar materials encountered on-site, should be classified as Hazardous when disposing off-site.

9.0 Conclusions & Recommendations (Cont'd)

9.4 Classification of Waste (Cont'd): -

For the remaining made ground and topsoil materials, it may be the case that some of the Non-Hazardous soils may meet the criteria for Inert Waste, however it was noted that some of these materials had Total Organic Carbon levels above 3% and thus would not be suitable for disposal at an Inert Landfill Facility. Waste Acceptance Criteria (WAC) testing should be completed once final volumes of material for off-site disposal are known.

The waste classification report and the results of the contamination screening should be forwarded on to the chosen landfill for their assessment. It should be noted that this Waste Classification Report is only applicable to those made ground materials which have been sampled and screened as part of the assessment. If materials, other than those covered by this report, are to be discarded from site as a waste to landfill or there is a significant increase in the volume of materials to be discarded, then these additional materials will also need to be assessed using Technical Guidance WM3: Guidance on the classification and assessment of Waste.

9.5 Ground Contamination Assessment: -

From the results of the additional supplementary contamination screening, elevated levels Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(ah)anthracene and asbestos have been recorded and represent a potential risk to human health where exposure pathways are available. A summary of the ground contamination on-site, can be found in Table 9.2 below and on the following page. From the results, a total of 3no. contamination zones have been identified.

Table 9.2

Contamination Zones	Comments
Zone A: Materials tested within TP10 and TP12 returned with raised levels of PAH's exceeding critical concentration levels for both 'Residential with Home Grown Produce' and 'Public Open Space (Residential)'.	<u>Remediation:</u> <ul style="list-style-type: none"> All future end uses within this zone categorised as 'Residential with Home Grown Produce' (Private Gardens) will require the use of a robust clean cover system totalling at least 600mm in thickness. All future end uses within this zone categorised as 'Public Open Space (Residential)' will require the use of a robust clean cover system totalling at least 300mm in thickness. Additional 'Hotspot' and delineation testing should be completed to reduce the overall area of suspected raised PAHs. <u>Usage for cut & fill operations:</u> <ul style="list-style-type: none"> Materials may be used for cut & fill operations in some areas with no further requirements provided they have the correct geotechnical parameters. If materials are used in areas categorised as "Residential with Homegrown Produce" (Private Gardens), a robust clean cover system totalling at least 600mm in thickness must be used to cover these materials, regardless of location on-site. If materials are used in areas categorised as 'Public Open Space (POS)', a robust clean cover system totalling at least 300mm in thickness must be used to cover these materials, regardless of location on-site. <u>Usage as site-won materials:</u> <ul style="list-style-type: none"> Soils and subsoils / clays must not be used as site-won materials for robust clean cover systems of either 'Residential with Home Grown Produce' or 'Public Open Space (Residential)'

9.0 Conclusions & Recommendations (Cont'd)

9.5 Ground Contamination Assessment: -

Table 9.2 (Cont'd)

Contamination Zones	Comments
<p>Zone B: Materials tested within WS02 returned with raised levels of asbestos (Chrysotile) exceeding detection limits.</p> <p>As asbestos was identified in only 1 of the 20 samples tested, as well as its percentage composition being less than 0.001%, it is not considered to pose a significant risk to end users at this time however, remedial measures will still be required.</p>	<p>Remediation:</p> <ul style="list-style-type: none"> All future end uses within this zone categorised as 'Residential with Home Grown Produce' (Private Gardens) will require the use of a robust clean cover system totalling at least 600mm in thickness. All future end uses within this zone categorised as 'Public Open Space (Residential)' will require the use of a robust clean cover system totalling at least 300mm in thickness. Additional 'Hotspot' and delineation testing can be completed to reduce the overall area of suspected asbestos. Depending on the total volumes of material identified, it may be possible to excavate and dispose of all contaminated materials off site. If this methodology is undertaken, additional validation works will be required. <p>Usage for cut & fill operations:</p> <ul style="list-style-type: none"> Materials may be used for cut & fill operations in some areas with no further requirements provided they have the correct geotechnical parameters. If materials are used in areas categorised as "Residential with Homegrown Produce" (Private Gardens), a robust clean cover system totalling at least 600mm in thickness must be used to cover these materials, regardless of location on-site. If materials are used in areas categorised as 'Public Open Space (POS)', a robust clean cover system totalling at least 300mm in thickness must be used to cover these materials, regardless of location on-site. <p>Usage as site-won materials:</p> <ul style="list-style-type: none"> Soils and subsoils / clays must not be used as site-won materials for robust clean cover systems of either 'Residential with Home Grown Produce' (Private Gardens) or 'Public Open Space (Residential)'
<p>Zone C: Within Trial Pits TP13, TP13C, TP13D and TP14 located in the south eastern portion of the site, suspected possible 'Landfill' materials were encountered proven to depths of up to c.2.12m bgl. The full scope and extent of this feature was not identified, and only partially delineated, due to access issues relating to the overgrown vegetation across this portion of the site.</p>	<p>Remediation:</p> <ul style="list-style-type: none"> This material has been classified as Hazardous and as such, this material, as well as any other similar materials encountered on-site, must be disposed of at a hazardous landfill No further remediation in relation of Human Health or Controlled Waters is required on in-situ materials within this zone. <p>Usage as site-won materials:</p> <ul style="list-style-type: none"> Soils and sub-soils / clays must not be used as site-won materials for robust clean cover systems of either 'Residential with Home Grown Produce' (Private Gardens) or 'Public Open Space (Residential)' <p>Usage for cut & fill operations:</p> <ul style="list-style-type: none"> Due to the deleterious nature of the materials, these materials would not meet the specification for use as a Class 1 or a Class 2 material within the Series 600 Earthworks - Vol.1 Specification for Highway Works, February 2016 and as such, should not be used for any cut and fill operations. It is advised, where possible, this material should not be disturbed and left in-situ.

