



Remediation Strategy and Implementation Plan Residential Development Neighbourhood, Rochdale

Report Prepared for Willmott Dixon Construction Ltd

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Contents

1.0	Introduction	1
1.1	General.....	1
1.2	Background	1
1.3	Report Structure	3
1.4	Limitations to Report	3
2.0	Site Description and Environmental Setting.....	4
2.1	Site Location.....	4
2.2	Site Description and Surrounding Land Use	4
2.3	Site History	4
2.4	Environmental Setting.....	5
2.5	Unexploded Ordnance (UXO)	5
3.0	Summary of Site Investigation Work.....	6
3.1	Curtins Site Investigation	6
3.1.1	Objectives and Phases of Investigation	6
3.1.2	Scope of Site Investigation Works	6
3.1.3	Chemical and Geotechnical Testing.....	7
3.1.4	Ground Gas and Groundwater Monitoring	8
3.1.5	Findings of the Ground Investigation	8
	Soils.....	10
	Water Resources.....	11
3.2	LK Remediate Investigation	14
3.2.1	Objectives and Scope	14
3.2.2	Findings of the Investigation	14
3.2.3	Conceptual Model Following Additional 2022 Investigation	16
4.0	Outline Remediation Strategy	17
5.0	Remediation Strategy and Implementation Plan	18
5.1	Remediation Objective.....	18
5.1	Plausible Pollutant Linkages	18
5.3	Development Proposals and Enabling Works.....	19
5.4	Remediation Strategy.....	19
5.5	Remediation Implementation Plan	21
5.5.1	Asbestos Management Plan	22
5.5.2	Materials Management Plan	23

5.5.3	Excavation of Soils	24
5.5.4	Discovery Strategy – Unforeseen or Unexpected Contamination	24
5.5.5	Import of Soils	24
5.5.6	Installation of Gas Protection Measures	25
5.6	Health, Safety and Environmental Management	25
5.6.1	Health and Safety	25
5.6.2	Environmental Protection	26
5.6.3	Waste Management.....	27
6.0	Validation Plan	28
6.1	Scope of Planned Validation Works	28
6.1.1	General.....	28
6.1.2	Screening and Removal of ACM/Contaminated Soils.....	30
6.1.3	Validation of Soils Imported to Site/Re-use of Soils	30
6.1.4	Discovery Strategy.....	31
6.1.5	Validation of Cover Layer	31
6.1.6	Validation of Ground Gas Protection Measures.....	31
6.1.7	Materials Management Plan	32
6.1.8	Validation Report	32
	References	33

Figures

Figure 1 – Site Location

Figure 2 – Proposed Development Layout

Appendices

Appendix 1 – Curtins Exploratory Hole Location Plans

Appendix 2 – Revised Conceptual Site Model by Curtins

Appendix 3 – Curtins Adopted Soil Generic Assessment Criteria

Appendix 4 – Enabling Works Summary Drawings

Appendix 5 – Re-use and Acceptance Criteria

1.0 Introduction

1.1 General

Booth King Partnership Ltd (BKP) has been commissioned by Willmott Dixon Construction Ltd to provide a Remediation Strategy in relation to ground contamination and ground gas for a proposed development off Richard Street, Rochdale (see Figure 1), known as Neighbourhood. The proposed residential development comprises apartment blocks, low rise residential properties with private gardens and associated access roads and areas of soft landscaping including an area of public open space (see Figure 2).

This final version of the Remediation Strategy has been prepared by BKP on the basis of the current development proposals, existing site investigation information (including supplementary information from an investigation carried out by LK Remediate in July 2022) and consultation with the project team.

1.2 Background

A Phase 1 Preliminary Risk Assessment and a Phase 2 Ground Investigation have been completed for the proposed development by Curtins. The findings of which are provided in the following two reports:

- Neighbourhood, Rochdale, Phase 1 Preliminary Risk Assessment prepared for Willmott Dixon Construction Limited, Curtins Ref: 075882-CUR-00-XX-RP-GE-001, Revision V01, Issue Date 07 October 2020¹
- Neighbourhood, Rochdale, Phase 2 Ground Investigation prepared for Willmott Dixon Construction Limited, Curtins Ref: 075882-CUR-00-XX-RP-GE-001, Issue Date 23 July 2021²

In addition, the following reports have also been prepared by Curtins:

- Waste Classification Letter Report³
- Enabling Works, Neighbourhood, Rochdale – Flood Risk Assessment and Drainage Strategy, prepared for Willmott Dixon Construction Limited, Curtins Ref: (075882) NHRH-CUR-00-XX-RP-C-92001, Revision V01, Issue Date 09 July 2021

The Curtins investigation and assessment has indicated the presence of Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals (lead, arsenic and zinc) above assessment criteria for residential use in samples of made ground across the site. Elevated concentrations of aromatic petroleum hydrocarbons were also detected in some samples. In addition, investigations have indicated the presence of asbestos fibres (both chrysotile and amosite) in the soils.

In terms of ground gas, carbon dioxide was recorded up to a concentration of 8.8% v/v in wells across the site. Methane was typically recorded below the limit of detection in all wells, with

the exception of minor concentrations (maximum 0.4% v/v) recorded in one well (WS07). Curtins ground gas risk assessment indicated Characteristic Situation CS-2 in certain areas of the site.

An outline remediation statement to mitigate the identified risks was prepared by Tier Environmental Ltd. This was prepared to support the planning application for the Enabling Works. The intention of the statement was to provide a preliminary outline indication of possible options for the Remedial Options Appraisal, Remediation Strategy and Verification Plan Report to be provided in support of the detailed planning application. This Remediation Statement indicated that the following remediation strategies were expected to be incorporated into the development:

- (i) A review of the depths required for a clean cover system for rear gardens (600mm) and soft landscaped areas (300mm); and
- (ii) A review of the ground gas protection measures required based on findings from site investigations completed by Curtins (and previously Delta Simons) which indicated Amber 2 but was expected to potentially reduce to Green and Amber 1 through a zoning plan.

In 2022, LK Remediate were commissioned by Willmott Dixon to undertake an additional site investigation to supplement the existing information to support the remediation and enabling works. This investigation was carried out in July 2022 and comprised twenty-one mechanically excavated trial pits to nominal depths of 3mbgl. Soil samples were taken for geotechnical testing, tarmac samples for coal tar assessment, a topsoil samples for classification purposes and three soil samples were submitted for contamination testing.

The findings of the additional site investigation were not materially different from the Curtins investigation with respect to the ground conditions encountered across the site and contamination results. Visual and olfactory evidence of hydrocarbon contamination were noted in 7 no. trial pits with contamination testing confirming elevated levels of metals, PAHs, petroleum hydrocarbons and the presence of asbestos fibres.

This document comprises the detailed remediation strategy and implementation plan, which has been developed based on the findings of the ground investigation and the proposed outline strategy but taking account of the detailed design of the development, construction programme and enabling works.

1.3 Report Structure

This report has been prepared in accordance with LCRM Guidance⁴. The structure of the report is as follows:

- Section 1 - Introduction to the Remediation Strategy and background to the project.
- Section 2 - A description of the site and summary of the environmental setting.
- Section 3 – A summary of the site investigations carried out and the ground conditions prior to development.
- Section 4 – This describes the outline remediation strategy.
- Section 5 - This sets out the proposed remediation strategy and implementation plan.
- Section 6 - This describes the validation plan for the remedial works. The proposed scope of the verification of the remedial works is detailed together with the validation sampling and testing proposed.

1.4 Limitations to Report

For the work, reliance has been placed on publicly and privately available data from the sources identified; the sources are not exhaustive, and further information relevant to the site may be available from other sources. When using the information, it has been assumed it is correct. No attempt has been made to verify the information.

Booth King Partnership (BKP) has taken the findings and recommendations of the Curtins investigation as a basis for preparing the Remediation Strategy. As far as BKP is aware the conclusions and recommendations from the Curtins Investigations have not yet been agreed with the Planning Authority. There is, therefore, the risk that on review of the Curtins site investigation report and this Remediation Strategy the Planning Authority may require additional investigation and assessment.

It is important to recognise that, when investigating or developing land, sub-surface conditions may vary spatially and over time. Therefore, BKP cannot guarantee conditions across the site.

It should be noted that new information, including changes to the development design, revised practices, or changes in legislation may necessitate the re-interpretation of the report, completely or in part.

2.0 Site Description and Environmental Setting

The information provided in this section is taken from the Curtins Ground Investigation Report¹.

2.1 Site Location

The site is located off Richard Road in Rochdale. The site is centred on approximate National Grid Reference (NGR) SD 89926 12942. A Site Location Plan is included as Figure 1.

Access to the site is from the Central Retail Park car park on the southern boundary.

2.2 Site Description and Surrounding Land Use

The site is currently vacant and surrounded by fencing and a locked gateway. It occupies approximately 2.42 hectares in plan area. The site's last use was as a retail park and therefore the site surface covering is characterised by tarmac and concrete. Relic floor slabs of the former retail units remain in the north, east and southwest, with the remaining area occupied by the former car park. Small areas of soft landscaping are located across the areas of tarmac (historic car parks) and a grassed area is located in the north-eastern corner. Due to the fact the site has been vacant for some time, the site has become overgrown in some of the areas of soft landscaping and there are varying amounts of fly tipped rubbish around site. The site is generally flat and resides at approximately 138 to 140 metres above Ordnance Datum (m AOD). There is a slight dip in ground level from south-west to north-east across the site.

