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PHASE 2: GROUND INVESTIGATION REPORT

HIGHFIELDS APARTMENTS

HIGHFIELDS CENTRE

NEW NORTH ROAD

HUDDERSFIELD

HD1 5LS

Project No: 24-112

Prepared By:

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08/05/2024

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

Report Type:- Phase 2: Ground Investigation Report
Project:- 24-112 – Highfields Apartments, Huddersfield
Prepared For:- Broadgrove Planning & Development Ltd

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APPENDICES

Appendix I	Location Plan, Aerial Photograph, Existing Site Layout Plan, Proposed Development Layout Plan
Appendix II	Exploratory Hole Location Plan, Borehole and Hand Pit Record Sheets
Appendix III	Ground Gas and Groundwater Monitoring Certificate
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1.0 Introduction

May 2024

As requested by Broadgrove Planning & Development Ltd and following the results of the Phase 1: Desk Top Study Report (Arc Environmental Ref. 18-754 – November 2018), Ground Investigation works were completed for the site at Highfields Centre, New North Road, Huddersfield, HD1 5LS where proposals have been made to convert former college building into 33 no. residential apartments, with associated car parking and areas of soft landscaping.

The intrusive investigation works comprised sinking of 4 no. windowless sampling boreholes (WS01 - WS04), with the installation of 3 no. combined ground gas and groundwater monitoring wells (WS02, WS03 & WS04), and 5 no. manually excavated trial pits (HDP01 – HDP05).

Boreholes WS01 - WS04 were undertaken to determine the ground conditions and facilitate installation of gas and water level monitoring wells, and manually excavated pits HDP01 – HDP05 were undertaken to allow for removal of additional soils samples.

The positions of the investigation locations can be seen on the Exploratory Hole Location Plan, a copy of which can be seen in Appendix II. It should be noted that this plan is for orientating purposes only, as the positions shown are approximate and the plan is not to a standard scale.

2.0 Site Details

Table 2.1

(N = north, S = south, E = east, W = west)

Site Name & Address:	Highfields Centre, New North Road, Huddersfield, HD1 5LS
National Grid Reference:	413910, 417170 (Representative of the central part of the site).
Description of Location:	The site is located off New North Road to the north-west of Huddersfield City Centre in a mixed residential and commercial setting. This site is comprised of 2 no. large buildings (building A and B), with a link building and link tower joining the two, and a small separate derelict toilet block. A small carpark and lawn occupy the north-eastern area of the site, accessed via Highfields Road. The central northern portion of the site is comprised of a split level, paved and gravelled, walled garden.
Site Boundaries:	N = Highfields Road with mixed residential and commercial properties beyond, E = Mixed residential and commercial properties with Highfields Road beyond, S = New North Road with residential and commercial properties beyond, W = New North Road with residential and commercial properties beyond.

3.0 Scope of Works

Table 3.1

Client:	Broadgrove Planning & Development Ltd
Project type:	Highfields Apartments
Site Location plan:	See Appendix I.
Layout plans (existing):	See Appendix I.
Layout plans (proposed):	See Appendix I.
Investigation Works:	4 no. windowless sampling boreholes (WS01 - WS04). 3 no. combined ground gas and groundwater monitoring wells (WS02, WS03 & WS04). 5 no. manually excavated trial pits (HDP01 – HDP05)
Laboratory Testing:	Geotechnical & Ground Contamination.
CLEA End-Use Classification:	Residential without home produce

3.0 Scope of Works (Cont'd)

The information contained in this report is limited to the area of the proposed development, as indicated on the Existing Site Layout Plan shown in Appendix I, and to those areas accessible during the ground investigation. When considering the full scope of the development any features and / or issues not specifically mentioned in this report cannot be assumed to have been covered.

4.0 Investigation Rationale

This ground investigation has been designed to provide information on the general ground and groundwater conditions where access would allow, within the boundaries of the site whilst targeting any specific potential areas of concern, as highlighted within the Phase 1: Desk Top Study Report. The investigation positions were created primarily for geotechnical purposes to assist in the design of new foundations for the proposed development with contamination screening undertaken to aid in assessing the risks to Human Health, Controlled Waters and off site disposal.

The rationale behind the location of each borehole is summarised in Table 4.1 below.

Table 4.1

<u>Potential issue</u>	<u>Exploratory Hole</u>
Determine the nature of the underlying ground conditions, including shallow groundwater.	WS01 - WS04
Determine the sites groundwater and ground gas regime.	WS02, WS03 & WS04
Determine the levels of contamination present within the initial deposits with a view to determining the risks posed towards Human Health, Controlled Waters and for possible off-site removal.	WS01 - WS04 and HDP01 – HDP05

4.1 Sampling & Site Protocols: -

All works associated with this ground contamination assessment and investigations have generally been completed in accordance with BS10175: British Standard Code of Practice for the Investigation of Potentially Contaminated Sites (2011+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.

4.1.1 Contamination Sampling: -

Samples were recovered by a representative of ARC Environmental Ltd. during the intrusive investigation works. All samples were stored at approximately 2°C - 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 to seal off the initial deposits. In addition, disposable plastic liners were used to collect samples from the boreholes carried out.

5.0 Ground Conditions

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

5.1 Soil Profile: -

A summary of the soil and rock profiles across the site can be found in Table 5.1 below.

Table 5.1

bcgl = below current ground level

Type of Strata	Depths Recorded (bcgl)	Description & General Comments
MADE GROUND: REWORKED GROUND:	From 0.00m up to c.0.10m and c.0.70m. From c.0.70m up to c.1.30m.	Initial surfacing comprised of asphalt within intrusion locations WS01 and HDP02. Location HDP01 identified astroturf surfacing, WS02 identified gravel surface cover, and HDP03 was located within a planter and identified topsoil at the surface. The remainder of the locations were undertaken within soft landscaping where the initial surfacing comprised of grass overlying topsoil. The made ground deposits generally comprised of dark brown sandy clay with fragments of sandstone and brick. Within WS03, potentially reworked clays were identified between 0.70m and 1.30m depth.
SUPERFICIAL GEOLOGY:	From c.0.10m and c.1.30m to c.0.35m and c.1.80m bcgl.	Superficial deposits were identified in all locations with the exception WS01, and generally comprised stiff light brown sandy gravelly clay with fragments of sandstone.
SOLID GEOLOGY: (Pennine Lower Coal Measures)	From c.0.30m and c.1.80m - c.0.50m and 2.00m bcgl	Comprised light brown weak weathered sandstone. The boreholes were terminated within the weathered sandstone.

5.2 Groundwater and Stability: -

Groundwater ingress was not noted within any of the intrusion locations.

Combined ground gas and groundwater monitoring wells were installed in WS02, WS03 and WS04 to carry out a subsequent programme of gas and groundwater monitoring. The results are discussed further in Section 6.3.

6.0 Insitu Testing

6.1 Insitu Standard Penetration Tests: -

Insitu standard penetration tests (SPT's) were carried out on the potentially reworked clay and solid geological deposits encountered within the boreholes, in order to determine their relative strength using a normal split spoon sampler. The results are shown as uncorrected 'N' values on the graphic borehole record sheets, adjacent to the appropriate sample level and are also summarised 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.

6.0 Insitu Testing (Cont'd)

6.1 Insitu Standard Penetration Tests (Cont'd): -

Table 6.1

<u>Type of Strata</u>	<u>Range of SPT 'N' Values</u>	<u>Comments</u>
POTENTIALLY REWORKED CLAY	20	Sandy clay strata – SPT N values indicate medium to high strength clays
SOLID GEOLOGY: (WS01-WS04)	66-75 Blows for limited penetration	Weak weathered sandstone

6.2 Hand Shear Vane Tests: -

Hand shear vane tests were carried out on the clay superficial deposits identified within borehole WS04, the results of which are summarised in table 6.2 below.

Table 6.2

<u>Type of Strata</u>	<u>Representative shear strength</u>	<u>Comments</u>
DRIFT GEOLOGY: (clay)	94kN/m ²	Sandy gravelly clay strata – shear vane value indicated high strength clays

6.2 Insitu Gas & Water Monitoring: -

The Phase 1: Desk Top Study Report concluded that the risk from hazardous ground gas production / migration affecting the site was low to medium. However, to fully assess the risks, ground gas and water monitoring standpipes were installed in WS02, WS03 and WS04, to check for the possible presence of ground gas.