9.0 Conclusions & Recommendations (Cont'd)

9.5 Ground Contamination Assessment: -

A drawing summarising the locations where contamination was identified be found in Appendix VI.

It is recommended that a Phase 3: Remediation Strategy be prepared and submitted as part of the planning application process, which will detail the remedial measures required, as well as a subsequent Phase 4: Validation Report upon completion of the development works. The PAHs and Asbestos identified will require further delineation works and remedial measures in the form of 'Hotspot' identification and removal as well as a clean cover system (design details to be agreed with the Local Authority / Planning Department).

All the contamination screening results should be provided to the Main Contractor / Project Coordinator, for use in 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 UKWIR Water Pipe Material Selection Screening: -

Generally, in accordance with the UKWIR Guidance (Guidance for the selection of water supply pipes to be used in Brownfield sites), 4 no. samples recovered from the trail were screened for the full UKWIR testing suite. The results are contained within the attached Chemtech Environmental Limited Analytical Reports and seen in the UKWIR Water Pipe Screening and Assessment Sheet in Appendix VI and are summarised below.

- WS05, WS07, WS10 & WS18 – PE, PVC & Barrier Pipe (PE - AL - PE)

It should be noted that Vistry Group should obtain confirmation from the local water mains utility supplier that these pipe materials are appropriate for this site and proposed development.

9.7 Gas Protection Measures: -

When considering these results to date, in accordance with CIRIA C665, the GSV for CO₂ would fall below the lower target concentration of 0.07l/hr and would equate to a Characteristic Situation 1 (CS1) site classification though consideration should be given to the depleted concentrations of O₂ identified to date, as this may require an increase in the characteristic situation by an order of 1 (i.e., Characteristic Situation 2 Classification) resulting in additional gas protection measures being required.

A further 3 no. visits are outstanding and following the completion of these visits, a final assessment will be carried out and the results issued as an addendum report.

9.8 General Comments: -

Where we have sampled and tested for asbestos this is discussed in the report. Whilst we would target any asbestos sampling and testing in accordance with a Conceptual Site Model and site findings, there is always the possibility, along with other contamination, that undiscovered asbestos exists between sample locations and the possibility of unknown asbestos exists on all sites.

9.0 Conclusions & Recommendations (Cont'd): -

9.8 General Comments (Cont'd): -

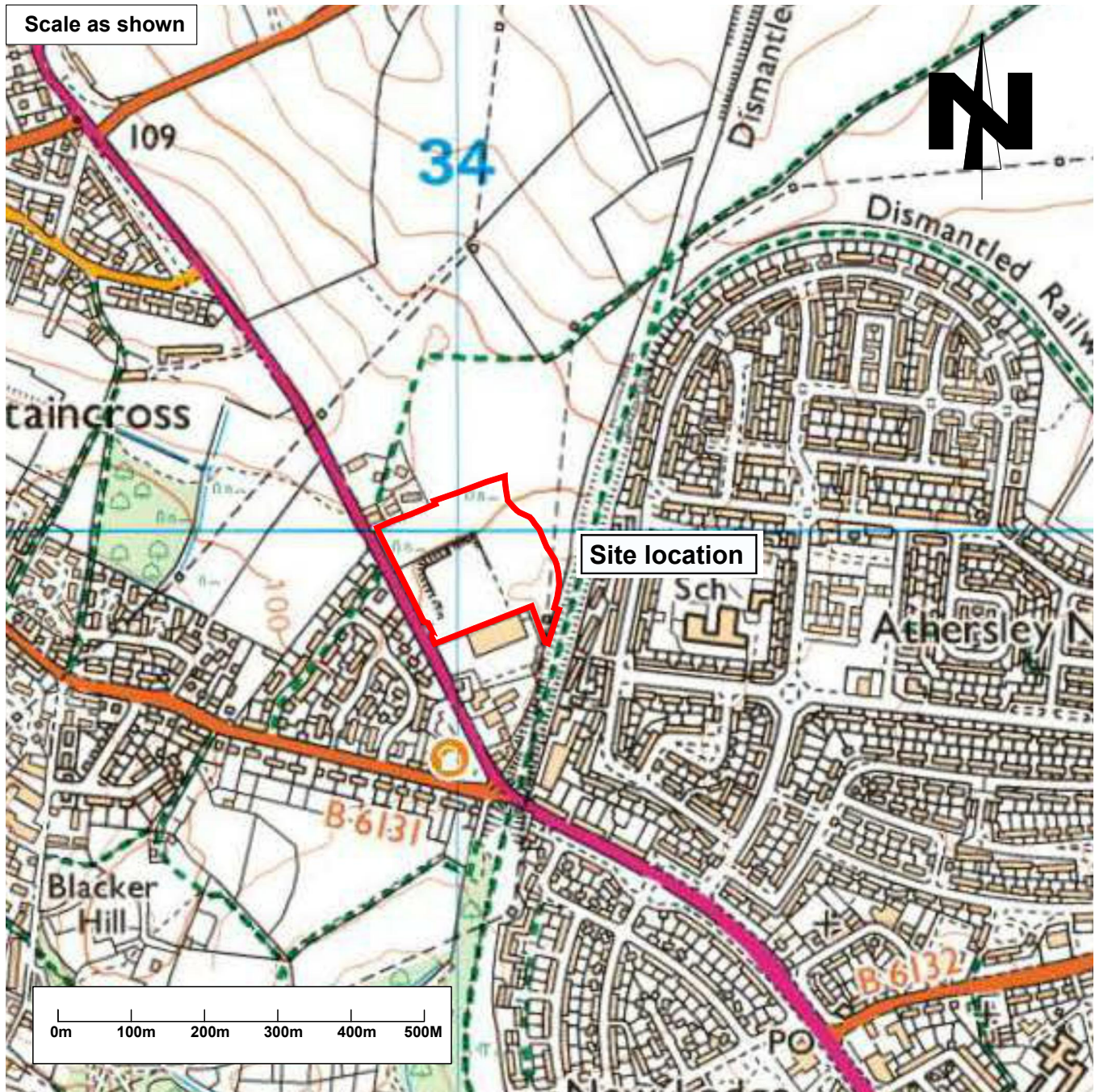
For future site works, adequate lateral trench support will be required for excavations, to prevent trench wall collapse or over excavations, as well as to create a safe working environment, and any excavations on this site should remain open for as short a period as possible, since some of these materials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