The surrounding land-uses comprise of a mix of commercial and residential uses. To the north is Milnrow Road and to the north-west is the A640 with small commercial and residential premises beyond. To the east is Oldham Road with a mixture of commercial premises beyond. To the south-east is Central Retail Park, which is bound by the railway line to the south. To the south and south-west is the Rochdale Masonic Buildings, Richard Street and some residential properties beyond. To the west is A640 (Drake Street) with the Metrolink tram line and small commercial and residential premises beyond.

2.3 Site History

Early historical mapping (1850-1930s) shows most of the site was predominantly occupied by canal basin and wharfs with warehouses, works and residential dwellings. By the 1950s, the western canal basin was infilled and the central area of the site was noted to be a depot with a garage in the east. By 1977, both canal basins, and the canal in the south, had also been infilled, with a timber yard in the north. There was significant redevelopment of the site in the 1980s associated with the construction of Central Retail Park, comprising three commercial warehouses/retail units. A car park was located centrally within the site, with smaller retail units in the west. The retail units appear to have been demolished sometime after 2006 mapping.

2.4 Environmental Setting

Table 2.1 below provides a summary of the environmental setting of the site.

Table 2.1 Summary of Environmental Setting

Category	Description
Geology	The published geology is indicated to be superficial deposits of Glaciofluvial Deposits comprising of sand and gravel with some clay and silt. The superficial deposits are underlain by bedrock comprising the Pennine Lower Coal Measures (sandstone, siltstone, mudstone and some coal). Shallow coal seams (<30m bgl) are not anticipated to be present beneath the site. One BGS recorded fault line is located approximately 60m south of the site. The site is located on the downthrow side of the southwest to northeast orientated fault.
Mining & Quarrying	The site is situated in a coal mining reporting area; however, it is not within a development high risk area. The nearest recorded mine entries are located approximately 1km west, and the nearest coal subcrop is approximately 133m west, dipping to the west. There are no BGS recorded mineral sites within 500m of the site. It is stated in the Curtins Preliminary Risk Assessment that a low risk is identified to the proposed development from coal mining legacy and no further action is required.
Ground Stability	No hazards associated with ground stability were identified as part of the Curtins Preliminary Risk Assessment.
Hydrogeology	Glaciofluvial superficial deposits and the Pennine Lower Coal Measures Formation bedrock are designed as Secondary A Aquifers. The site is not located within a Source Protection Zone (SPZ). There are no active groundwater extraction points located within 1km of the site.
Hydrology	The nearest surface water feature is the River Roch 221m north of the site, flowing from east to west. There are thirteen recorded surface water abstraction points located within 1km of the site boundary. The nearest are two abstractions for the production of energy (hydroelectric power) 248m to the north. There are no potable surface water abstractions within 1km of the site.
Designated Ecological Sites	The nearest designated ecological site is the Rochdale Canal SSSI, located approximately 650m to the south-east of the site. The Canal is also designated as a Special Area of Conservation (SAC). The reason for the designations is that the Rochdale Canal contains important habitats for submerged aquatic plants and emergent vegetation, including extensive colonies of the nationally scarce SAC species floating waterplantain <i>Luronium natans</i> . The site also supports a diverse assemblage of aquatic flora, notably its assemblage of pondweeds.

2.5 Unexploded Ordnance (UXO)

Details of UXO risk is provided in the Curtins Phase 1 Preliminary Risk Assessment Report. This states that the risk mapping for UXOs has placed the site in a low risk area and historic mapping records no ruins post WWII on site or locally.

3.0 Summary of Site Investigation Work

3.1 Curtins Site Investigation

3.1.1 Objectives and Phases of Investigation

Curtins carried out an intrusive ground investigation in March/April 2021.

The objectives of the investigations were to confirm the preliminary risk assessment and provide data in support of the structural and civil engineering design.

3.1.2 Scope of Site Investigation Works

The site investigation undertaken comprised:

- Twenty-two window sample boreholes (WS01 – WS22) progressed to depths of up to 5.45m bgl to assess shallow ground conditions and collect samples for chemical and geotechnical testing.
- Fourteen cable percussive boreholes (CP01 – CP14) drilled to depths between 20 and 30m bgl to confirm deeper ground conditions for potential pile design and collect samples for chemical and geotechnical testing.
- Seventeen machine excavated trial pits (TT01-TT10 and TTA-TTG). TT01 to TT10 were to confirm shallow ground conditions and undertaken in locations where it was assumed canal walls might be. TTA to TTG were located to enable the thickness of existing ground floor slabs to be recorded and to record any existing foundations. Samples were collected for chemical analysis, WAC testing of tarmac samples and to determine the suitability of shallow soils for re-use in earthworks. TTA (also labelled SA01) was used for a soakaway test.
- Eight hand dug trial pits. Four of these (HD01 to HD04) were used to determine the foundations of the retaining wall on the south-western boundary. The other four all related to the hand dug service pit for TT04 and were labelled CP04 (A-C). There were a number of locations due to a concrete obstruction(s).

Ground gas and groundwater monitoring standpipes were installed within twelve of the window sample boreholes (WS02, WS04, WS06, WS07, WS09 to WS12, WS15, WS17, WS19 and WS20) and twelve of the cable percussive boreholes (CP02, CP04D and CP05 to CP14). Curtins state that the screened sections were focused on the more permeable deposits where possible, where ground gas and groundwater may be encountered. Ground gas monitoring wells were installed within the shallow window samples to assess soils most likely to be a source of ground gas generation. Deeper monitoring wells installed within the cable percussion boreholes were primarily designed to determine groundwater levels. A summary of the monitoring well response zones is provided on Table 3.2 of the Curtins Phase 2 Report. Response zones were located in a range of strata including Made Ground, granular Alluvium, granular and cohesive Glaciofluvial Deposits, Organic Sand.

Six ground gas and groundwater level monitoring visits were undertaken over a three month period (between April and July 2021) following installation of the monitoring wells.

The location of the exploratory holes is shown on the drawing contained in Appendix A of the Curtins Phase 2 Ground Investigation Report (Curtins Drawing No. 075882-CUR-00-XX-DR-GE-004-V03).

3.1.3 Chemical and Geotechnical Testing

The laboratory selected by Curtins for chemical and geotechnical analysis was i2 Analytical Laboratory (UKAS and MCERTS accredited).

Curtins state that reflecting the site's historical industrial land use across the site, and the two back-filled canals, the sampling positions were generally located in a non-targeted, systematic array across the entire site to give adequate and representative coverage with respect to the sites proposed residential end use and the immediate environmental setting, concentrated in the near surface deposits.

As part of the assessment for potential contamination at the site, up to 76 no. samples of shallow soil were subjected to chemical analysis, including heavy metals, Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPH), Asbestos Screening, pH, sulphate, Soil Organic Matter (SOM), Cyanide and Total Phenols. Sixty-three samples were of the Made Ground (including tarmac and concrete), 10 no. sample in natural Sand, 2 no. in natural Clay and 1 no. in natural Silt.

Up to 15 no. of the above samples (where soils had a hydrocarbon odour and/or ash and clinker were observed) were also tested for Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), Phenols by HPLC and additional inorganic determinands (Free Cyanide, Ammoniacal Nitrogen as N, NH_3 and NH_4).

Asbestos quantification was completed on 17 samples which had positively identified asbestos fibres.

Six samples of tarmac were tested for the 'Tarmac Additional Testing' Suite to aid determination of their initial waste classification. This comprised Coal Tar and Tar Residue.

Groundwater samples were recovered from 7 no. of the cable percussive boreholes (CP02, CP04D, CP05, CP06, CP08, CP09 and CP11). These were tested for 'Water Suite A' which comprised pH, Total Hardness, heavy metals, Phenol, Cyanide, Sulphate, PAHs and TPH.

As part of the assessment of the geotechnical parameters at the site, soil samples were subjected to selected geotechnical analysis.

3.1.4 Ground Gas and Groundwater Monitoring

Six rounds of ground gas monitoring were undertaken over a three month period between 13th/14th April and 23rd June 2021, with barometric pressure recorded between 975 mb to 1016 mb. Barometric pressures <1000 mb were recorded on the second, third and fourth monitoring visits. Falling barometric pressure was recorded on the fourth and fifth monitoring visits.

Monitoring included for methane, carbon dioxide, hydrogen sulphide, carbon monoxide and gas flow. Records of ambient conditions including atmospheric pressure were also made.

Groundwater level monitoring was undertaken in each well location as part of the gas monitoring programme.

The ground gas assessment considers the ground gas monitoring results obtained from the shallow window sample boreholes. As the deeper wells installed in the cable percussive boreholes were designed primarily to assess groundwater levels in the deeper superficial deposits and obtain groundwater samples.

3.1.5 Findings of the Ground Investigation

3.1.5.1 Ground Conditions

The ground conditions across the site, determined during the Curtins ground investigation works, comprised predominantly granular Made Ground with various constituents. These Made Ground soils typically overlay superficial deposits comprising Alluvium generally in the western area of the site, with Peat / organic soils locally, underlain by interbedded cohesive clay and silt and granular sand and gravel Glaciofluvial deposits. Where progression through the Glaciofluvial Deposits was achieved, Glacial Till clay was encountered. Bedrock was not encountered, with the investigation completed at a maximum depth of 30.45m bgl (108.06m AOD).

Made Ground was encountered in all exploratory holes across the site. The thickness of the Made Ground ranged from 0.35m (WS04) to 6.00m bgl (CP02); but was generally 1.5-3m thick. The base of the Made Ground was encountered at 132.51-139.35m AOD.

Concrete, reinforced concrete (existing ground floor slabs) and tarmacadam were encountered at the majority of exploratory hole locations typically 0.05-0.22m thick and underlain by a sand and gravel yellow/grey sub-base.

Grass over topsoil was encountered in TT02, CP01 and CP10 only at 0.15-0.20m thickness.