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, 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 430 series soil gas analysers, with integral flow meter, and a Geotechnical Instruments electronic dipmeter. The response zones were designed to target any ground gas from on and off site sources.

Based on the Phase 1: Desk Top Study report and 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 **moderate sensitivity** i.e. apartments (Tables 5.5a & 5.5b – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).
- The risk associated with the generation potential of a source is considered as **low** (Based on the findings of intrusive works).
- Monitoring over a **minimum of three months** with **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).

6.0 Insitu Testing (Cont'd)

6.2 Insitu Gas & Water Monitoring (Cont'd): -

- A targeted and phased programme of gas monitoring will be 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 also during low atmospheric pressure events (i.e. c.1000mb and below).

For this site, the monitoring visit undertaken to date were taken during falling and rising atmospheric pressure trends to correlate with differing conditions. Monitoring of the weather conditions and predicated atmospheric pressures (Met Office Surface Pressure Charts) will be carried out up to 72 hours in advance of proposed monitoring visits, in order that a reasonable period of data is obtained to determine atmospheric trends, and also to target the 'worst case' scenario.

A summary of the results for the visits undertaken to date, compared with the 'inert' background gas levels is presented in Table 6.3 below, whilst a copy of the monitoring certificate is attached in Appendix III.

A further four monitoring visits have been scheduled and the results along with the final recommendations will be issued as an addendum report.

Table 6.3

*Note – Atmospheric trend taken from www.weatheronline.co.uk for Wakefield

Position	Date	Atmospheric Pressure (mbar)	Water (m bgl)	CH ₄ (%v/v)	LEL (%v/v)	CO ₂ (%v/v)	O ₂ (%v/v)	Flow Rate (l/hr)
Background		~	~	0	0	0	21.0	<0.1
WS02	24/04/2024	1005	Dry	0.0	0.0	2.7	17.4	<0.1
WS03			Dry	0.0	0.0	0.8	19.3	<0.1
WS04			Dry	0.0	0.0	2.4	17.8	<0.1
WS02	09/05/2024	1014	Dry	0.0	0.0	2.5	18.7	<0.1
WS03			Dry	0.0	0.0	0.3	20.1	<0.1
WS04			Dry	0.0	0.0	3.2	16.7	<0.1

From the results undertaken to date, no levels of Methane (CH₄) have been recorded during the monitoring period. However, detectable concentrations of Carbon Dioxide (CO₂) have been recorded, up to a maximum recorded level of 3.2% v/v, with associated oxygen (O₂) concentrations (minimum 16.7% v/v). A negligible flow rate of <0.1 l/hr has been recorded during the monitoring period undertaken.

Based on the results undertaken to date, in accordance with CIRIA Report C665, an initial risk assessment has been completed for this site, by converting the results in Table 6.3 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). Using the maximum values recorded, as no levels of Methane have been recorded, the GSV for Carbon Dioxide only has been calculated, the results of which are shown below:

$$\text{Carbon Dioxide GSV} = 0.032 (3.2\%) \times 0.1 = 0.0032 \text{ l/hr}$$

When considering these results, based on the guidance given in CIRIA C665, it can be seen that the highest GSV value (for CO₂) is below the assessment GSV of 0.7 l/hr, which would place this site within a Characteristic Situation 1 (CS1) suggesting that no gas protection measures will be required for this site.

It should be noted that a further four monitoring visits still need to be completed and once the monitoring programme has been completed, the gas risk assessment will be updated, and the results issued as an addendum letter report. From the water monitoring undertaken, no groundwater ingress into the monitoring wells has been recorded.

7.0 Laboratory Testing

All laboratory testing was undertaken by Chemtech Environmental of Stanley, Co. Durham (UKAS & MCERTS accredited).

7.1 Determination of pH & SO₄: -

Representative samples of the made ground and recovered during the investigation, were tested to determine their acidic (pH) and soluble sulphate (SO₄) levels. The results are shown in Table 5.1 below and are also contained within the Chemtech Environmental Limited Analytical Report (Ref. 132237) a copy of which is attached.

Table 5.1

Position	Depth (m)	Strata	pH	SO₄(mg/l)	Design SO₄ Class	ACEC Class
HDP01	0.10	MG	9.0	24	DS-1	AC-1
HDP02	0.05	MG	8.5	53	DS-1	AC-1
HDP03	0.15	MG/TS	8.6	21	DS-1	AC-1
HDP04	0.15	MG	8.6	19	DS-1	AC-1
HDP05	0.15	MG/TS	7.2	20	DS-1	AC-1

MG = Made Ground, MG/TS = Made Ground Topsoil, NS = Natural Strata, ACEC = Aggressive Chemical Environment for Concrete site classification

From these results, the pH values for the samples of soil tested range from 7.2 to 9.0 and the amount of soluble sulphate present ranges from 19mg/l to 53mg/l. Therefore, in accordance with BRE Special Digest 1: 2005, the site can be given a classification of Class DS-1. When considering the nature of the materials tested and assuming mobile groundwater the assessment of the Aggressive Chemical Environment for Concrete (ACEC) based on brownfield ground conditions, is AC-1.

7.2 Contamination Screening & Screening Strategy: -

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

Although no visual and / or olfactory evidence of any significant fuel / oil type contamination was noted within the exploratory positions carried out, for completeness and to aid in an assessment for off-site disposal classification, representative samples were tested for Speciated PAH (Polycyclic Aromatic Hydrocarbons), Speciated TPH (Total Petroleum Hydrocarbons). Furthermore, the samples were also screened for Asbestos.

7.0 Laboratory Testing (Cont'd)

7.2 Contamination Screening & Screening Strategy (Cont'd): -

The catalogue of testing results can be found in the Chemtech Analytical Report (Ref 132237), attached in Appendix IV, and the total analysis carried out is summarised below:

- 5 no. soil samples screened for a generic (metals and non-organics) soil suite which includes the following determinants; Arsenic, Cadmium, Chromium (III & VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide and Total Organic Carbon (TOC).
- 5 no. soil samples screened for Speciated Polycyclic Aromatic Hydrocarbons (PAH's).
- 5 no. soil samples screened for Speciated Total Petroleum Hydrocarbons (Aliphatic / Aromatic + BTEX).
- 5 no. soil samples screened for the presence of asbestos.

The contamination results have been used to carryout Level 1 Quantitative Risk Assessment for Human Health and Controlled Waters.

8.0 Ground Contamination Risk Assessment

8.1 Methodology: -

Following completion of the contamination screening undertaken on various samples from this site, Level 1 quantitative ground contamination risk assessments have been undertaken, generally in accordance with the Land Contaminated: Risk Management (LCRM) (EA 2020).

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

Based on the Revised Conceptual Site Model (RCSM) for this site (described further in Section 8.4), a site-specific screening strategy for the site has been developed (see Section 7.2) and risks from potential contaminants have been assessed for both 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).

8.2 Human Health Risk Assessment: -

The results of the soil screening have been assessed by comparing the maximum values (C_M) recorded for each analyte to the critical concentration values (C_C) chosen for the Areas. The results of the testing are contained in Appendix IV, and the risk assessment has been summarised in Table 8.1 on the following page.