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.

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 Engineer should be sought.

END OF REPORT

APPENDIX I



Client:

VISTRY WEST YORKSHIRE

Project Title:

Proposed Residential Development

Site 2 – Land Adjacent to

Wakefield Road, Mappleton, Barnsley

Drawing Title:

Location Plan

Job Reference:

26-405

Drawing Number:

–

Revision:

–

Drawn by:

P.D

Date:

28.07.26

Scale at A4:

As shown

Checked by:

S.D

Approved by:

S.D

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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Legend



Approximate site boundary

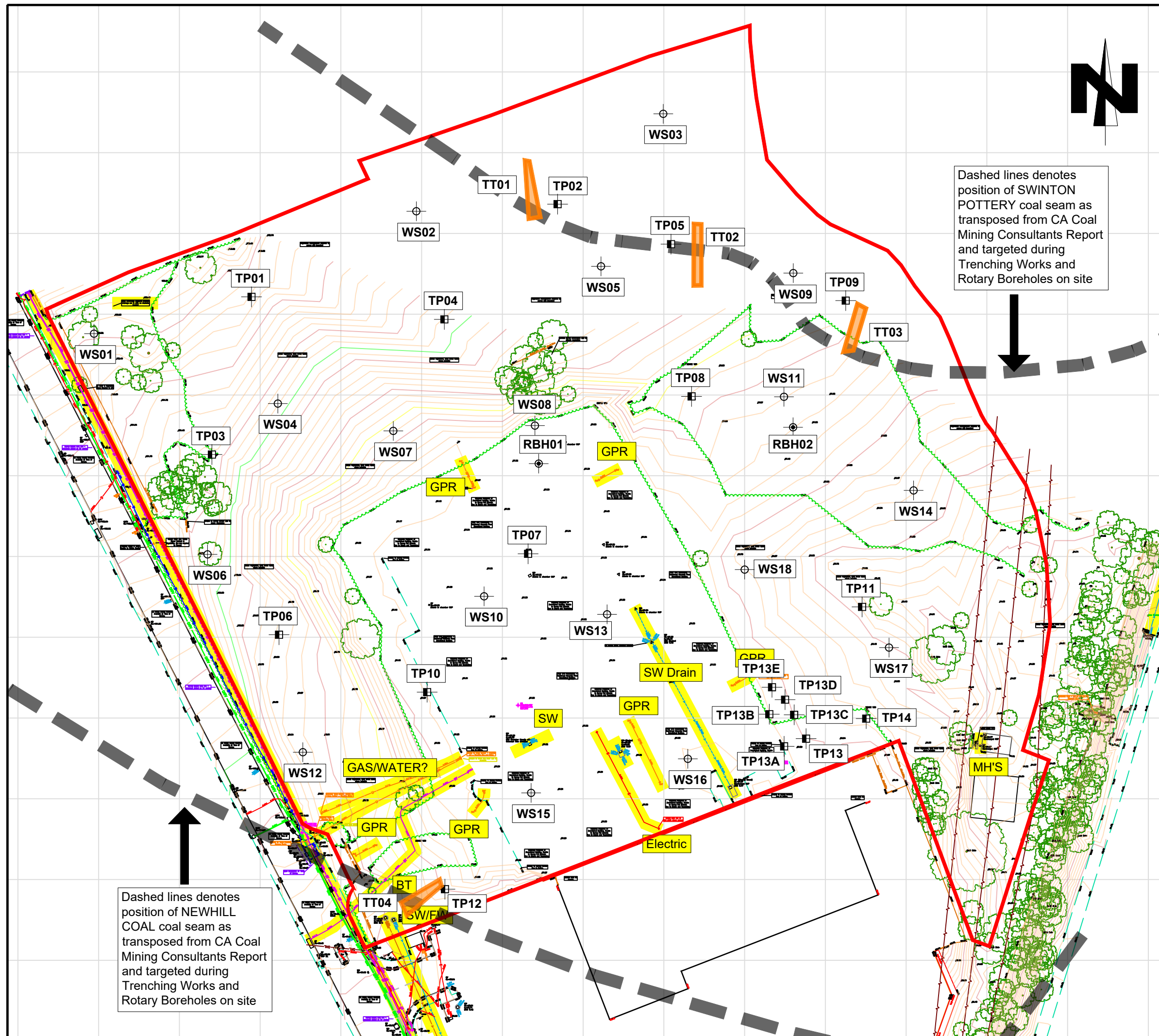
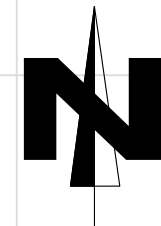
rev.	date	amendments	drawn	chckd