Made Ground was predominantly granular, described as typically slightly silty gravelly fine to coarse sand. Gravel is fine to coarse angular to rounded sandstone, mudstone, concrete, brick, slate, wood, ash, clinker, glass and rare coal, plastic and metal. Rare to occasional boulders of bricks, sandstone and mudstone.

Made ground likely associated with the two basins in the centre-west and centre-east of the site was encountered in WS06, WS13A, WS15, TT01, TT04, TT06A - F, CP04D, CP05, CP06, CP07 and CP09.

Slight to strong hydrocarbon odours were observed in Made Ground soils in eight exploratory holes. Organic odours were observed by the engineer in five exploratory holes, CP04D, SA01/TTA, TT01, TT04 and WS21. Made Ground described as or containing a gravel of ash was recorded in 9 no. of the exploratory holes.

A detailed account of the ground conditions ground conditions is provided in the Curtins Phase 2 Report. This includes details of the visual and olfactory observations of contamination in Table 5.7 of the Report.

3.1.5.2 Groundwater Observations

Groundwater was encountered in 18 no. exploratory holes during the investigation. The groundwater strikes ranged from between 1.20 and 2.70m bgl where it was encountered in the granular Made Ground. Two water strikes were encountered in the Alluvium at 3.30 m bgl (in TTC) and 4.60 mbgl (in CP01) and one water strike was made in the Peat Deposit at 2.70m bgl in TT01. Groundwater was encountered between 4.00 and 24.50 m bgl in the granular Glaciofluvial Deposits, with two strikes at varying depths in CP04D and CP10, indicating multiple water bodies in the more granular components of the Deposits.

The Cable Percussion boreholes were developed on 28th April 2021 and groundwater samples collected on the 10th and 12th May 2021. There was insufficient depth of groundwater in CP07 to allow a sample to be collected. The groundwater in boreholes CP10, CP12, CP13 and CP14 did not recharge at a fast enough rate to allow for the collection of groundwater samples. An issue of 'silting up' of the wells was found to be an issue in some wells, in particular CP02 and CP12.

Four rounds of groundwater monitoring were undertaken between 13/14th April and 26th May 2021. Window sample boreholes WS06, WS09, WS10, WS11 and WS12 were recorded as dry on all monitoring visits. Perched groundwater within the shallow Window Sample boreholes has been recorded at 138.21- 135.55m bgl.

Due to the variability of the interbedded granular and cohesive Glaciofluvial Deposits, groundwater level with the superficial strata have been recorded at 135.92-126.74m AOD.

3.1.5.3 Contamination Assessment

Soils

The contamination assessment completed by Curtins was based on the previous masterplan and for the human health assessment the site was split into comparison with Generic Assessment Criteria (GAC) for 'Residential without home grown produce' in the north-western area of the site where apartments and soft landscaping were proposed and 'Residential with home grown produce' in the south-eastern area of the site where housing and private gardens were proposed.

Whilst the proposed masterplan has been amended slightly, with a reduction in the footprint area of the apartment blocks and a more efficient site layout for the housing giving more usable amenity space the fundamental split between apartments and soft landscaping on the north-western side of the site and housing on the south-eastern side remains and therefore the Curtins assessment remains valid. A summary of the assessment is provided below.

Apartments (Residential without homegrown produce)

Analytical data for soil samples from 25 no. exploratory holes located across the north-eastern area were compared to the adopted GAC by Curtins. This comprised 28 no. Made Ground samples and 5 no. samples of natural ground. Ten Made Ground samples recorded concentrations of contaminants above the GAC. Slight exceedances for a number of PAHs were recorded in all 10 no samples. This included Benzo(a)anthracene, Benzo(b)fluorene, Benzo(a)pyrene, Dibenzo(ah)anthracene, Naphthalene and Chrysene). Lead was recorded above the GAC in 4 no. samples and Arsenic in 2 no. samples (but from the same location: WS13A). The TPH-CWG Aromatic fraction C21-C35 was also found to exceed the relevant GAC in one sample (WS13A at 2.80m). Concentrations of VOCs and SVOCs were recorded above the limit of detection in WS13A and CP07.

All samples were screened for asbestos with asbestos positively identified in 8 no. Made Ground soil samples. Identification of the asbestos indicated Chrysotile fibres in 7 no. samples and Chrysotile cement material on 1 no. sample (WS13A).

Housing (Residential with Home Grown Produce)

Analytical data for soil samples from 28 no. exploratory holes located across the area of proposed low-rise housing were compared to the adopted GAC by Curtins. Thirty-five samples of Made Ground and 8 no. samples of natural ground were included in the assessment. Sixteen Made Ground samples recorded concentrations of contaminants above the adopted GACs. Similarly, to the Apartment area, exceedances were recorded for PAHs, Lead, Arsenic and TPH. An exceedance of the Zinc GAC was also recorded in TT05. The TPH-CWG Aromatic fractions C16-C21 and C21-C35 were also found to exceed the relevant GAC in one sample (WS15 at 2.20m). Concentrations of VOCs and SVOCs were recorded above the limit of detection in TT05, TT09, TT10, WS15 and WS20.

Details of the exceedances are detailed on Table 7.3.1a and b of the Curtins Phase 2 Report.

Of the thirty-five Made Ground soil samples analysed for asbestos ID, nine recorded positive identification of asbestos fibres, with no asbestos identified in the eight natural soil samples tested. Where asbestos was positively identified in the laboratory, asbestos quantification analysis was then undertaken. Chrysotile loose fibres were detected in 8 no. of the samples with Amosite fibres identified in 2 no. of the samples. Concentrations above <0.001 % w/w were recorded in 4 no. samples (two in TT10, one in WS15 and one in WS20). Concentrations ranged from 0.001 to 0.026 % w/w.

Water Resources

The rationale for the assessment criteria adopted for the assessment is set out in the Curtins Phase 2 Report. In summary, taking into account the low sensitivity and distance to the nearest surface water receptor, and that the site is underlain by a Secondary A Aquifer, the results of laboratory analysis of groundwater samples have been assessed against EU Drinking Water Standards. In the absence of DWS, WHO Water Standards have been utilised.

With respect to the proposed receptor (Glaciofluvial Deposits and Alluvium, Secondary A Aquifers), two determinants were recorded at slightly elevated concentrations greater than the relevant DWS: Sulphate in CP08 and Nickel in CP02, CP04D & CP06.

3.1.5.4 Geotechnical Assessment

Assessments and recommendations relating to foundation design and floor slab design were also provided in the Curtins Report¹ however these are outside the scope of this Remediation Strategy. The Curtins Report should be referenced for this information if required.

3.1.5.5 Ground Gas Risk Assessment

In summary the ground gas risk assessment completed by Curtins was based on data from six rounds of gas monitoring from twelve shallow window sample undertaken over a twelve week period under varying barometric conditions. The assessment has been completed with reference to BS8485

Curtins state that:

- Maximum peak carbon dioxide (CO₂) concentrations ranged between $<0.1\%$ v/v and 8.8% v/v throughout the monitoring period. The greatest maximum carbon dioxide concentrations were recorded in WS07, WS09, WS11, and WS19.
- Methane concentrations were typically recorded below the limit in all monitoring wells throughout the monitoring period, with exception of WS07 on the second (0.2% v/v) and sixth (0.4% v/v) monitoring visits.
- Hydrogen Sulphide (H₂S) and Carbon Monoxide (CO) were recorded below the limit of detection of the monitoring instrument in all monitoring wells during each of the monitoring visits.
- Maximum peak air flow rates ranging between <0.1 l/hr and -22.2 l/hr were recorded, while steady state air flow rates were always recorded below the limit of detection of the monitoring instrument (<0.1 l/hr).

Where negative flow rates were recorded, it has been assumed by Curtins that a positive air flow rate of the same value may be possible. Therefore, the absolute value of any negative air flow rates was used in this assessment.

An appraisal of ground conditions by Curtins relative to the detection and concentration of ground gas suggests that the sporadic presence of organic rich soils and peat across the site may represent the source of the carbon dioxide recorded. Where elevated levels of carbon dioxide were recorded in wells within the Made Ground no putrescible material was noted on the exploratory hole log. Organic sand and peat were present in a number of the wells where elevated carbon dioxide levels were recorded, including WS02, WS07, WS11 and WS19. Curtins suggest that other sporadic pockets of organic rich soils may exist in other locations underlying the proposed apartment buildings.

Curtins calculated a GSV of 0.0004 l/hr for methane based on the data from WS07. It was concluded by Curtins that methane presents a low risk to site end users based on the low concentrations of methane recorded and no flow from WS07, in addition to concentrations below the limit of detection across the remainder of the site.

GSVs ranging from 0.0001 to 0.0088 l/hr were derived for carbon dioxide across the twelve monitoring wells using steady state flow data. The calculated GSV's are all low and would be indicative of a Characteristic Situation 1 (CS-1) gas regime, however, elevated Carbon Dioxide concentrations of >5% v/v were recorded in shallow monitoring installations installed within WS07, WS09, WS11 and WS19, which based on the guidance indicate consideration should be given to increasing the Characteristic Situation to CS-2 for apartments, or low-rise housing.

A preliminary zoning for ground gas protection is provided in the Curtins Phase 2 Report based on the results of the ground gas monitoring. However, it is recommended that this is reviewed based on the earthworks proposals and final site/building layout with further gas monitoring possibly required post earthworks to confirm and justify the zoning and or define it in relation to building footprints.