8.0 Ground Contamination Risk Assessment (Cont'd)

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

Table 8.1

Bold = result exceeds critical concentration

Analyte	Critical Conc. (C _c)	No. of Samples Screened	Max. Conc. (C _M) Recorded	No. of Samples > C _c
Arsenic	40 ⁽¹⁾	5	24	0
Cadmium	85 ⁽¹⁾	5	<1.6	0
Chromium III	910 ⁽¹⁾	5	55	0
Chromium VI	6 ⁽¹⁾	5	<0.04	0
Copper	7100 ⁽¹⁾	5	50	0
Lead	310 ⁽²⁾	5	284	0
Mercury	56 ⁽¹⁾	5	<0.7	0
Nickel	180 ⁽¹⁾	5	39	0
Selenium	430 ⁽¹⁾	5	<3	0
Zinc	40000 ⁽¹⁾	5	104	0
Cyanide	34 ⁽³⁾	5	<1	0
Speciated PAH's				
Acenaphthene	3000 ⁽¹⁾	5	18.06	0
Acenaphthylene	2900 ⁽¹⁾	5	22.02	0
Anthracene	310000 ⁽¹⁾	5	67.00	0
Benzo(a)anthracene	11 ⁽¹⁾	5	207.98	2
Benzo(a)pyrene	3.2 ⁽¹⁾	5	163.03	4
Benzo(b)fluoranthene	3.9 ⁽¹⁾	5	190.42	4
Benzo(ghi)perylene	360 ⁽¹⁾	5	72.66	0
Benzo(k)fluoranthene	110 ⁽¹⁾	5	82.58	0
Chrysene	30 ⁽¹⁾	5	201.90	2
Dibenz(ah)anthracene	0.31 ⁽¹⁾	5	25.85	4
Fluoranthene	1500 ⁽¹⁾	5	419.51	0
Fluorene	2800 ⁽¹⁾	5	20.25	0
Indeno(123cd)pyrene	45 ⁽¹⁾	5	82.67	2
Naphthalene	2.3 ⁽¹⁾	5	5.38	2
Phenanthrene	1300 ⁽¹⁾	5	203.61	0
Pyrene	3700 ⁽¹⁾	5	331.92	0
Speciated TPH's				
VPH Aliphatic (>C5-C6)	42 ⁽¹⁾	5	<0.05	0
VPH Aliphatic (>C6-C8)	100 ⁽¹⁾	5	<0.05	0
VPH Aliphatic (>C8-C10)	27 ⁽¹⁾	5	<0.05	0
EPH Aliphatic (>C10-C12)	130 ⁽¹⁾	5	<10	0
EPH Aliphatic (>C12-C16)	1100 ⁽¹⁾	5	102.79	0
EPH Aliphatic (>C16-C35)	65000 ⁽¹⁾	5	185.91	0
EPH Aliphatic (>C35-C44)	65000 ⁽¹⁾	5	67	0
VPH Aromatic (>EC5-EC7)	370 ⁽¹⁾	5	<0.05	0
VPH Aromatic (>EC7-EC8)	860 ⁽¹⁾	5	<0.05	0
VPH Aromatic (>EC8-EC10)	47 ⁽¹⁾	5	<0.05	0
EPH Aromatic (>EC10-EC12)	250 ⁽¹⁾	5	<10	0
EPH Aromatic (>EC16-EC21)	1900 ⁽¹⁾	5	105.20	0
EPH Aromatic (>EC21-EC35)	1900 ⁽¹⁾	5	80.71	0
EPH Aromatic (>EC35-EC44)	1900 ⁽¹⁾	5	67.19	0
BTEX				
Benzene	0.38 ⁽¹⁾	5	<0.001	0
Toluene	88 ⁽¹⁾	5	<0.001	0
Ethylbenzene	83 ⁽¹⁾	5	<0.001	0
m & p-Xylene	79 ⁽¹⁾	5	<0.00	0
o-Xylene	88 ⁽¹⁾	5	<0.001	0
Asbestos	Presence	6	NAD	0

⁽¹⁾ = I.QM ClEH Suitable 4 Use Levels (S4UL Nov 2014 (Revised August 2015) – Commercial 1.0% SOM, ⁽²⁾ = CASL Values (Commercial), ⁽³⁾ = ATRISK^{SOIL} SSV, Note = All units are mg/kg, NAD = No Asbestos Detected.

8.0 Ground Contamination Risk Assessment (Cont'd)

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

The results have identified the following:

- The maximum concentration (C_M) values for several speciated PAH's exceed the critical concentration (C_C) values taken for the site.
- The results of the asbestos screening have not identified the presence of asbestos.

4 no. of the 5 no. soil samples tested for contamination identified elevated concentrations of contaminants. The 4 no. samples in question were removed from varying strata, with 1 no. removed from topsoil and 3 no. from made ground. The 1 no. sample which did not identify elevated concentrations was a sample of topsoil removed from a new planter.

Consequently, it is considered that the soils present near the surface of the site pose a risk to end users of the site, and remedial measures will be required as part of the proposed development works.

When considering the risks to the construction workforce, the results can be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations. For further guidance reference should be made to the Health and Safety Executive (HSE) document EH40/2005 Workplace exposure limits.

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 obvious visual or olfactory evidence of hydrocarbon / fuel derived contamination noted in the boreholes.
- There was no 'free product' recorded during the investigation.
- Whilst some elevated concentrations of contaminants were recorded on site, these are thought to be confined to the surface soils.
- Shallow groundwater was not encountered during the investigation works.
- Combination of permeable & impermeable superficial deposits below the site.
- Solid geology is the Secondary Aquifer-A.
- The site is not recorded within a Source Protection Zone (SPZ). There are no SPZ's within c.500m of the site.
- There are no Water Abstractions recorded on site. There are no points within c.500m of the site boundary. Ref: Phase1 Desk Top Study Report (Arc Environmental Ref. 18-754 – November 2018),
- There are no surface water features within a plausible migration distance.
- The proposed development will not significantly alter surface water infiltration.

Consequently, when taking into all of the above, the risk to Controlled Waters from on-site contamination is considered to be very low and therefore no further works are considered necessary with this regard.

8.0 Ground Contamination Risk Assessment (Cont'd)

8.4 Revised Conceptual Site Model (CSM): -

From the findings of the results of the intrusive investigation works, a revised Conceptual Site Model (RCSM) has been developed for this site, and is represented in Table 8.2 on the following page which summarises any identified contaminant sources, plausible migration pathways and potentially sensitive receptors identified for this site, assuming no remediation, additional protection measures and / or removal of the sources contamination takes place.

Table 8.2

	<i>Sources (S)</i>		<i>Pathways (P)</i>		<i>Receptors (R)</i>
S1	Potential ground contamination present within any made ground deposits associated with on site and adjacent historical uses including construction / demolition debris. Elevated levels were recorded	P1	Ingestion & Dermal Contact.	R1	Human health - (End users and construction workforce) Considered to be at significant risk.
		P2	Air – Inhalation of vapours (indoor & outdoors) and contact with dust generated through the construction works		
S2	Possible source of diffuse pollution i.e., potential leakage from the electrical substations adjacent to the site. No visual or olfactory evidence was observed during the investigation works				
S3	Possible on-site / off-site sources of hazardous ground gases (in connection with any underground coal mine workings – considered moderate risk). No elevated readings of CO₂ and CH₄ have been recorded to date. (4 no. monitoring visits remain outstanding)	P3	Plant uptake and attached soils.	R2	Controlled Waters: Groundwater within the underlying solid geology (identified as a Secondary Aquifer - A). There are no surface water features within a plausible migration distance to the site Not Considered to be at significant risk.
		P4	Migration through existing services / permeable strata		
		P5	Direct contact with building materials	R3	Adjacent sites. Not Considered to be at significant risk.
		P6	Surface runoff, infiltration & leachate migration	R4*	Building materials & protection of water pipes*
				R5*	Flora and fauna

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

8.4.1 Sources: -

From the results of the Phase 1: DTS and the results of the intrusive investigation works, the primary source of ground contamination identified for this site is the made ground encountered in the boreholes and hand pits above the natural superficial deposits and sandstone bedrock. Elevated concentrations of Polycyclic Aromatic Hydrocarbons have been identified within the made ground strata, which may pose a risk to construction workers and future end users.

8.0 Ground Contamination Risk Assessment (Cont'd)

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

8.4.1 Sources (Cont'd): -

The natural strata is not considered to represent a potential source of ground contamination and there was no evidence of potential cross contamination or mobile contaminants impacting these materials.

There is a potential risk to end users posed by mine gas migrating upwards from unrecorded coal mine workings beneath the site. The gas monitoring completed to date did not identify any elevated concentrations of methane or carbon dioxide, however, 4 no. additional rounds of monitoring are proposed, the results of which will be provided as an addendum to this report.

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. 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 home-grown 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.*

When considering the construction work force, exposure pathways through direct contact, ingestion and dust inhalation will be available during part of the construction process, and therefore adequate PPE should be provided to protect the work force during this period.

8.4.3 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 an adult working exposure period of up to 49 years (i.e. 16 to 65).