Client:
VISTRY WEST YORKSHIRE

Project Title:
Proposed Residential Development
Site 2 – Land Adjacent to Wakefield Road
Mapplewell Road, Barnsley

Drawing Title:
Existing Site Layout Plan

Scale at A3: NTS @ A3	Date: 07.09.26	Drawn by: P.D	Approved by: S.D
Job Ref: 26-405	Drg no: —	Rev: —	



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Legend	
	Approximate site boundary
	Windowless sampling borehole location
	Mechanically Excavated Trial Pit Position
	Trial Trench Position to Target Recorded Coal Seams
	Rotary Borehole Position

rev.	date	amendments	drawn	chckd

Client:
VISTRY WEST YORKSHIRE

Project Title:
Proposed Residential Development
Site 2 – Land Adjacent to Wakefield Road
Mapplewell Road, Barnsley

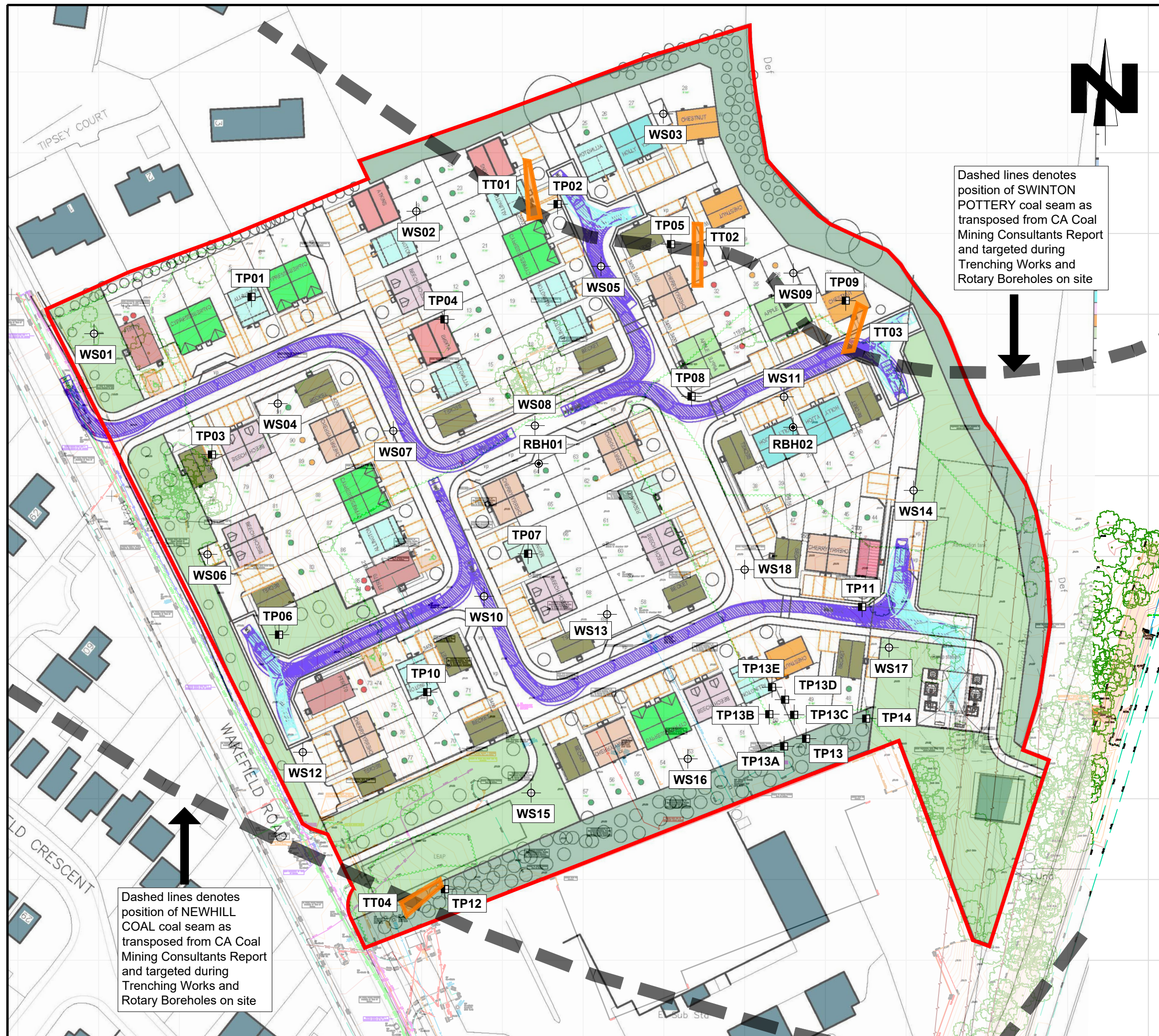
Drawing Title:
Exploratory Hole Location Plan
– Existing Layout (07.08.26)