3.1.5.6 Revised Conceptual Site Model and Recommendations

The conceptual site model was revised by Curtins based on the findings of the intrusive site investigation. In summary they state:

- A Moderate risk rating is identified to residential site end-users, from soils and dust from inhalation and ingestion due to exceedances of heavy metals, TPH's and PAH's and identification of asbestos fibres and Asbestos Containing Material debris at concentrations of up to 0.312% w/w (apartments site) and up to 0.026% w/w (dwellings with private gardens site). A clean cover system is therefore recommended in gardens and soft landscaped areas.
- A Moderate/ Low risk rating is identified to construction workers and adjacent residents, from soils across the majority of the site through inhalation and ingestion of soil or dust, accounting for appropriate PPE and sanitary facilities are utilised during all groundworks and construction works. Due to the identification of loose asbestos

fibres and ACM debris an asbestos management plan should be put in place during construction works.

- A Moderate / Low risk rating is identified to site end users from ground gases arising (carbon dioxide) from Made Ground and natural organic rich soils on the site, characterised by CS-2 gas regime in the vicinity of WS07, WS09, WS11 and WS19 due to elevated concentrations of carbon dioxide. Further monitoring and assessment to be undertaken upon completion of earthworks.
- A Low risk rating is identified to controlled waters (Groundwater and Surface Waters) following the ground investigation. No evidence of free product or gross contamination was identified in site soils and only marginal exceedances were identified above Drinking Water Standards for sulphate and nickel in samples obtained from superficial deposits. Furthermore, these thresholds are considered conservative with respect to groundwater given the site is not situated within a Source Protection Zone. The site is situated a significant distance to the River Roch, the nearest surface water feature 221m north of site.

Based on the findings of the ground investigation, the following geo-environmental recommendations were made by Curtins:

1. A clean cover system is recommended in private gardens and soft landscaped areas to break the source-pathway-receptor linkage between made ground soils and end users. This is likely to include a thickness of topsoil/subsoil overlying a geotextile membrane to prevent residents and maintenance workers digging into the contaminated soils. The thickness of capping is likely to vary between private gardens and shared landscaping.
2. Gas Protection measures are recommended, as detailed in Curtins Drawing Ref. 075882-CUR-00-XX-DR-GE-013-P01, in accordance with Characteristic Situation 2 for apartments and low-rise housing. Further ground gas monitoring undertaken post-Enabling Works could be undertaken to further assess the risk across the site.
3. It is recommended that construction workers are provided with appropriate PPE and sanitary facilities, with reference to the environmental testing results presented.
4. It is recommended that an Asbestos Management Plan is put in place with input from a specialist to safely manage the risk from asbestos in soils during construction.
5. A Remediation Strategy and Verification report will be required to detail and approve the above measures.

3.2 LK Remediate Investigation

3.2.1 Objectives and Scope

LK Remediate (LKR) were commissioned by Willmott Dixon to undertake additional site investigation at the Site in support of the remediation and enabling works. It is understood that LK Remediate are the partner company of Willmott Dixon who have been appointed to carry out the remediation and enabling works for the Neighbourhood development.

The additional investigation works were undertaken on 11th and 12th July 2022 and comprised twenty-one mechanically excavated trial pits (TP101-121) to nominal depths of approximately 3mbgl.

The primary aim of the investigation was to examine ground conditions, in particular in the area of the canal basins and to collect geotechnical samples to support the enabling works, including confirmation of the physical (as well as chemical) suitability of ground materials to be re-used within the development plan. The investigation also included the collection of tarmac samples for coal tar assessment and a topsoil sample for classification purposes. Three samples of soil were also submitted for chemical analysis for a broad range of contaminants.

3.2.2 Findings of the Investigation

The results of the investigation are provided in the following report produced by LK Remediate:

- Site Investigation for Rochdale 'Neighbourhood' prepared for Willmott Dixon Construction, Document Ref: LKR221043_SI Rev 1, Final dated 5th August 2022.

The LK Remediate Report should be referenced for the full set of results. In summary:

- The ground conditions beneath the site generally comprised tarmac and concrete hardstanding underlain by a sub-base layer of demolition type rubble with brick, concrete and stone gravel which in turn was underlain by generally granular Made Ground with occasional brick and concrete fragments (potentially reworked natural strata).
- Generally, Made Ground within infilled canal basins was thicker than outside of the canal basin areas. Made Ground within these areas contained more common occurrences of deleterious materials such as wood and metal. Soft clayey silty Made Ground identified within some locations within the anticipated canal infilling areas were considered by LK Remediate likely to be canal sediments. These sediments were often associated with olfactory indications of contamination.
- Natural strata was encountered as variously clayey Sand, with occasional organic and peaty inclusions.
- No significant ingresses of groundwater were encountered in any trial pits. Some pits noted localised perched groundwater within Made Ground.

- Visual and olfactory evidence of hydrocarbon contamination (odours, sheens) were noted in seven of the trial pits: TP106, TP107, TP109, TP112, TP113, TP118 and TP119.
- Similar to the findings of the Curtins investigation, the contamination testing of the 3 no. soil samples submitted for analysis from trial pits TP106, TP112 and TP119 indicated elevated levels of arsenic, lead, PAHs and aromatic hydrocarbons (in the range C12 to C35) when compared to the relevant generic assessment criteria. A maximum concentration of 12,000 mg/kg was recorded in TP106 for the aromatic range C21-C35.
- As per the Curtins investigation, Asbestos fibres were detected and identified in the soil samples. Chrysotile was identified in all three trial pits with amosite identified in TP106 and TP112 and Crocidolite also identified in TP112. The total percentage of asbestos recorded ranged from 0.021 to 0.036%.
- Five representative samples of tarmac were collected and submitted for analysis of coal tar. The laboratory confirmed the samples do not contain coal tar contamination. Dibenzothiophene, a biomarker present in coal tar, was not detected by SVOC analysis. This, in conjunction with no PAH contamination, confirms no coal tar is present in the samples.
- In terms of the topsoil sample submitted for analysis and classification it was found that the sample does not fall within the 'multipurpose' range for soil texture class, mass loss of ignition or extractable potassium. It was concluded by LK Remediate that this may not preclude its use with the possible addition of fertiliser or other additives.
- Eight samples were analysed for a number of geotechnical parameters including particle size distribution, particle density, Atterberg limits and compaction (optimum moisture content/maximum dry density).
- Sample TP106 had very high initial moisture content (in excess of 75%) and optimum moisture content (30%), a very low particle density (1.65Mg/m^3) and maximum dry density (1.09Mg/m^3) and a noticeable degree of chemical contamination. This material is believed indicative of canal basin sediments and is considered by LK Remediate unsuitable for re-engineering in its current state.
- The results for the remaining seven samples indicated well-graded granular fill with comparable particle densities and compaction behaviour. A narrow range of optimum moisture contents (9.6% -13%) and maximum dry densities ($1.81 - 2.00\text{ g/m}^3$). LK Remediate concluded that these materials could be suitably re-engineered as general fill.

3.2.3 Conceptual Model Following Additional 2022 Investigation

The findings of the LK Remediate investigation have helped inform the detailed design of the remediation and enabling works and have not materially changed the conclusions drawn by Curtins on the conceptual site model of potential pollutant linkages, risks to receptors and the remedial actions recommended to address the identified unacceptable risks. The ground conditions encountered, and contaminants of concern identified, reflect the findings of the Curtins investigation. There is, therefore, no requirement to update the conceptual site model following the additional investigation.

The additional investigation has corroborated the initial conclusion that the most likely source of the hydrocarbon contaminated material that was encountered during the Curtins investigation is associated with the made ground material within the canal basins, in particular the sediments at the base of the basins. The investigation has also confirmed that this material is unlikely to be suitable for use as engineered fill in its current state. The additional investigation and geotechnical testing indicate that materials outside of the basins are likely to be suitable for re-use as general fill.

4.0 Outline Remediation Strategy

A preliminary outline remediation strategy was prepared by Tier Environmental Ltd in June 2021 to support the intention to undertake remediation on the site during the enabling works phase of the development.

The outline strategy was based on a review of Geo-environmental Assessments carried out by Delta-Simons for Rochdale Borough Council in 2018 as well as the Phase 1 and Phase 2 assessments completed by Curtins in 2020/21.

Tier stated that the two reports indicated that there are contaminants of concern that are in excess of the Residential with Homegrown Produce Site End Use Generic Acceptance Criteria (GACs) as follows:

- Elevated levels of TPHs
- Elevated levels of PAHs
- Elevated levels of lead and arsenic
- Localised positive identification of asbestos with a handful of areas >0.1%
- Curtins indicated positive identification of VOC/SVOCs where no GACs are available, the initial assessment of these is related to the dye industry (2-Methylnaphthalene and Anthraquinone).

Tier indicated that the following Remediation Strategies were expected to be incorporated into the development:

- A review of the depths required for a clean cover system for rear gardens (600mm) and soft landscaped areas (300mm).
- A review of the ground gas protection measures required based on findings from both consultant reports, currently Amber 2 is expected but a zoning plan will potentially reduce this to areas of Green and Amber 1.

A procedure for dealing with unforeseen or unexpected contamination was also recommended.

5.0 Remediation Strategy and Implementation Plan

5.1 Remediation Objective

The overall objective of the remediation strategy is to allow the safe redevelopment of the site for a residential end use of apartments with soft landscaping (including public open space) and low-rise housing with private space/gardens.

The remediation strategy is based on:

- The principles of 'suitable for use';
- Risk based assessments comprising identification of sources, pathways and receptors and linkages between them;
- Modifying or controlling identified pollutant linkages by undertaking action on one or more of the components of the linkage;
- Utilisation of sustainable on-site solutions where practicable that will minimise the import and export of materials, including re-use of suitable site won materials.
- Providing sustainable and practicable solutions to waste management within the context of the current waste management legislative regime.