Key generic assumptions for *Residential* and *Public Open Space (Residential)* are based upon a typical residential property, consisting of a two-storey small terraced house, with private garden, and a *Commercial* end use based upon a typical commercial or light industrial property, consisting of a three-storey office building (pre-1970). No buildings are anticipated for *Allotment* or *Public Open Space (Park)* end uses.

Within the CLEA Risk Assessment Model for Human Health there are 6 no. generic end use categories presently in use, as follows;

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

When considering the proposed end use of this site, the Level 1 Risk Assessment has taken a conservative best fit end use category as: 2) *Residential - without home grown produce*

9.0 Conclusions & Recommendations

9.1 Ground Conditions: -

Made ground is recorded in all the boreholes from ground level to c.0.10m and c.0.70m bcgl with initial surfacing comprised of asphalt, gravel, astroturf, topsoil, or grass overlying topsoil. Made ground deposits generally comprised sandy clay with fragments of sandstone and brick. Some potentially reworked sandy clay deposits were also identified at depths of between 0.70m and 1.30m bcgl within WS03.

The superficial deposits are recorded in all the boreholes except for WS01, generally comprised stiff light brown sandy gravelly clay with fragments of sandstone, and were identified to bottom depths of between c.0.35m and c.1.8m bcgl .

Solid geological deposits were recorded in WS01-WS04 and HDP03, comprised of weak weathered sandstone, and was recorded to depths of at least c. 2.0m bcgl.

9.2 Groundwater & Stability: -

Groundwater ingress was not observed within the boreholes during the investigation works or during the initial two gas and water level monitoring rounds. Therefore, it is not considered that of groundwater control measures will be required for any trenching at the site.

For future site works, adequate lateral trench support may 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 of time. Reference to CIRIA 97 'Trenching Practice' would be beneficial to establish a suitable means of support or battering of excavation sides during construction.

9.3 Foundation Options: -

It is understood that the proposed development does not include the addition of any new buildings. However, should new buildings be proposed in the future, it is anticipated that the sandstone bedrock found beneath the site will provide a suitable bearing strata.

9.4 Hazardous Ground Gas Risk Assessment: -

From the results of the gas monitoring visits undertaken to date, no methane (CH₄) levels have been recorded however, detectable levels of Carbon Dioxide (CO₂) have been recorded, up to a maximum level of 3.2% *v/v*, and Oxygen (O₂) concentrations (minimum 16.7% *v/v*) have also been recorded. Flow rates of <0.1 l/hr have been recorded during the monitoring visit completed to date.

When considering these results in accordance with CIRIA Report C665, the resulting GSV for this site would be 0.0032 l/hr. Therefore, this suggests that the site should be given Characteristic Situation 1 classification, resulting in no gas protective measures being required for the proposed development.

It should be noted that a final risk assessment will be undertaken following the completion of the remaining gas monitoring visits (minimum 4 no. outstanding visits), and this will be issued as an addendum to this report.

9.0 Conclusions & Recommendations (Cont'd): -

9.5 Ground Contamination: -

The results of the contamination screening carried out on the made ground deposits across the area of the proposed development returned several concentrations of Polycyclic Aromatic Hydrocarbons above the critical concentration values taken for the site. No asbestos was detected within any of the soil samples tested. Consequently, these materials are considered to pose a significant risk to Human Health where exposure pathways are available. As a result, it is recommended that treatment, removal, protection measures and / or further detailed quantitative risk assessment is required, potential remedial measures available are discussed further in Section 9.6.

When taking into account the results of the intrusive investigation, contamination screening, and the overall environmental setting of site i.e. not situated within close proximity to any groundwater abstractions or surface water features, the risk to Controlled Waters from on-site contamination is considered to be very low and no further assessment / works are considered necessary.

When considering the risks to the construction workforce, the results can be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations. For further guidance reference should be made to the Health and Safety Executive (HSE) document EH40/2005 Workplace exposure limits.

9.6 Preliminary Remediation Statement: -

From the results of the Level 1 Risk Assessment, it can be seen that elevated levels of several Speciated PAH's have been recorded within the made ground that represents a potential risk to the proposed end users.

When considering the elevated levels of contamination, where buildings and areas of hardstanding are proposed/present then the *source-pathway-receptor* model will not exist and there is not considered to be a health risk to the future end users. However, in areas of soft landscaping there is the potential for dermal contact, plant uptake and inhalation of dust.

Taking into account the nature of the proposed development it is felt that the most suitable remedial option available is the installation of a clean cover system within any areas of soft landscaping. At this stage it is estimated that a minimum 450mm thick cover system will be required.

Where remedial works are completed across the site, confirmatory validation testing, and photographic evidence of the chosen remediation strategy would be required by the Local Authorities. Prior to any remedial works being undertaken, a remediation strategy may be required, this should be agreed with the LA, and once implemented, the remediation work should be validated by a suitably qualified Geo-environmental Engineer to ensure that all works are being completed in strict accordance with the agreed Remediation Strategy.

9.7 General Comments: -

With regard to asbestos in soil, where we have sampled and tested for asbestos this is discussed in the report. However, there is always the possibility, along with other contamination, that localised undiscovered asbestos may exist between sample locations.

9.0 Conclusions & Recommendations (Cont'd): -

9.7 General Comments (Cont'd): -

If during the site preparatory works, any asbestos or other contamination is identified or suspected, then works should stop and recourse should be made to a suitably experienced / qualified geoenvironmental engineer and / or asbestos surveyor for their advice.

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.

It is also recommended that adequate surface drainage should be designed and installed by a competent contractor, to prevent surface water 'ponding' or collection, during and post construction, particularly where the existing surface drainage system is disrupted or damaged.

In addition, for deeper excavations, drainage, service runs or the like that may pass close to or beneath any existing or 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 or adjacent old foundation based at a higher level.

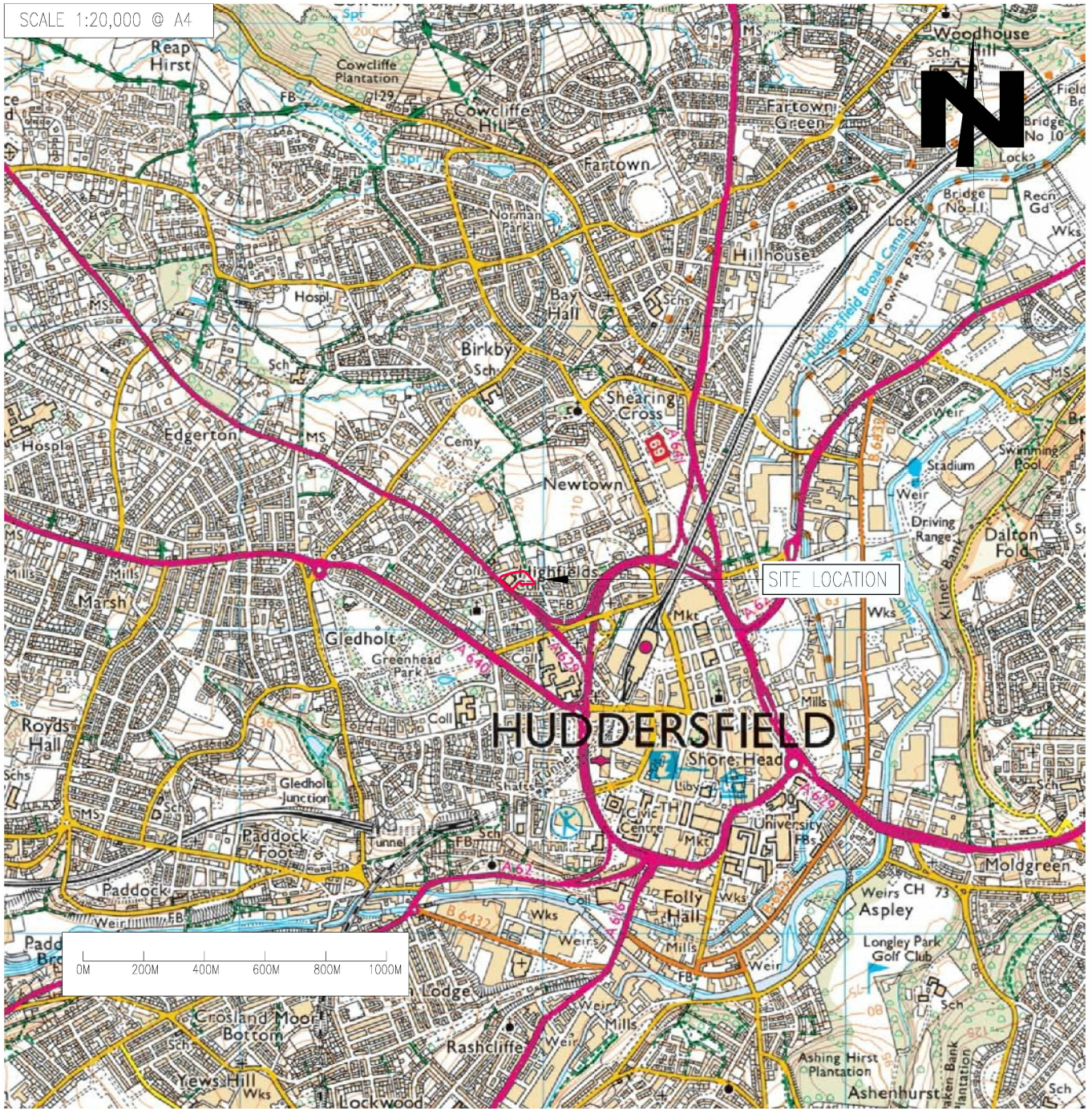
An "observational technique" can be applied to the design and construction of this site, and where ground conditions seem to vary from that indicated from the conceptual ground model derived from works to date, then advice from a suitably qualified Engineer should be sought.