Scale at A3: NTS @ A3	Date: 27.07.26	Drawn by: P.D	Approved by: S.D
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Job Ref: 26-405	Drg no: —	Rev: —
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Dashed lines denotes position of NEWHILL COAL coal seam as transposed from CA Coal Mining Consultants Report and targeted during Trenching Works and Rotary Boreholes on site

Dashed lines denotes position of SWINTON POTTERY coal seam as transposed from CA Coal Mining Consultants Report and targeted during Trenching Works and Rotary Boreholes on site



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Legend

	Approximate site boundary
	Windowless sampling borehole location
	Mechanically Excavated Trial Pit Position
	Trial Trench Position to Target Recorded Coal Seams
	Rotary Borehole Position

rev.	date	amendments	drawn	chckd
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Client:
VISTRY WEST YORKSHIRE

Project Title:
Proposed Residential Development
Site 2 – Land Adjacent to Wakefield Road
Mapplewell Road, Barnsley

Drawing Title:
Exploratory Hole Location Plan
– Proposed Layout (07.08.26)

Scale at A3: NTS @ A3	Date: 27.07.26	Drawn by: P.D	Approved by: S.D
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Job Ref: 26-405	Drg no: —	Rev: —
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APPENDIX II



Key to exploratory hole symbols and abbreviations

SAMPLE TYPES

ACM - Asbestos sample	AMAL - Amalgamated sample	B - Bulk disturbed sample
BLK - Block sample	C - Core sample	CBR - CBR test sample
D - Disturbed sample	ES - Environmental sample	EW - Environmental water sample
G - Gas sample	J - Jar sample	L - Liner sample
TW - Pushed thin wall sample	U - Undisturbed sample	UT - Undisturbed thin wall sample
W - Water sample	T - Tub sample	JT - Jar and Tub sample

IN-SITU TESTS

HV - Hand shear vane	HV(r) - Hand shear vane residual	PID - Photo ionisation detector
PP - Hand penetrometer	SPT - Standard penetration test	SPT(C) - SPT using cone

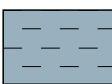
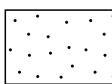
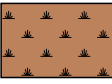
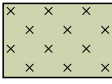
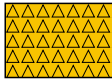
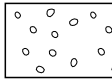
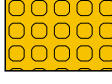
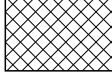
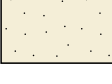
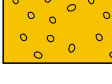
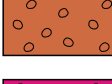
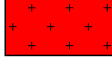
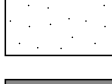
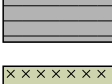
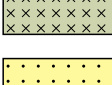
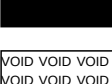
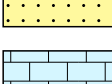
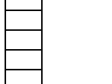
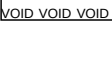
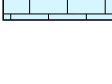
GROUNDWATER

 Groundwater strike	 Groundwater rest level
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ROTARY CORE DETAILS

TCR - Total core recovery (%)	SCR - Solid core recovery (%)	RQD - Rock quality designation (%)
FI - Fracture index	NI - Non-intact core	AZCL - Assumed zone of core loss

LEGEND

 Topsoil	 Clay	 Chalk	 Sand backfill
 Peat	 Silt	 Breccia	 Gravel backfill
 Made ground [cohesive]	 Sand	 Conglomerate	 Arising
 Concrete	 Gravel	 Metamorphic	 Bentonite
 Wood	 Cobbles	 Igneous	 Concrete
 Brick	 Boulders		 Grout
 Bituminous material	 Mudstone		 Plain pipe
 Gypsum	 Siltstone		
 Coal	 Sandstone		 Slotted pipe
 Void	 Limestone		



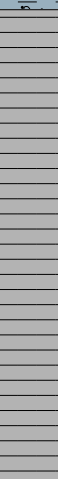
Trial Pit

TP01

Sheet 1 of 1

Hole Type TP	Easting 433937.86	Northing 410004.30	Ground Level (m) 103.73	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 03/08/2026	End Date 03/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (thickness) (m)	Strata	
		Depth (m)	Type/ Ref	Results			Legend	Description
		0.15	ES	110 (kPa)	103.46	(0.27)		Vegetation overlying dark brown slightly clayey gravelly sandy soil. Gravel comprises fine to coarse angular to sub-angular of sandstone and anthropogenic fragments of brick and glass. [MADE GROUND]
						0.27		Stiff dark brown to grey sandy slightly gravelly CLAY. Gravel comprises fine to medium angular to sub-angular mudstone & siltstone. [RESIDUAL SOIL]
	0.90	B						
	1.00	HV(r)					(1.67)	
	1.80	D						
		1.80	D		101.79	1.94		Extreamly weak black friable completely weathered shaley MUDSTONE recovered as tabular angular gravel with occasional rounded clasts of orange brown clay. [PENNINE MIDDLE COAL MEASURES]
		2.50	LB			(1.26)		
		3.10	B		100.53	3.20		End of Trial Pit at 3.20m