The remediation strategy has been developed in accordance with the Land Contamination Risk Management (LCRM) guidance (which replaced the Model Procedures for the Management of Land Contamination (CLR 11) 2004 published by the Environment Agency).

5.1 Plausible Pollutant Linkages

The plausible source-pathway-receptor linkages that could result in a risk to the proposed development and future end users and therefore that require remediation are shown in Table 5.1. It should be noted that the risks presented by these linkages are considered to be moderate and moderate-low.

Table 5.1 Plausible Pollutant Linkages

Source	Pathway	Receptor
Shallow soils with elevated levels of heavy metals (Arsenic, Lead, Zinc), TPH's and PAH's above GAC and the presence of asbestos fibres and Asbestos Containing Material (Chrysotile and Amosite) up to 0.312% w/w. (NB. Hydrocarbon contaminated materials located primarily within the canal basins)	Direct contact (ingestion and inhalation) with soils and dust in gardens and areas of soft landscaping	Future residents and end users of the apartments and low-rise housing
		Construction and maintenance workers
Elevated levels of carbon dioxide as a result of the presence of pockets of organic rich and peat soils and possibly Made Ground	Migration into buildings through existing service corridors and the underlying superficial deposits	Future residents of the houses and apartment blocks Building Structures

5.3 Development Proposals and Enabling Works

The proposed development currently comprises of two apartment blocks with associated hard and soft landscaping located on the north-eastern side of the development site and low-rise housing on the remainder of the site comprising of 81 homes (which are a mixture of 2 to 4 bed houses). All homes will have private usable amenity at ground floor level, which includes private gardens in most cases. There is an area of public open space between the apartments and the housing area.

It is understood that the enabling works comprise of a significant earthworks operation with the aim of removing sub-surface obstructions, including canal walls, existing foundations and other obstructions which may inhibit pile installation. The works will also involve a cut and fill operation to prepare site levels and a piling mat for development. It is envisaged that ground bearing slabs will be utilised, constructed on the development platform following site turnover. A summary of the enabling works as currently proposed, as produced by LK Remediate are included in Figures 1 to 7 in Appendix 4.

5.4 Remediation Strategy

Based on the findings of the Phase 2 Contamination Assessment, the current development proposals and scope of the enabling works, the Remediation Strategy comprises:

- Implementation of an asbestos management plan which includes removal ('picking') of any Asbestos Containing Materials from the surface of the site ahead of the 'site turnover' in the enabling works. This is to prevent any further contamination by asbestos.
- Implementation of a Materials Management Plan (MMP) as part of the cut and fill operation to provide a suitable development platform.
- Removal of hydrocarbon contaminated soils exceeding assessment criteria from below the footprint of the apartment buildings and residential houses. These materials may however be suitable for use within other areas of the developments scheme, such as the area of public open space (POS). Re-use of the material will require an assessment of the physical and chemical properties of the material to ensure it meets the requirements for fill material within the POS area.
- Provision of a suitable thickness of clean and inert cover material in areas of soft landscaping, public open space and in private gardens and private amenity spaces (if these are to comprise of soft landscaping or there is the possibility that residents are able to remove any initially laid hard landscaping and hence could come into direct contact with potentially contaminated shallow soils).
- Incorporation of suitable gas protection measures within the apartment buildings and low-rise housing.
- Implementation of a Discovery Strategy for any unforeseen or unexpected contamination encountered during the enabling or construction works.

Therefore, the remedial activities, are anticipated to comprise the following:

1. Screening of soils during the excavation / turning over of the site to identify and remove where practicable:
 - a) Any visible asbestos containing material, if excavated materials are to be mechanically screened and/or crushed (this is to prevent any further contamination of ground materials by asbestos fibres). This should form part of the asbestos management plan to be implemented at the site by the remedial/enabling works contractor. This includes removal from the site surface to prevent materials being crushed and asbestos fibres being spread across the site.
 - b) Hydrocarbon contaminated soils/sediments from below the footprint of the houses and apartments. This material appears to be present within the old canal basins and is unlikely to be geotechnically suitable for general engineering fill without treatment. Material can be stockpiled for testing to determine whether material is suitable for re-use (with or without treatment) or requires off-site treatment or disposal. Visual and olfactory evidence of hydrocarbon contamination was observed in exploratory holes WS13 (2.70-3.00m), CP04 (0.58-1.20m) and CP07 (1.20-4.00m). Exceedance of GACs for TPH aromatic hydrocarbons were recorded at WS13A, WS15, TT05 and TT10. Hydrocarbon contamination was also identified within 7 no. trial pits in the LK Remediate additional investigation. The presence of further undiscovered areas across the site is a possibility, although the lines of evidence indicate material is located within the basins.
 - c) Organic rich soils and peaty material from soil arisings in areas below and adjacent to building footprints. It is not the intention to remove all such peaty soils and organic rich materials from depth below buildings as the remedial design includes for gas protection measures to buildings. However, it is assumed peat and organic rich materials are unlikely to be suitable as engineering fill and will be screened from excavated materials for geotechnical reasons and as such this will also reduce the gassing potential below buildings. This material can be stockpiled and tested for possible re-use on-site, in for instance landscaped areas.
 - d) Any significant putrescible material from the Made Ground, again to reduce the potential for the generation of ground gas. It is assumed that such material will be removed anyway as part of the ground works for geotechnical reasons to meet the required specifications for material used within the development platform (similar to peat and organic rich soils).
2. In the absence of additional gas monitoring and assessment post groundworks, then installation of gas protection measures commensurate with Characteristic Situation 2 is recommended in all residential housing and the apartments. An assessment of the requirement for hydrocarbon vapour membranes should be made post groundworks if there have been any practical constraints to removal of hydrocarbon material from below the building footprints.
3. Import of clean subsoil and topsoil into garden and landscape areas (including the area of public open space) to make up the shortfall to any suitable site won material. Clean cover soils are to be placed above a geotextile or break layer (no dig layer) in garden areas or

private amenity areas. The standard depth of clean cover utilised to form a simple cover layer is 600mm in gardens/private amenity space and 300mm in areas of soft landscaping and public open space. The soils to be used within the clean cover should meet the criteria detailed in Appendix 5.

4. A watching brief / discovery strategy to be implemented to deal with any unforeseen or undiscovered contamination or suspected contamination during the enabling or construction works.
5. Validation of remedial actions in accordance with the Verification Plan.

5.5 Remediation Implementation Plan

The Remediation Strategy requires the implementation of the following key tasks:

- Consultation with development project team and stakeholders and agreement of the Remediation Strategy with the local planning authority.
- Preparation of an Asbestos Management Plan to include appropriate health and safety and environmental precautions during groundworks. This should be underpinned by the CL:AIRE Asbestos in Soil (CAR-SOIL™) Guidance.
- Preparation and submission of a Materials Management Plan (MMP) in accordance with the CL:AIRE publication The Definition of Waste – Development Industry Code of Practice (v2) for re-use of soils on-site.
- Screening of soils during the enabling groundworks to identify and remove ACM, hydrocarbon contaminated soils and sources of ground gas including putrescible material within the Made Ground and organic rich soils, as detailed in Section 5.4.
- Stockpiling and testing of soils removed during the screening / site turnover work, as required, to determine whether soils can be retained on-site (with or without treatment) or require off-site treatment or disposal.
- Additional waste classification testing for any excess soils to be removed from site as part of the cut and fill exercise. This may include Made Ground and bituminous surfacing material (tarmac) if present in excess of re-use quantities. Initial testing undertaken by Curtins on the tarmac at the site indicates the material was laid post 1980 without tar binder and would not be classed as Hazardous Waste. The additional testing as part of the LK Remediate investigation confirms the tarmac does not contain coal tar. Made Ground has initially been classified as Hazardous by Curtins if it were to be disposed of off-site. The remediation/enabling works contractor will need classify any materials (in accordance with the Waste Classification Guidelines) that are due to be removed off-site as waste.
- Implementation of a discovery strategy to deal with any unforeseen or undiscovered contamination or suspected contamination during the enabling or construction works.
- Installation of gas protection measures, as required by the updated ground gas risk assessment or commensurate with Characteristic Situation 2 in all residential housing and apartment blocks in the absence of further monitoring. Re-assessment of the requirement for any hydrocarbon vapour membrane following the groundworks.

- Import of suitable subsoil and topsoil to provide a cover layer in areas of soft landscaping, private gardens or amenity spaces. Imported soils to be sampled and tested prior to import and on delivery to ensure they meet the Cover Soil Criteria for the site (Appendix 5). If there are suitable site-won materials that can be used in the cover layer these will also need to be sampled and tested at the required frequency to ensure they meet the relevant end use criteria, depending upon where soils are to be used within the development (i.e. either gardens or public open space).
- Suitable records of the earthworks and remedial activities (including waste disposal and soil imports and implementation of gas protection measures) to be maintained by the contractor so that they can be used as lines of evidence for the verification of the Remedial Works. Records to be kept as set out in the Verification Plan.

These tasks are described in more detail in the following sections.

5.5.1 Asbestos Management Plan

Asbestos fibres were positively identified in seventeen of sixty-three soil samples tested in the Curtins investigation. Eleven of these samples recorded <0.001% w/w asbestos and are likely to present a low risk to construction workers by aerial dispersion if disturbed during the works. Five soil samples recorded concentrations of asbestos fibres in soils ranging from 0.001-0.026% w/w. Three samples submitted in the additional LK Remediate investigation also indicated the presence of asbestos fibres/clumps up to 0.036%.

One soil sample identified Chrysotile asbestos hard/cement type material in WS13A at 1.50m below ground level (bgl), approximately 138.31m AOD. This fragment has recorded a concentration of 0.312% w/w but reflects the ACM % and not fibre % in surrounding soils.