END OF REPORT

APPENDIX I

Location Plan, Aerial Photograph, Existing Site Layout Plan, Proposed
Development Layout Plan

SCALE 1:20,000 @ A4



Client:
Broadgrove Planning & Development Ltd

Project Title:
Proposed Redevelopment
Highfields Centre, New North Road
Huddersfield, HD1 5LS

Drawing Title:
Location Plan

rev.	date	amendments	drawn	checked

Job Reference:
18-754

Drawing Number:
-

Revision:
-

Drawn by:
P.D

Date:
07.11.18

Scale at A4:
As Shown

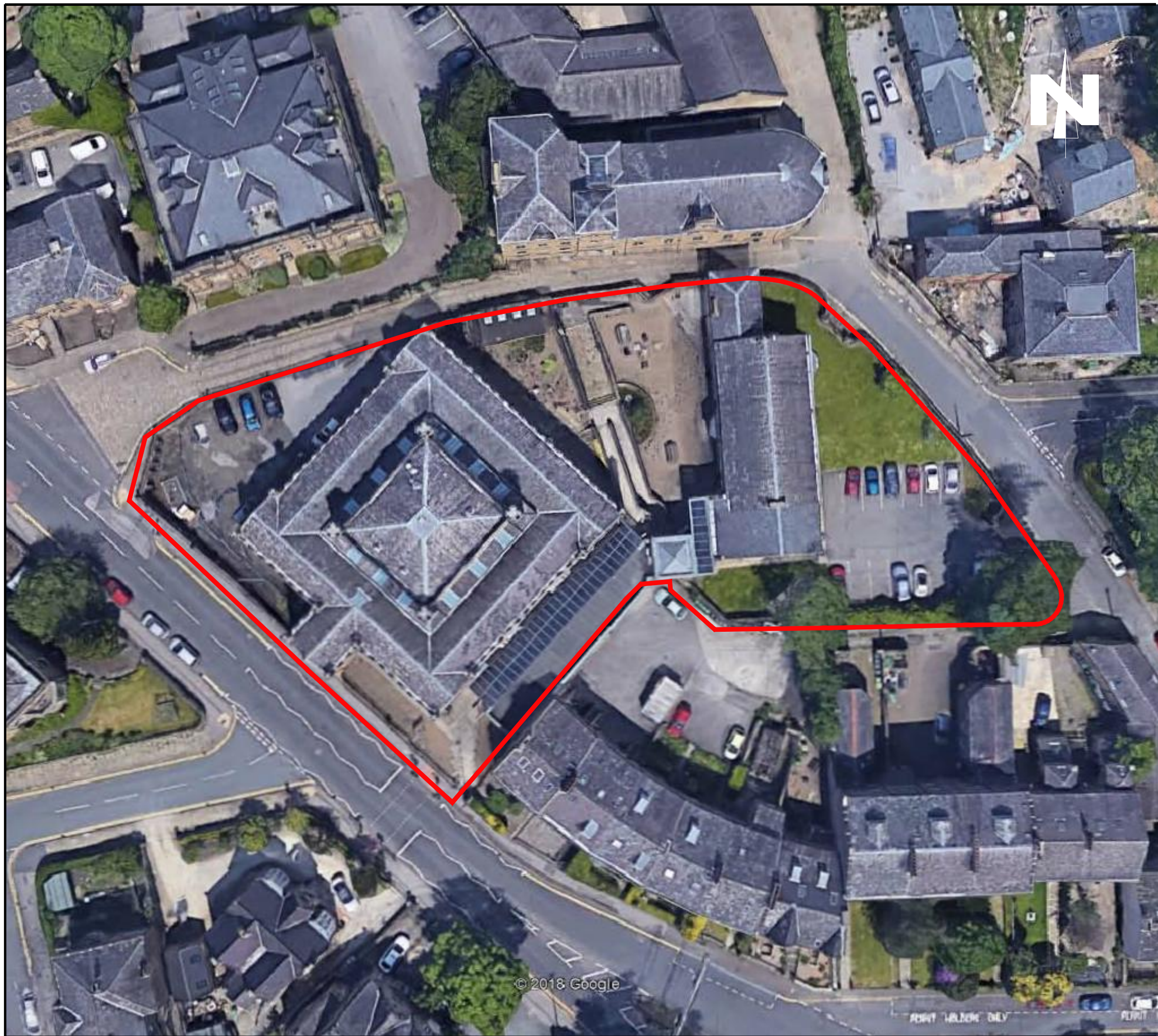
Checked by:
J.W

Approved by:
J.W

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	chkd

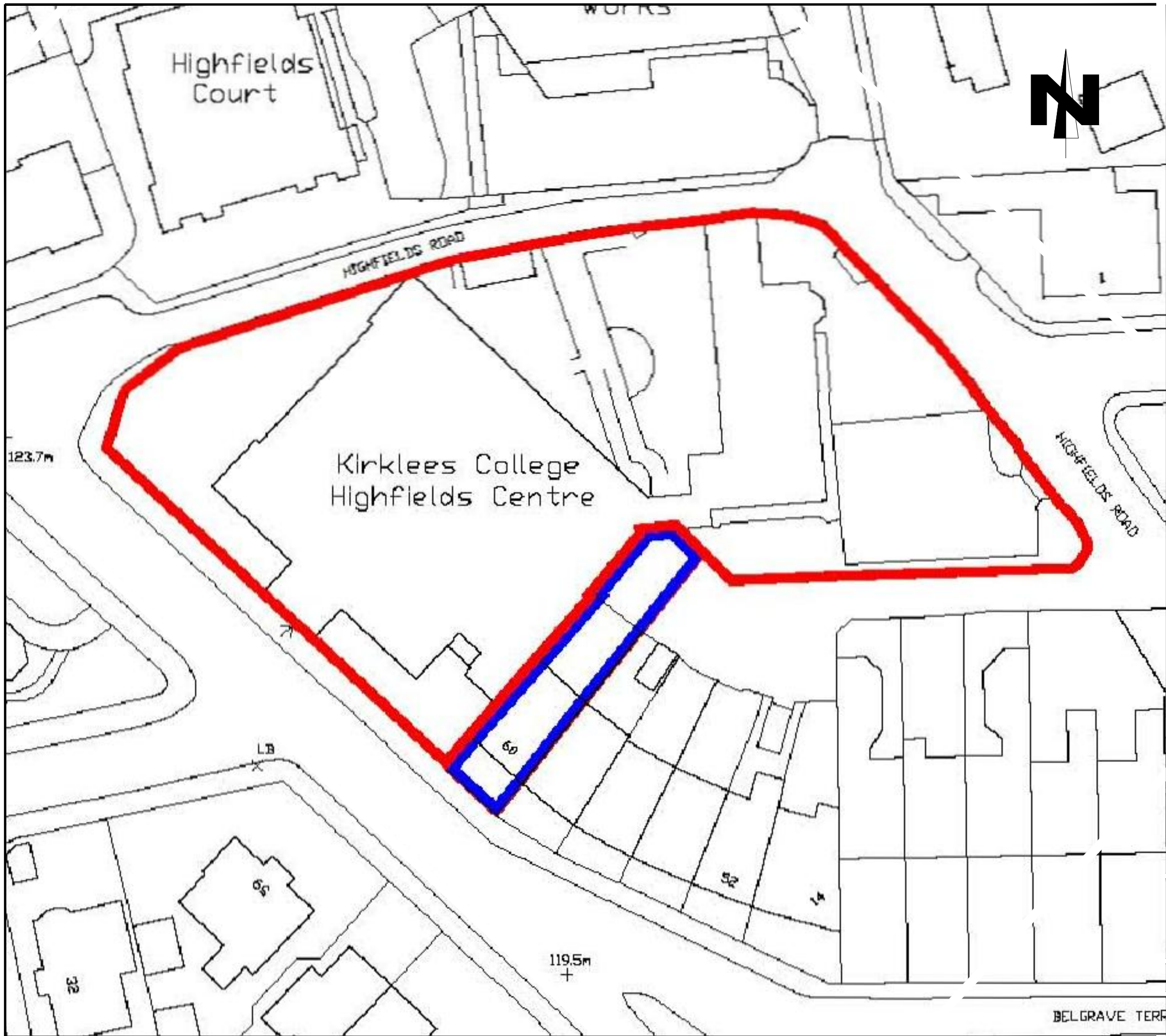
Client:
Broadgrove Planning & Development Ltd