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 3.20m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
Checked By: S.D Approved By: S.D Status: FINAL		



Trial Pit

TP02

Sheet 1 of 1

Hole Type TP	Easting 434013.67	Northing 410027.26	Ground Level (m) 101.96	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 03/08/2026	End Date 03/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (m) <small>(thickness)</small>	Strata	
		Depth (m)	Type/ Ref	Results			Legend	Description
		0.35	ES		101.49	0.47		Vegetation overlying dark brown sandy clayey slightly gravelly TOPSOIL. Gravel comprises fine to medium angular to sub-angular sandstone. [TOPSOIL]
						0.47		Stiff orange brown mottled light grey sandy CLAY. [GLACIAL TILL]
		1.00	HV(r)	105 (kPa)		(0.93)		
		1.20	B		100.56	1.40		Extremely weak dark brown completely weathered interbedded MUDSTONE & SILTSTONE recovered as gravelly sandy clay. [PENNINE MIDDLE COAL MEASURES]
		1.90	B		99.86	2.10		Very weak dark grey and orange highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey gravel. [PENNINE MIDDLE COAL MEASURES]
		2.40	D			(0.60)		
					99.26	2.70		End of Trial Pit at 2.70m

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 2.70m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
	Checked By: S.D Approved By: S.D Status: FINAL	



Trial Pit

TP03

Sheet 1 of 1

Hole Type TP	Easting 433928.06	Northing 409965.23	Ground Level (m) 102.11	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 03/08/2026	End Date 03/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests		Level (m)	Depth (m) <small>(thickness)</small>	Strata	
		Depth (m)	Type/ Ref			Legend	Description
		0.10	ES		(0.39)		Vegetation overlying dark brown sandy clayey slightly gravelly soil. Gravel comprises fine to coarse angular to sub-angular sandstone and anthropogenic fragments of brick and concrete. [MADE GROUND]
				101.72	0.39		
		0.70	D		(0.55)		Firm orangish brown mottled light grey sandy clay. (POSSIBLE REWORKED MATERIAL) [MADE GROUND]
		1.00	HV(r)	101.17	0.94		Stiff light grey mottled orangish brown slightly gravelly sandy CLAY. Gravel comprises fine to coarse angular to sub-angular mudstone. [RESIDUAL SOIL]
					(0.61)		
		1.50	D	100.56	1.55		Extremely weak dark brown to brown friable completely weathered interbedded MUDSTONE & SILTSTONE recovered as very clayey gravelly sand. [PENNINE MIDDLE COAL MEASURES]
		1.80	B		(0.67)		
				99.89	2.22		Very weak dark grey and orange highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey silty gravel. [PENNINE MIDDLE COAL MEASURES]
		2.40	D	99.61	2.50		
							End of Trial Pit at 2.50m

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 2.50m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
Checked By: S.D Approved By: S.D Status: FINAL		



Trial Pit

TP05

Sheet 1 of 1

Hole Type TP	Easting 434041.77	Northing 410017.35	Ground Level (m) 101.06	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 03/08/2026	End Date 03/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests		Level (m)	Depth (m)	Strata	
		Depth (m)	Type/ Ref			Legend	Description
		0.10	ES	100.87	(0.19)		Vegetation overlying dark brown sandy clayey slightly gravelly TOPSOIL. Gravel comprises fine to medium angular to sub-angular sandstone. [TOPSOIL]
					0.19		Stiff orangish brown mottled light grey sandy CLAY. [GLACIAL TILL]
		0.90	D		(1.70)		
		1.00	HV(r)				
		1.40	B				
				99.17	1.89		Extremely weak black highly weathered shaley MUDSTONE recovered as tabular angular gravel with occasional rounded clasts of orange brown clay and fragments of coal. [PENNINE MIDDLE COAL MEASURES]
		2.50	B		(1.33)		
				97.84	3.22		End of Trial Pit at 3.22m
		3.50	D				

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 3.22m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
Checked By: S.D Approved By: S.D Status: FINAL		



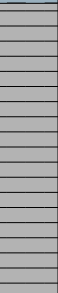
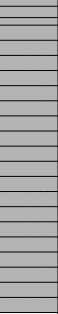
Trial Pit