The presence of asbestos does not prevent the re-use of materials on-site. The Principal Contractor should, however, procure and act upon an Asbestos Management Plan (AMP) for all site works where site soils are likely to be disturbed. This is to protect health and the environment. Furthermore, it is considered that the Asbestos Management plan should allow for an Asbestos Containing Material (ACM) watching brief, picking and disposal operation during excavations.

The AMP should be underpinned by the CL:AIRE Asbestos in Soil (CAR-SOIL™) Guidance. The Guidance has been prepared with the support of the Health and Safety Executive and presents the definitive explanation of how the legal requirements of the Control of Asbestos Regulations 2012 (CAR 2012 or the Regulations) have been interpreted to apply to work with asbestos contaminated soil and construction & demolition (C&D) materials.

As stated by CL:AIRE, the guidance is underpinned by the fundamental requirements expressed in the Regulations, in relation to the protection of employees from risks related to exposure to asbestos but is set within a carefully considered framework designed specifically for soil and C&D materials contaminated with asbestos.

In order to be more directly applicable to the risks associated from work on soil and C&D materials contaminated with asbestos, the Regulations have been interpreted in order to allow practical guidance to be produced that is fit for purpose whilst allowing compliance to be demonstrated with the overarching requirements set out in the Regulations.

ACM are manufactured products and are, when encountered in soil by the picking exercise or by other means, defined as waste and must be removed from site and transported to a suitably licensed waste facility for disposal.

Soils having asbestos fibre identified at greater than 0.1% w/w and ACM having asbestos content at greater than 0.1% w/w determines a Hazardous Waste classification for disposal.

5.5.2 Materials Management Plan

In order to demonstrate compliance with waste legislation with respect to the re-use of any soils on the site, the CL:AIRE Definition of Waste: Development Industry Code of Practice (the Code of Practice) should be followed.

The Code of Practice (CoP) sets out good practice for the development industry to use when assessing if materials are classified as waste or not. The CoP allows the user to come to the view on whether material is waste or not and importantly provides an accepted framework from demonstrating this to the regulators. The Environment Agency (EA) will take account of the CoP in deciding whether to regulate materials as waste. If materials are dealt with in accordance with this CoP the EA considers that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development.

There are 3 basic elements to good practice:

1. Ensuring an adequate Materials Management Plan (MMP) is in place covering the use of materials on the site.
2. Ensuring the MMP is based on an appropriate risk assessment that underpins the remediation strategy, concluding that the objectives of preventing harm to human health and pollution of the environment will be met if materials are used in the proposed manner.
3. Ensuring that materials are actually treated and used as set out in the MMP and risk assessment.

It is recommended that the CoP is adopted and followed on this project and that a Material Management Plan is developed following agreement of the Remediation Strategy.

On completion of the preparation of the MMP, a Qualified Person must review the relevant documents and provide a Declaration (submitted to the EA) before excavation work commences. At the conclusion of the works a Verification Report will be prepared, as detailed in Section 6 of this document.

5.5.3 Excavation of Soils

The excavation of shallow soils is to be undertaken in a controlled manner across the site. It will be the responsibility of the remediation/enabling works contractor to develop and follow a safe and controlled excavation plan and site materials management plan as part of their Construction Phase Environmental Management Plan (CEMP).

If known contaminated or suspected contaminated material needs to be stockpiled, this should be done in a separate area of the site, on a hardstanding or sheeted area which should be bunded and covered where possible to prevent runoff and dust generation respectively. The stockpile should be clearly signed as contaminated soils.

Where soils have been shown to be 'uncontaminated' and meet the criteria for re-use, then soils can be stockpiled away from potentially contaminated soils. Where necessary, measures are to be taken to prevent dust generation from such stockpiles.

5.5.4 Discovery Strategy – Unforeseen or Unexpected Contamination

A discovery strategy will be maintained during the remediation works and any unknown contamination encountered will be appropriately investigated and dealt with to mitigate any future risks to the development. The planning authority will be informed of any unknown contamination encountered.

A procedure will need to be developed and implemented by the Principal/Enabling Works Contractor. Typically, this may comprise:

- Stopping the activity where unexpected contamination is encountered/discovered.
- Securing the area (with fencing and signage) to prevent access by other site personnel.
- Reporting the suspected contamination to the appropriate site supervisor.
- Informing the relevant parties, including the regulatory authority.
- Investigation of the suspected contamination by the incumbent environmental consultant. This may include a site visit and sampling and testing of the material.
- Assessment of the results of any investigation and agreeing subsequent remedial actions (if needed) with the relevant interested parties.
- Implementation and verification of any agreed actions.

5.5.5 Import of Soils

Subsoil and topsoil imported to site, for use in the garden and landscape areas, should be chemically tested prior to import to demonstrate that materials are suitable for use on the site. It is recommended that samples are tested for the suite of parameters presented in the table presented in Appendix 5 and concentrations should not exceed those specified in the table (these are based on the GAC used for the site).

It is also recommended that topsoil used on the site should meet the requirements of the Specification for Topsoil BS3882: 2015.

With respect to the number and frequency of testing, this will depend on the volume of soils to be imported to the site. Recommendations would be for imported soils to be tested on a

frequency of 1 sample per 250m³ of soil. Testing frequencies will need to be agreed as part of this remediation strategy with the regulatory authority.

5.5.6 Installation of Gas Protection Measures

The site has provisionally been classified as either Characteristic Situation 1 or 2 (in accordance with CIRIA C665) and the site zoned based on gas monitoring data gathered to date.

Given the proposed strategy to remove potential identified sources of ground gas, namely organic rich soils and any putrescible material within the Made Ground, during the turnover of the upper portion of the ground, additional gas monitoring may confirm a reduction in the gas protection measures. At this stage no additional gas monitoring is proposed.

In the absence of additional gas monitoring and assessment post groundworks, then installation of gas protection measures commensurate with Characteristic Situation 2 is recommended in all residential housing and the apartments.

Where CS-2 protection measures are required:

- For ground bearing slabs the minimum gas protection score required from the soil gas protection measures will be accumulated by appropriately detailed reinforced concrete ground slabs and the provision of an appropriate gas resistant membrane to achieve scores 1.5 and 2.0 respectively; a total of 3.5.

The typical scope of protective measures for a residential building set out in C665 are:

- Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM and underfloor venting.
- Beam and block or pre-cast concrete and 2000g DPM / reinforced gas membrane and underfloor venting. All joints and penetrations sealed

The requirement for gas protection measures commensurate with Characteristic Situation 2, if needed, for the apartments and houses will be included on the foundation design drawings.

An assessment of the requirement for a hydrocarbon vapour proof membrane will also need to be carried out following the groundworks if there has been any constraints to removal of all the hydrocarbon contaminated soils and sediments from below building footprints.

5.6 Health, Safety and Environmental Management

5.6.1 Health and Safety

All remedial works are to be carried out in accordance with Health and Safety Guidance Note HS(G) 150 'Health and Safety in Construction' 2006⁷ and will be managed under the Construction, Design and Management Regulations 2015⁸, as appropriate.

The contractor undertaking the works will be required to produce a Health and Safety Plan which will include method statements for the work and risk assessments appropriate to the

work being carried out together with the COSHH assessments. The main hazards associated with the remediation works, which will need to be assessed by the contractor at a minimum, are considered to be:

- Contaminated soils containing elevated levels of asbestos, heavy metals, TPH and PAHs
- Presence of ground gas, in particular elevated levels of carbon dioxide
- Excavation works
- Plant and vehicle movements
- Operating plant and machinery
- Manual handling in association with gas membrane installation

Other guidance documents that should be referenced as necessary and where relevant as part of the development of the health and safety plan for the remedial works are:

- Health and Safety Guidance Note HS(G) 66 'The Protection of Workers and the General Public during the Development of Contaminated Land' 1991⁹ and
- Guidelines for the Safe Investigation of Landfills and Contaminated Land 1993¹⁰.

5.6.2 Environmental Protection

The appointed contractor for the works will be required to comply fully with current environmental legislation and guidance and will be required to provide method statements detailing the environmental protection measures to be implemented at the site during the excavation work. This will form part of the Construction phase Environmental Management Plan (CEMP) for the site and development. The requirements for environmental protection include control of noise, vibration, and dust and protection of controlled waters during the works.

Of particular note will be:

- The control of dust during the excavation of contaminated soils. If necessary, dust suppression measures are to be implemented, such as dampening down soils to prevent dust generation.
- The development is surrounded by residential properties and therefore measures to mitigate dust and noise during remedial works, particularly from plant and machinery, should be implemented.
- Prevention of the uncontrolled release of fuels or other potentially polluting substances during groundworks and construction.
- Any fuel tanks are to be doubled banded, with refuelling areas compliant with good practice guidance for fuels storage and delivery. This should include being positioned away from watercourses.
- Prevention of groundwater run-off from the site during any excavations below the water table.

5.6.3 Waste Management

All waste soils removed from site will be done so in accordance with the Duty of Care Regulations using licensed carriers and the use of consignment notes or waste transfer tickets, as appropriate depending on the final classification of waste.

All waste transfer documentation will be maintained by the Contractor for verification as part of the validation of the remedial works, as detailed in Section 6 of this document.

A Materials Management Plan will be prepared for soils that are to be re-used on-site, as described in Section 5.4.2.

An initial waste classification has been completed by Curtins but it is incumbent upon the Principal and earthworks contractors to confirm the waste classifications and carry out any additional testing that is required.

6.0 Validation Plan

6.1 Scope of Planned Validation Works

6.1.1 General

As set out in the LCRM Guidance, an important element of the remediation process is the requirement to provide an accurate and permanent record of remediation and the standard it has achieved.