Project Title:
 Proposed Redevelopment
 Highfields Centre, New North Road
 Huddersfield, HD1 5LS

Drawing Title:
 Aerial Photograph

Scale at A3: NTS @ A3	Date: 07.11.18	Drawn by: P.D	Approved by: J.W
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Job Ref: 18-754	Drg no: -	Rev: -
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LEGEND	
	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd

Client:
Broadgrove Planning & Development Ltd

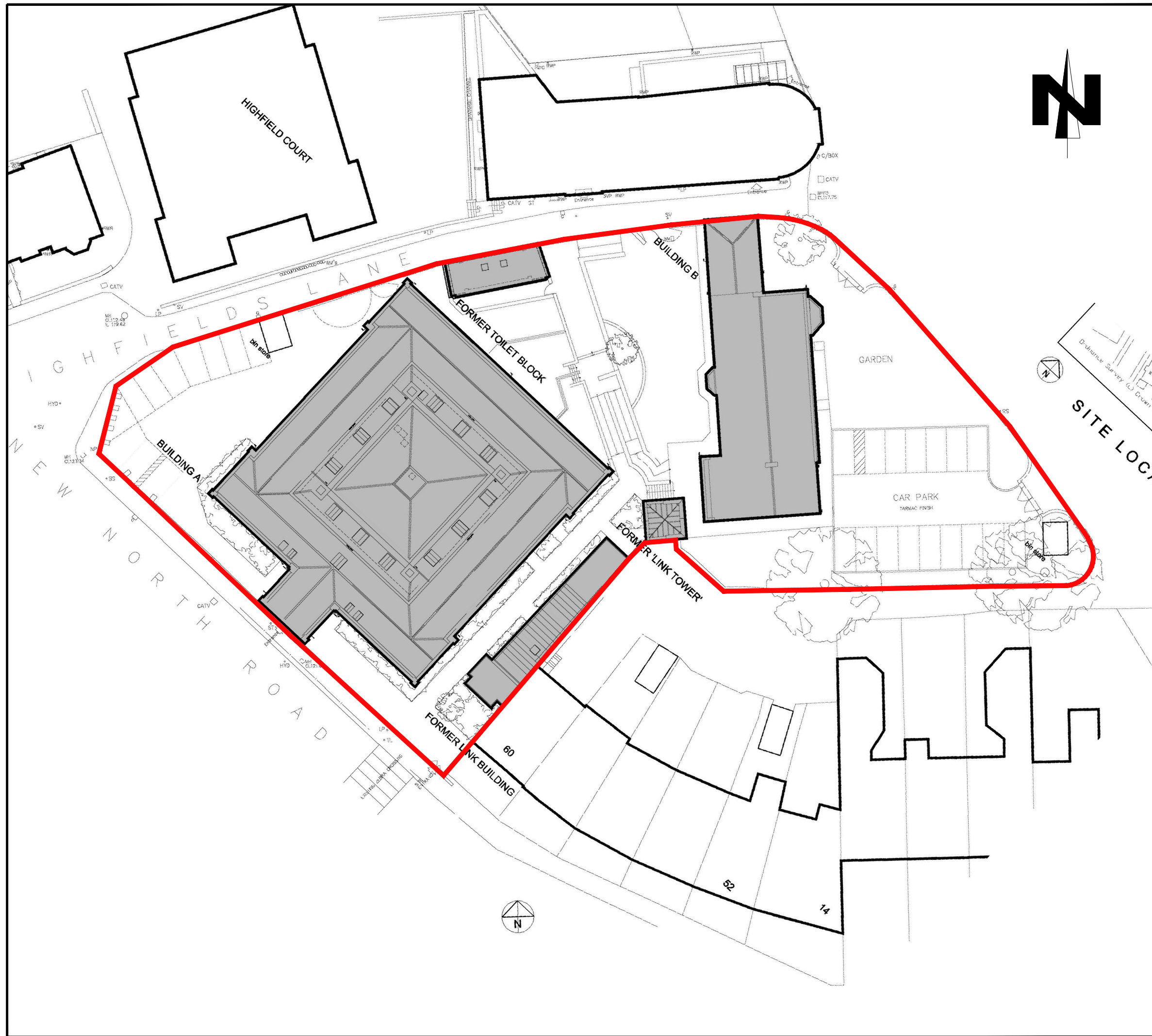
Project Title:
 Proposed Redevelopment
 Highfields Centre, New North Road
 Huddersfield, HD1 5LS

Drawing Title:
 Existing Site Layout Plan

Scale at A3: NTS @ A3	Date: 07.11.18	Drawn by: P.D	Approved by: J.W
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Job Ref: 18-754	Drg no: -	Rev: -
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BELGRAVE TERR



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LEGEND	
	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd

Client:
Broadgrove Planning & Development Ltd

Project Title:
 Proposed Redevelopment
 Highfields Centre, New North Road
 Huddersfield, HD1 5LS

Drawing Title:
 Proposed Development Layout Plan

Scale at A3: NTS @ A3	Date: 07.11.18	Drawn by: P.D	Approved by: J.W
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Job Ref: 18-754	Drng no: -	Rev: -
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APPENDIX II

Exploratory Hole Location Plan, Borehole and Hand Pit Record Sheet



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LEGEND	
	APPROXIMATE SITE BOUNDARY
	WINDOWLESS SAMPLING BOREHOLE LOCATION
	MANUALLY EXCAVATED TRIAL PIT POSITION