TP06

Sheet 1 of 1

Hole Type TP	Easting 433944.68	Northing 409920.63	Ground Level (m) 100.58	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 03/08/2026	End Date 03/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level	Depth	Strata			
		Depth (m)	Type/ Ref	Results	(m)	(m)	Legend	Description		
		0.40	ES	78 (kPa)	100.02	(0.56)		Vegetation overlying dark brown sandy clayey slightly gravelly TOPSOIL. Gravel comprises fine to medium angular to sub-angular sandstone. [TOPSOIL]	0.5	
		1.00	HV(r)			0.56		Firm to stiff becoming very stiff dark orangish brown mottled grey sandy CLAY. [GLACIAL TILL]	1.0	
		1.20	B			(0.85)				
		1.90	D			99.17	1.41		Extremely weak dark brown to brown friable completely weathered interbedded MUDSTONE & SILTSTONE recovered as sandy slightly gravelly clay. [PENNINE MIDDLE COAL MEASURES]	1.5
		2.50	D			98.36	2.22		Very weka dark grey highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey silty gravel. [PENNINE MIDDLE COAL MEASURES]	2.5
					97.58	3.00	End of Trial Pit at 3.00m		3.0	
									3.5	
									4.0	

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 3.00m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
Checked By: S.D Approved By: S.D Status: FINAL		



Trial Pit

TP08

Sheet 1 of 1

Hole Type TP	Easting 434046.86	Northing 409979.65	Ground Level (m) 99.22	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405		Start Date 03/08/2026	End Date 03/08/2026

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests		Level (m)	Depth (m) <small>(thickness)</small>	Strata	
		Depth (m)	Type/ Ref			Legend	Description
		0.30	ES	98.80	(0.42)		Vegetation overlying dark brown sandy clayey slightly gravelly TOPSOIL. Gravel comprises fine to medium angular to sub-angular sandstone. [TOPSOIL]
		1.00 1.00	HV(r) D	97.72	0.42 (1.08)		Stiff light grey mottled orangish brown sandy CLAY. [GLACIAL TILL]
		1.70	B	97.02	1.50 (0.70)		Extremely weak dark brown to brown friable completely weathered interbedded MUDSTONE & SILTSTONE recovered as recovered as slightly gravelly silty clayey sand. [PENNINE MIDDLE COAL MEASURES]
		2.40	B	96.52	2.20 (0.50)		Very weak dark grey highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey silty gravel. [PENNINE MIDDLE COAL MEASURES]
					2.70		End of Trial Pit at 2.70m

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 2.70m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
Checked By: S.D Approved By: S.D Status: FINAL		



Trial Pit

TP09

Sheet 1 of 1

Hole Type TP	Easting 434085.04	Northing 410003.38	Ground Level (m) 99.37	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405		Start Date 03/08/2026	End Date 03/08/2026

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (m) <small>(thickness)</small>	Strata	
		Depth (m)	Type/ Ref	Results			Legend	Description
		0.10	ES		99.13	(0.24)		Vegetation overlying dark brown sandy clayey slightly gravelly TOPSOIL. Gravel comprises fine to medium angular to sub-angular sandstone. [TOPSOIL]
						0.24		Stiff light orangish brown mottled grey sandy gravelly CLAY. [GLACIAL TILL]
		0.70	D			(1.06)		
		1.00	HV(r)	100 (kPa)				
		1.20	B		98.07	1.30		Extremely weak dark brown to brown friable completely weathered interbedded MUDSTONE & SILTSTONE recovered as recovered as slightly gravelly sandy silty clay. [PENNINE MIDDLE COAL MEASURES]
		2.00	D		97.37	2.00		Very weak dark grey highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey silty gravel. [PENNINE MIDDLE COAL MEASURES]
		2.50	B			(1.40)		
					95.97	3.40		End of Trial Pit at 3.40m

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 3.40m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
	Checked By: S.D Approved By: S.D Status: FINAL	



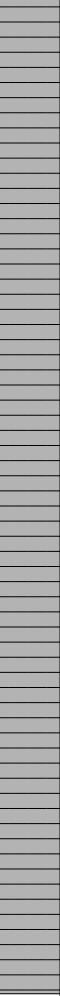
Trial Pit

TP10

Sheet 1 of 1

Hole Type TP	Easting 433981.37	Northing 409906.40	Ground Level (m) 98.29	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 03/08/2026	End Date 03/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level	Depth	Strata								
		Depth (m)	Type/ Ref	Results	(m)	(m)	Legend	Description							
		0.25	ES		98.18	(0.11) 0.11		Asphalt [MADE GROUND]							
						(0.26)		Dark brown sandy gravel with moderate cobble content. Gravel comprises fine to coarse angular to sub-angular sandstone, mudstone and anthropogenic fragments of brick. Cobbles comprise angled sandstone and anthropogenic brick.							
		0.50	D		97.92	0.37		[MADE GROUND]	0.5						
						(0.40)		Stiff light grey mottled orangish brown sandy CLAY. [GLACIAL TILL]							
		1.50	D		97.52	0.77		Extreamly weak dark grey highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey silty gravel. [PENNINE MIDDLE COAL MEASURES]	1.0						
														1.5	
2.50	B			(2.63)					2.0						



Trial Pit

TP11

Sheet 1 of 1

Hole Type TP	Easting 434089.09	Northing 409927.52	Ground Level (m) 96.09	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405		Start Date 03/08/2026	End Date 03/08/2026