In order to achieve this initially a verification plan is prepared which sets out the requirements for gathering data to demonstrate that remediation meets the remediation objectives and the remediation criteria. This verification plan is outlined below in Table 6.1 with additional details provided in the following sub-sections.

On completion of the remediation a Verification Report will be produced which provides a complete record of all the remediation activities on site and the data collected as identified in the verification plan to support compliance with the agreed remediation objectives and criteria. It will also include a description of the work (as built drawings) and details of any unexpected conditions found during remediation and how these were dealt with. This Verification Report will also be used to demonstrate that the Materials Management Plan has been followed and met. Depending upon the phasing of the works the Verification Report may be split into two parts, the initial report for the groundworks, which will encompass the verification of the Materials Management Plan and then a second part which will encompass the verification of the cover layers in the gardens, public open space and landscaped areas.

Table 6.1 Verification Plan

Remediation Activity	Remedial Objective/Criteria to be met	Proposed Validation	Record
Preparation and implementation of Asbestos Management Plan (AMP)	Safe management of identified asbestos in soils during earthworks	Review of Asbestos Management Plan Site visit(s) to check AMP is being implemented	AMP Record of site visit/audit
Preparation and implementation of Materials Management Plan (MMP)	Adherence to Code of Practice for re-use of contaminated soils	Review of MMP and check that MMP signed off by Qualified Person Site visit(s) to check MMP including on-site records being maintained and that validation/verification by third party is being followed and completed. Review Validation Report on completion	MMP QP sign off record Record of site visit/audit and review of on-site records. MMP Validation/Verification Report

Remediation Activity	Remedial Objective/Criteria to be met	Proposed Validation	Record
Preparation of Construction Environmental Management Plan (CEMP) to address wider environmental pollution control including dust and noise	Pollution Prevention Control/Minimise environmental impacts of remedial works	Review of CEMP Site visit(s) to check CEMP is being followed	CEMP Record of site visit/audit
Screening of soil during groundworks to turn over shallow soils and remove existing foundations and obstructions and provide development platform	Removal of ACM, hydrocarbon contaminated soils, organic rich soils and putrescible material in Made Ground, as required	Site visit(s) to observe groundworks, the screening of identified material and material management.	As built drawing(s) and topographic records showing worked areas. Material tracking sheets and drawings Photographs of excavation work and material recovered. MMP Verification/Validation Report
Sampling and testing of soils for re-use and/or removal off-site	To ensure soils are suitable for re-use and are classified correctly for off-site treatment or disposal.	Review of analytical test data for samples taken to ensure they meet re-use criteria for soils used below formation level (see Appendix 5). Soil sampling/testing to be determined by Contractor in accordance with cut and fill volumes and MMP requirements.	Test data and relevant assessments for re-use or waste classification MMP Verification/Validation Report
Removal & off-site disposal of soils	Removed in accordance with Duty of Care Regulations	Inspection of waste carrier details and waste transfer tickets	Copies of example waste transfer notes within validation report
Re-use/Import of soils for soft landscaped areas or private gardens or amenity areas	To meet chemical criteria in Appendix 5 (GAC for residential or POS use)	Source sampling prior to import to demonstrate soils are suitable for use and validation sampling once imported. Sampling of soils prior to import. 1 sample per 250 cubic metres.	Laboratory test results for soil samples Record of volumes imported/re-used Photograph of soils being placed As built drawings with final levels
Provision of cover layer in areas of soft landscaping and private gardens and amenity spaces	To meet agreed specification for the cover layer including thickness of layer, composition and inclusion of geotextile and 'no dig' layer	Site visit(s) to observe construction and specification of the cover layer in both soft landscaping and garden areas. Verification required for each plot/area May require hand dug trial holes to validate thickness and	Topographic data (before and after placement of materials in the cover layer) Site observations/records from site visits. Photographic records of cover layer and any inspection trial holes.

Remediation Activity	Remedial Objective/Criteria to be met	Proposed Validation	Record
		construction depending on timing of visits. Review of topographic data to confirm levels before after placement of materials.	
Installation of ground gas protection measures	Certified installation of suitable membrane and other requirements to meet CS-2	Provision of installation certificates for membranes Site visit(s) to confirm measures installed as per design drawings	Installation certificate(s) As built drawings showing gas protection measures incorporated into buildings Photographs of gas protection measures in place in apartment block and houses.

6.1.2 Screening and Removal of ACM/Contaminated Soils

The Asbestos Management Plan will set out the methodologies and procedures for screening soils and the 'picking' of ACM for off-site removal. As part of these it should specify the requirements for testing of soils for health & safety and environmental purposes.

The Materials Management Plan will similarly set out the methodologies and procedures for the re-use of soils on site (see Appendix 5 for criteria). Results of sampling of material for re-use in the cover layer to be compared to the acceptance criteria for the determinants set out in Appendix 5.

Additional lines of evidence to be gathered include:

- Photographs of the excavations during and upon completion of the work.
- As built drawings showing the area and depth of soil worked.
- Material movement records and drawings.
- Inspection of a selection of waste carrier notices to demonstrate that soils have been taken and disposed of at a suitably licensed waste management facility.

6.1.3 Validation of Soils Imported to Site/Re-use of Soils

The proposed validation for imported soil comprises the following:

- Review of supplied source testing to demonstrate the suitability of the material prior to import (i.e. meets Imported Soil Criteria).
- Imported soil sampled and tested on-site at a frequency of 1 sample per 250m³ of soil, prior to placement.

- Samples to be tested for pH, metals, PAHs, TPH, sulphate, sulphide, cyanide and asbestos (as a minimum).
- Analytical data to be compared to Imported Soil Criteria (as set out in Appendix 5).
- Sampling and testing of representative topsoil samples for the British Standard Topsoil Specification (BS3882), as the cover layer is required to comprise at least 150mm of topsoil.

Soils to be re-used will be tested as part of the additional sampling either in-situ ahead of the works or from stockpiles following stripping of soils across the site, as described in Section 5.4.1. The test data from this sampling will be included in the Validation Report together with a record of the volumes re-used and the location where soils have been placed.

6.1.4 Discovery Strategy

A discovery strategy will be maintained during the groundworks i.e. if any unknown contamination is discovered during the construction works then the local authority will be contacted and a strategy agreed for dealing with the contamination.

Validation works will comprise the recording of such contamination within the validation report including copies of location plans, test data and the strategy agreed to deal with contamination.

6.1.5 Validation of Cover Layer

Both the quality and composition of the soils to be used in the cover layer will need to be validated together with the thickness to ensure they meet the specification for the cover layer, once this has been agreed.

Validation of the quality and chemical/physical composition of the soils can be carried out prior to soils being laid in landscaped areas or gardens, with additional checks on individual plots if needed.

Verification can also be undertaken on a plot by plot basis if required in order to release properties in phases as required. The programme of validation for the cover layer can be agreed once the overall construction programme has been established and agreed.

6.1.6 Validation of Ground Gas Protection Measures

It should be demonstrated that the specified gas protection measures have been successfully implemented at the site, including the following:

- Certified As Built Drawings should be supplied that show the detail of the installed protection measures.
- Records of the suitability of the materials used should be maintained and provided as part of the Verification Report e.g. certificates on the specification of the gas resistant membrane used.

- Visual inspections should be carried out, on all properties, of the gas resistant membranes laid for evidence of tears or gaps around service entries. Records of the visual inspections should be maintained and included in the Verification Report including photographic evidence.
- Any certificates from independent checks (such as through the NHBC or Building Control Inspections) or from specialist suppliers or installers should be maintained and included in the Verification Report.

6.1.7 Materials Management Plan

Materials subject to excavation, disposal, treatment and/or re-use must be tracked and evidence generated to provide an auditable trail. In accordance with the Code of Practice the tracking system must contain:

- Procedures such that contaminated materials that are not suitable for re-use do not cross contaminate the wastes that are suitable for re-use.
- Procedures to demonstrate that materials that do not require treatment and those that have had treatment (if applicable), reach their specific destination within the development site.
- Procedures such that waste for off-site disposal or treatment is properly characterised and goes to the correct facility.
- Methods of recording such that there is a clear audit trail of the use of materials. Tracking forms and drawings – e.g. loads in to stockpiles prior to re-use or stockpiled awaiting use (as appropriate)
- A system for keeping and maintaining records.
- A specified location where records will be kept (records need to be kept for at least 2 years after the completion of the works and production of the Verification Report)

A Materials Management Plan (MMP) verification report should be produced following completion of the earthworks at the site.