rev.	date	amendments	drawn	chckd

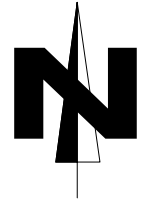
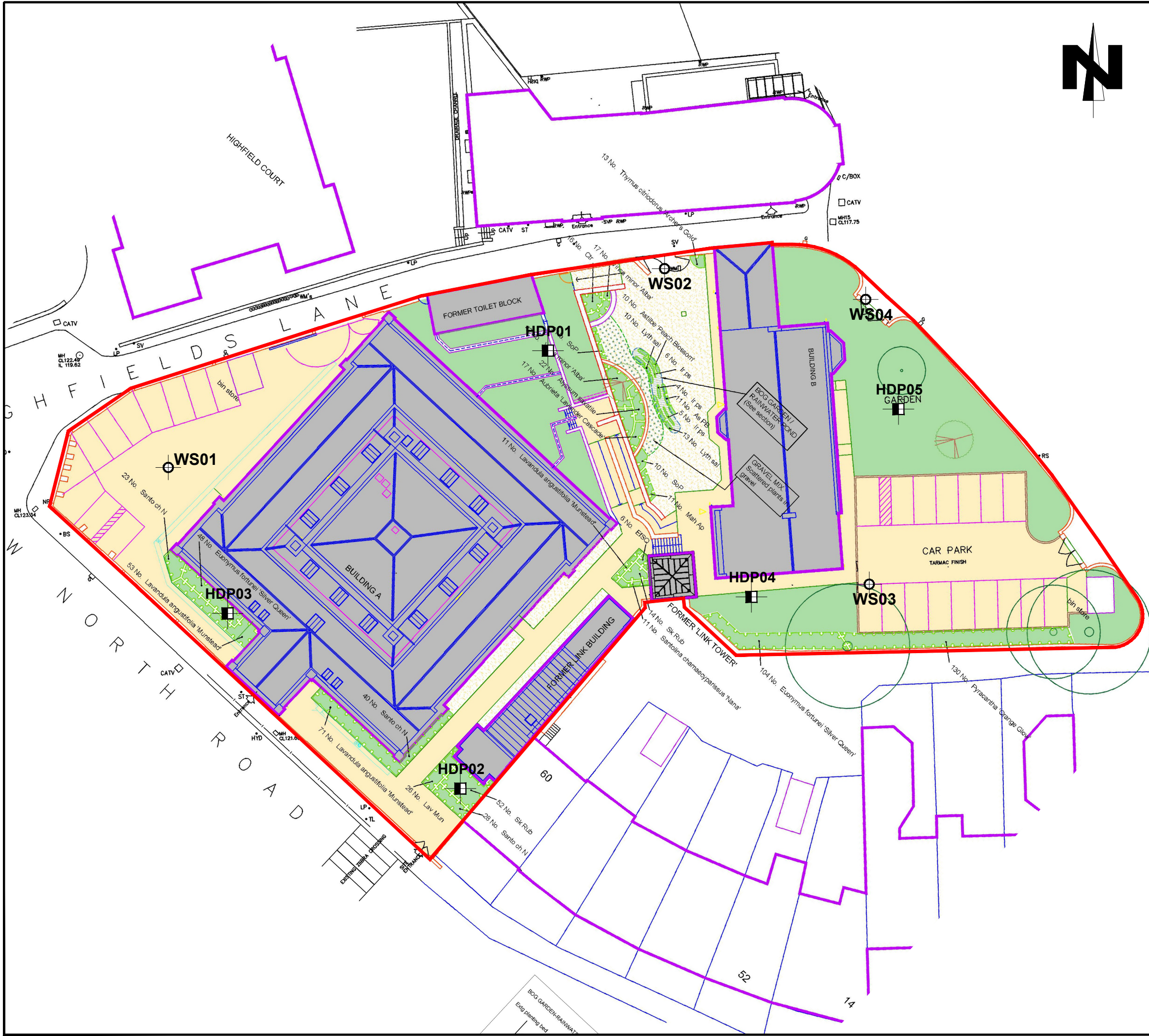
Client: **Broadgrove Planning & Development Limited**

Project Title:
Highfields Apartments
Highfields Centre, New North Road
Huddersfield, HD1 5LS

Drawing Title:
Exploratory Hole Location Plan

Scale at A3: NTS @ A3	Date: 07.05.24	Drawn by: P.D	Approved by: T.W
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Job Ref: 24-112	Drg no: -	Rev: -
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APPENDIX III

Ground Gas and Groundwater Monitoring Certificate

Arc Environmental Ground Gas & Groundwater Monitoring Certificate



Site:	HIGHFIELD
Ref:	24-112

Visit	Date	Time	Equipment	Weather	Initials	Comments	Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Trend	Methane (% v/v)		Methane (% LEL)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Hydrocarbons (GFM 435 only)		Other Gases (PPM)			Depth to Water (m bgl)
											Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Hex %	PID Cf	PID (Isobutylene)	H ₂ S	CO	
1	24/04/24	9.30am	GFM435	OVERCAST	PR		WS01	<0.1	1005			0.0	0.0		2.7		17.4				0.0	0.0	DRY	
							WS02	<0.1	1005			0.0	0.0		0.8		19.6				0.0	0.0	DRY	
							WS03	<0.1	1005			0.0	0.0		2.4		17.8				0.0	0.0	DRY	
2	05/09/2024	10.15am	GFM435	SUNNY	PR		WS01	<0.1	1016			0.0	0.0		2.5		18.7				0.0	-1.0	DRY	
							WS02	<0.1	1014			0.0	0.0		0.3		20.1				0.0	1.0	DRY	
							WS03	<0.1	1015			0.0	0.0		3.2		16.7				0.0	-1.0	DRY	
3			GFM435		PR		WS01	<0.1				0.0	0.0								0.0	0.0		
							WS02	<0.1				0.0	0.0								0.0	0.0		
							WS03	<0.1				0.0	0.0								0.0	0.0		
4			GFM435		PR		WS01	<0.1				0.0	0.0								0.0	0.0		
							WS02	<0.1				0.0	0.0								0.0	0.0		
							WS03	<0.1				0.0	0.0								0.0	0.0		
5			GFM435		PR		WS01	<0.1				0.0	0.0								0.0	0.0		
							WS02	<0.1				0.0	0.0								0.0	0.0		
							WS03	<0.1				0.0	0.0								0.0	0.0		
6					PR		WS01	<0.1				0.0	0.0								0.0	0.0		
							WS02	<0.1				0.0	0.0								0.0	0.0		
							WS03	<0.1				0.0	0.0								0.0	0.0		

Notes:
 Detection limits - Methane = 0.0%, Carbon Dioxide = 0.0%, LEL = 0.0%, Oxygen = 0.0%, Flow = 0.1l/hr
 Monitoring order is from **Left to Right** across table
 Monitoring should be for **Not Less** than 3 minutes. However, if high concentrations of gasses initially recorded, monitoring should be for up to 10 minutes
 N/A = Not applicable = Off the scale

Cf = PID compensation Factor (1-10) - Must be used to multiply the PID reading to give an accurate measure of the total hydrocarbons in the borehole when methane is present
 Hex = Hexane (Valid and in range up to 2.000%) - Recorded when abnormally high methane is present.
 PID = Photo Ionisation Detector (Calibrated to Isobutylene)

APPENDIX IV

Laboratory Results



ANALYTICAL TEST REPORT

Contract no: 132237

Contract name: Highfields Apartments, Huddersfield

Client reference: 24-112

Clients name: ARC Environmental

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

Samples received: 12 April 2024

Analysis started: 12 April 2024

Analysis completed: 24 April 2024

Report issued: 24 April 2024

Key

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

Approved by:

Samantha Rogerson
Reporting Manager

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

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

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
132237-1	HDP01	0.10	Sand with Gravel	-	-	7.1
132237-2	HDP02	0.05	Sand with Gravel	-	-	12.2
132237-3	HDP03	0.15	Sand with Gravel	-	-	13.6
132237-4	HDP04	0.15	Sand with Gravel	-	-	18.8
132237-5	HDP05	0.15	Sand with Gravel	-	-	29.2