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (m) <small>(thickness)</small>	Strata	
		Depth (m)	Type/ Ref	Results			Legend	Description
		0.05	ES		96.01	(0.08) 0.08		Vegetation overlying dark brown sandy clayey slightly gravelly TOPSOIL. Gravel comprises fine to medium angular to sub-angular sandstone. [TOPSOIL]
								Firm to stiff light orangish brown mottled grey sandy CLAY. [GLACIAL TILL]
		1.00 1.00	HV(r) B	76 (kPa)		(1.29)		
		1.50	D		94.72	1.37		Extremely weak dark brown to brown friable completely weathered interbedded MUDSTONE & SILTSTONE recovered as recovered as slightly clayey gravelly sand. [PENNINE MIDDLE COAL MEASURES]
		2.10	B		94.09	2.00		Very weak dark grey highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey silty gravel. [PENNINE MIDDLE COAL MEASURES]
						(1.10)		
					92.99	3.10	End of Trial Pit at 3.10m	

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 3.10m TP JCB 3CX Stable L = 2.50m W = 0.60m	Logger KC
	Checked By: S.D Approved By: S.D Status: FINAL	



Trial Pit

TP12

Sheet 1 of 1

Hole Type TP	Easting 433985.77	Northing 409857.62	Ground Level (m) 98.88	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 04/08/2026	End Date 04/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests		Level (m)	Depth (m) <small>(thickness)</small>	Strata	
		Depth (m)	Type/ Ref			Legend	Description
		0.35	ES	98.83	(0.05) 0.05		Asphalt [MADE GROUND]
					(0.17)		
				98.66	0.22		Dark reddish brown sandy gravel. Gravel comprises fine to coarse angular to sub-angular anthropogenic fragments of brick. [MADE GROUND]
					(0.32)		
		0.80	B	98.34	0.54		Dark brown gravelly sand with moderate cobble content. Gravel comprises fine to coarse, angular to sub-angular sandstone and anthropogenic fragments of brick, metal and plastic. Cobbles are angular of anthropogenic brick. [MADE GROUND]
					(0.63)		
							Firm dark grey and black sandy slightly gravelly clay. Gravel comprises fine to coarse grained angular to sub-angular sandstone, mudstone and anthropogenic fragments of brick. [MADE GROUND]
		1.50 1.50	HV(r) B	97.71	1.17		Firm to stiff light orangish brown mottled grey sandy CLAY (RESIDUAL SOIL) [GLACIAL TILL]
					(0.73)		
		2.50	D	96.98	1.90		Extremely weak dark brown to brown friable completely weathered interbedded MUDSTONE & SILTSTONE recovered as recovered as slightly gravelly sandy silty clay. [PENNINE MIDDLE COAL MEASURES]
					(0.70)		
		3.00	LB	96.28	2.60		Very weak dark grey highly weathered interbedded MUDSTONE & SILTSTONE recovered as slightly clayey silty gravel. [PENNINE MIDDLE COAL MEASURES]
					(0.70)		
				95.58	3.30		End of Trial Pit at 3.30m

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 3.30m TP JCB 3CX Stable <div><div><div><div><div></div></div></div><div><div><div>L = 2.50m</div><div>W = 0.60m</div></div></div></div></div>	Logger KC
	Checked By: S.D Approved By: S.D Status: FINAL	



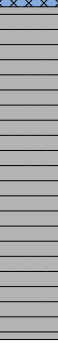
Trial Pit

TP13

Sheet 1 of 1

Hole Type TP	Easting 434075.22	Northing 409894.88	Ground Level (m) 97.99	Scale 1:20
Project Name Mapplewell Site 2	Project No. 26-405	Start Date 04/08/2026	End Date 04/08/2026	

Client Vistry	Consultant KC	Contractor
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Inst/ Backfill	Water Levels	Samples and Tests			Level (m)	Depth (thickness) (m)	Strata		
		Depth (m)	Type/ Ref	Results			Legend	Description	
		0.50	ES			(0.77)		Vegetation overlying dark brown sandy gravel with low cobble content. Gravel comprises fine to coarse angular to sub-angular sandstone, mudstone and anthropogenic fragments of brick, glass, metal, plastic, polystyrene, slate and tile. Cobbles are angular of anthropogenic brick. [MADE GROUND]	0.5
					97.22	0.77		LANDFILL comprising 30% plastic (bottles, sheeting, wrap etc.) . 25% rubber products (tyres, hot water bottles, hoses / tubing etc.), 20% metal (sheets, springs, wires etc.), 5% wood / paper and 20% matrix of gravelly sand. Gravel comprises fine to coarse angular to sub-angular sandstone, mudstone, coal fragments and anthropogenic debris. [MADE GROUND - LANDFILL]	1.0
		1.50	B				(1.35)		Extreamly weak dark brown to brown friable completely weathered interbedded MUDSTONE & SILTSTONE recovered as recovered as sandy silty clay. [PENNINE MIDDLE COAL MEASURES]
					95.87	2.12			
						(0.88)			2.5
					94.99	3.00		End of Trial Pit at 3.00m	3.0
									3.5
									4.0

Remarks No water observed during or on completion of the Trial Pit. Trial pit remained stable	Method, Plant, Stability, Dimensions 0.00 - 3.00m Stable L = 2.50m W = 0.60m	Logger KC
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Checked By: S.D Approved By: S.D Status: FINAL