Chemtech Environmental Limited

SOILS

Lab number			132237-1	132237-2	132237-3	132237-4	132237-5
Sample id			HDP01	HDP02	HDP03	HDP04	HDP05
Depth (m)			0.10	0.05	0.15	0.15	0.15
Date sampled			08/04/2024	08/04/2024	08/04/2024	08/04/2024	08/04/2024
Test	Method	Units					
Moisture Content	CE001	% w/w	7.1	12.2	13.6	18.8	29.2
Arsenic (total)	CE264 ^M	mg/kg As	8.4	24	11	18	19
Cadmium (total)	CE264 ^M	mg/kg Cd	<1.6	<1.6	<1.6	<1.6	<1.6
Chromium (total)	CE264 ^U	mg/kg Cr	55	30	38	43	31
Chromium (III)	CE208	mg/kg CrIII	55	30	38	43	31
Chromium (VI)	CE263	mg/kg CrVI	<0.04	<0.04	<0.04	<0.04	<0.04
Copper (total)	CE264 ^M	mg/kg Cu	41	50	23	48	48
Lead (total)	CE264 ^U	mg/kg Pb	39	66	42	217	284
Mercury (total)	CE264 ^U	mg/kg Hg	<0.7	<0.7	<0.7	<0.7	<0.7
Nickel (total)	CE264 ^M	mg/kg Ni	39	29	24	23	14
Selenium (total)	CE264	mg/kg Se	<3	<3	<3	<3	<3
Zinc (total)	CE264 ^M	mg/kg Zn	77	58	48	104	74
pH	CE004 ^M	units	9.0	8.5	8.6	8.6	7.2
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	24	53	21	19	20
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	1.0	10.2	3.8	4.8	6.5
PAH							
Acenaphthene	CE087 ^M	mg/kg	18.06	3.43	0.13	0.53	0.83
Acenaphthylene	CE087 ^M	mg/kg	18.75	22.02	0.25	0.49	0.32
Anthracene	CE087 ^U	mg/kg	64.47	67.00	0.62	1.57	1.86
Benzo(a)anthracene	CE087 ^U	mg/kg	207.98	172.17	1.30	4.78	6.08
Benzo(a)pyrene	CE087 ^U	mg/kg	163.06	129.58	1.05	4.03	5.33
Benzo(b)fluoranthene	CE087 ^M	mg/kg	190.42	150.98	1.26	4.79	6.45
Benzo(ghi)perylene	CE087 ^M	mg/kg	72.66	59.42	0.60	2.22	3.02
Benzo(k)fluoranthene	CE087 ^M	mg/kg	82.58	65.47	0.53	2.08	2.73
Chrysene	CE087 ^M	mg/kg	201.90	149.16	1.24	4.79	6.19
Dibenz(ah)anthracene	CE087 ^M	mg/kg	25.85	19.61	0.21	0.70	0.94
Fluoranthene	CE087 ^M	mg/kg	342.84	419.51	2.73	9.79	12.59
Fluorene	CE087 ^U	mg/kg	20.25	11.77	0.15	0.50	0.64
Indeno(123cd)pyrene	CE087 ^M	mg/kg	82.32	82.67	0.76	2.71	3.79
Naphthalene	CE087 ^M	mg/kg	5.27	5.38	0.05	0.19	0.28
Phenanthrene	CE087 ^M	mg/kg	137.89	203.61	1.88	5.13	6.82
Pyrene	CE087 ^M	mg/kg	326.35	331.92	2.29	8.39	10.95
PAH (total of USEPA 16)	CE087	mg/kg	1961	1894	15.1	52.7	68.8

Chemtech Environmental Limited

SOILS

Lab number			132237-1	132237-2	132237-3	132237-4	132237-5
Sample id			HDP01	HDP02	HDP03	HDP04	HDP05
Depth (m)			0.10	0.05	0.15	0.15	0.15
Date sampled			08/04/2024	08/04/2024	08/04/2024	08/04/2024	08/04/2024
Test	Method	Units					
BTEX & TPH							
Benzene	\$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	\$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	\$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001
m & p-Xylene	\$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001
o-Xylene	\$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001
VPH Aliphatic (>C5-C6) <small>HS_1D_AL</small>	\$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aliphatic (>C6-C8) <small>HS_1D_AL</small>	\$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aliphatic (>C8-C10) <small>HS_1D_AL</small>	\$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EPH Aliphatic (>C10-C12) <small>EH_2D_AL</small>	CE250	mg/kg	<10	<10	<1	<1	<1
EPH Aliphatic (>C12-C16) <small>EH_2D_AL</small>	CE250	mg/kg	102.79	14	<0.5	1	<0.5
EPH Aliphatic (>C16-C35) <small>EH_2D_AL</small>	CE250	mg/kg	185.91	107	8.19	6	4.36
EPH Aliphatic (>C35-C44) <small>EH_2D_AL</small>	CE250	mg/kg	53.71	67	6.08	2	1.06
VPH Aromatic (>EC5-EC7) <small>HS_1D_AR</small>	\$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aromatic (>EC7-EC8) <small>HS_1D_AR</small>	\$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aromatic (>EC8-EC10) <small>HS_1D_AR</small>	\$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
EPH Aromatic (>EC10-EC12) <small>EH_2D_AR</small>	CE250	mg/kg	<10	<10	<1	<1	<1
EPH Aromatic (>EC12-EC16) <small>EH_2D_AR</small>	CE250	mg/kg	102.79	14.18	<0.5	0.62	<0.5
EPH Aromatic (>EC16-EC21) <small>EH_2D_AR</small>	CE250	mg/kg	105.20	35.44	0.76	1.26	0.70
EPH Aromatic (>EC21-EC35) <small>EH_2D_AR</small>	CE250	mg/kg	80.71	71.92	7.43	5.09	3.66
EPH Aromatic (>EC35-EC44) <small>EH_2D_AR</small>	CE250	mg/kg	53.71	67.19	6.08	2.23	1.06
Subcontracted analysis							
Asbestos (qualitative)	\$	-	NAD	NAD	NAD	NAD	NAD

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE001	Moisture Content	Gravimetry	As received		0.1	% w/w
CE264	Arsenic (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.8	mg/kg As
CE264	Cadmium (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cd
CE264	Chromium (total)	Aqua Regia Extraction, ICPOES	Dry	U	2	mg/kg Cr
CE208	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		0.04	mg/kg CrIII
CE263	Chromium (VI)	Discrete Analyser	Dry		0.04	mg/kg CrVI
CE264	Copper (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cu
CE264	Lead (total)	Aqua Regia Extraction, ICPOES	Dry	U	3	mg/kg Pb
CE264	Mercury (total)	Aqua Regia Extraction, ICPOES	Dry	U	0.7	mg/kg Hg
CE264	Nickel (total)	Aqua Regia Extraction, ICPOES	Dry	M	2.1	mg/kg Ni
CE264	Selenium (total)	Aqua Regia Extraction, ICPOES	Dry	U	3	mg/kg Se
CE264	Zinc (total)	Aqua Regia Extraction, ICPOES	Dry	M	4	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO ₄
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
\$	Benzene	Headspace GC-FID	As received	U	0.001	mg/kg
\$	Toluene	Headspace GC-FID	As received	U	0.001	mg/kg
\$	Ethylbenzene	Headspace GC-FID	As received	U	0.001	mg/kg
\$	m & p-Xylene	Headspace GC-FID	As received	U	0.001	mg/kg
\$	o-Xylene	Headspace GC-FID	As received	U	0.001	mg/kg
\$	VPH Aliphatic (>C5-C6)	Headspace GC-FID	As received		0.05	mg/kg
\$	VPH Aliphatic (>C6-C8)	Headspace GC-FID	As received		0.05	mg/kg
\$	VPH Aliphatic (>C8-C10)	Headspace GC-FID	As received		0.05	mg/kg
CE250	EPH Aliphatic (>C10-C12)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aliphatic (>C12-C16)	Solvent extraction, GCxGC-FID	As received		0.5	mg/kg
CE250	EPH Aliphatic (>C16-C35)	Solvent extraction, GCxGC-FID	As received		3	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE250	EPH Aliphatic (>C35-C44)	Solvent extraction, GCxGC-FID	As received		0.5	mg/kg
\$	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	As received		0.05	mg/kg
\$	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	As received		0.05	mg/kg
\$	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	As received		0.05	mg/kg
CE250	EPH Aromatic (>EC10-EC12)	Solvent extraction, GCxGC-FID	As received		0.6	mg/kg
CE250	EPH Aromatic (>EC12-EC16)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC16-EC21)	Solvent extraction, GCxGC-FID	As received		1.5	mg/kg
CE250	EPH Aromatic (>EC21-EC35)	Solvent extraction, GCxGC-FID	As received		4.5	mg/kg
CE250	EPH Aromatic (>EC35-EC44)	Solvent extraction, GCxGC-FID	As received		2	mg/kg
\$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

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

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
132237-1	HDP01	0.10	N	
132237-2	HDP02	0.05	N	
132237-3	HDP03	0.15	N	
132237-4	HDP04	0.15	N	
132237-5	HDP05	0.15	N	

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ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Samples have been prepared and tested in accordance with the ADEPT guidance note (version 2013.12).

This sample matrix is outside the scope of the laboratory's accreditation. The corresponding method used for soils is UKAS and MCERTS accredited.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

Sampling was undertaken by Chemtech Environmental Limited and is outside the UKAS accreditation scope.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.

BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

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

Analytical results are inclusive of stones, where applicable.