6.1.8 Validation Report

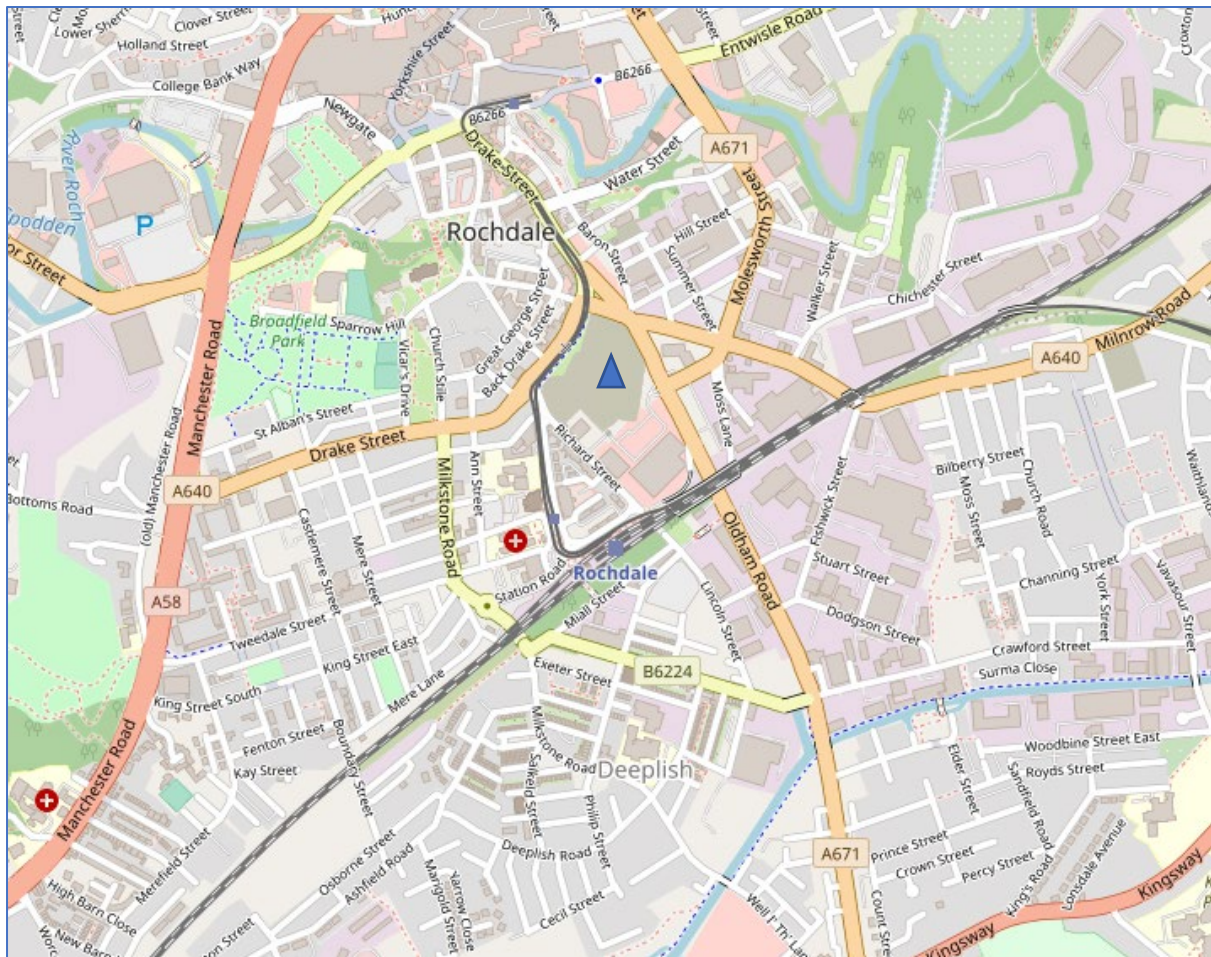
The final part of the planned validation work comprises the preparation of a report on completion of the validation works, for submission to the local authority to satisfy the planning conditions. The report will detail the remediation and validation works undertaken, present the results of analysis and lines of evidence gathered, as set out in the verification plan. Also to be included in the report are details on the presence (or absence) of any additional contamination encountered during the construction. The validation report will follow the format set out in LCRM⁸. If needed interim reports can be provided for phases of the development to allow release of properties. This will be dependent on the agreed construction programme.

References

1. Curtins, Neighbourhood, Rochdale, Phase 1 Preliminary Risk Assessment, Curtins Ref: 075882-CUR-00-XX-RP-GE-001 prepared for Willmott Dixon Construction Limited, dated 07 October 2020.
2. Neighbourhood, Rochdale, Phase 2 Ground Investigation prepared for Willmott Dixon Construction Limited, Curtins Ref: 075882-CUR-00-XX-RP-GE-001, Issue Date 23 July 2021
3. Waste Classification Letter Report prepared by Curtins (no date)
4. Enabling Works, Neighbourhood, Rochdale – Flood Risk Assessment and Drainage Strategy, prepared for Willmott Dixon Construction Limited, Curtins Ref: (075882) NHRH-CUR-00-XX-RP-C-92001, Revision V01, Issue Date 09 July 2021
5. Tier Environmental Ltd, Remediation Statement, Land at Richard Street, Rochdale, Ref: TE1583-TE-00-XX-RP-GE-002-V01, prepared for Willmott Dixon Construction Limited, dated 30/6/21
6. Revised Vision for Neighbourhood For Willmott Dixon and Rochdale Council, prepared by LeachRhodesWalker Architects Ref: LRW-8148-L(00)07F, dated 20.09.21
7. Landscape Design Document prepared by oobe for Neighbourhood Rochdale, dated January 2022 Ref:5551-OOB-XX-XX-RP-L-5000, Revision P03
8. Land Contamination Risk Management (LCRM) Guidance published by the Environment Agency dated 8th October 2020 and updated 19 April 2021 @gov.uk
9. British Standard - Topsoil Specification (BS3882), 2015
10. CARSOILTM Asbestos in Soil Guidance, 2016
11. Health and Safety Guidance Note HS(G) 150 'Health and Safety in Construction' 2006
12. Construction, Design and Management Regulations 2015
13. Health and Safety Guidance Note HS(G) 66 'The Protection of Workers and the General Public during the Development of Contaminated Land' 1991
14. Guidelines for the Safe Investigation of Landfills and Contaminated Land 1993.
15. CL:AIRE Definition of Waste: Development Industry Code of Practice (the Code of Practice)
16. CIRIA C552, Contaminated Land Risk Assessment, A Guide to Good Practice, 2001
17. BS8485: 2015+A1: 2019 British Standards Institution (2015) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
18. LK Remediate, Site Investigation for Rochdale 'Neighbourhood' prepared for Willmott Dixon Construction, Document Ref: LKR221043_SI Rev 1, Final dated 5th August 2022.

Figures

Figure 1: Site Location
Neighbourhood, Rochdale



© OpenStreetMap contributors



Site Location



boothking
PARTNERSHIP LIMITED
CONSULTING CIVIL AND STRUCTURAL ENGINEERS



GENERAL NOTES:

ALL DIMENSIONS ARE TO BE CHECKED ON SITE WITH ANY DISCREPANCIES REPORTED TO THE ARCHITECT PRIOR TO THE WORKS BEING CARRIED OUT.

ALL WORKS ARE TO BE IN ACCORDANCE WITH THE PLANNING APPROVAL AND ANY SUBSEQUENT APPROVED LOCAL AUTHORITY PLANNING CORRESPONDENCE INCLUDING DRAWINGS, DOCUMENTS AND REPORTS.

ALL WORKS ARE TO COMPLY WITH THE BUILDING REGULATIONS, BRITISH STANDARDS, CODE OF PRACTICE, AND ANY LOCAL STATUTORY REQUIREMENTS.

ALL WORKS ARE TO COMPLY WITH CURRENT HEALTH AND SAFETY LEGISLATION, H.S.E. RECOMMENDATIONS/GUIDANCE AND THE CURRENT C.D.M. REGULATIONS.

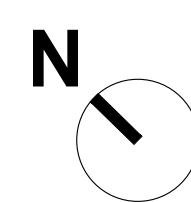
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH LEACH RHODES WALKER ARCHITECTS GENERAL ARRANGEMENT (L CODE) DRAWINGS, TOGETHER WITH RELEVANT DETAILED (A CODE) DRAWINGS AND SPECIFICATIONS.

FOR ALL STRUCTURAL WORKS REFER TO THE STRUCTURAL ENGINEERS INFORMATION.

FOR ALL MECHANICAL AND ELECTRICAL WORKS REFER TO THE MECHANICAL AND ELECTRICAL ENGINEERS INFORMATION.

FOR ALL ABOVE GROUND DRAINAGE WORKS REFER TO THE PUBLIC HEALTH ENGINEERS INFORMATION.

ALL PRODUCTS SPECIFIED ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS, SPECIFICATION AND DETAILS.



House Types

- 2 Bed 3 Person
- 3 Bed 4 Person
- 4 Bed 6 Person

Application Boundary

Total Apartments: 142
Total Houses: 81
Total Car Spaces: 108
Visitors Spaces: 27
Accessible: 6

P10FOR PLANNING	KM	CJG	22.04.22
P14FOR PLANNING	KM	CJG	22.04.22
P13LANDSCAPE AND HIGHWAYS	KM	CJG	19.07.22
P12CHANGES TO RED LINE, BOUNDARY TREATMENTS, LANDSCAPE AND HIGHWAYS JUNCTIONS & PAVEMENTS	KM	CJG	04.07.22
P11REVISED EDGE RED, CHANGES TO PARKING LAYOUT	KM	CJG	16.06.22
P10REVISED UNIT MIX AND HOUSE WIDTHS, BOUNDARY AND LEVELS, AMENDMENTS TO HIGHWAYS, ROADS AND PAVEMENTS	KM	CJG	13.06.22
P09REVISED UNIT MIX AND LAYOUT, BOUNDARY TREATMENTS AMENDED PARKING AMENDED	DL	CJG	31.05.22
P08WIDENING OF HOUSE TYPES (INCREASED WALL THICKNESS), REVISED UNIT MIX, SHAP HOUSES TO FRONT ENTRANCE ROAD INTO SITE	KM	CJG	24.05.22
P07PROPOSED LEVELS & ADDED	DL	CJG	11.05.22
P06HIGHWAYS AMENDMENTS	KM	CJG	11.05.22
P05REFUSE BINS, ROAD PAVEMENT/ TERRACE WIDTHS, LANDSCAPE	KM	CJG	10.05.22
P04WIP DRAFT ISSUE	KM	CJG	05.05.22
P03ISSUE FOR MEETING	KM	CJG	25.04.22
P02ISSUE FOR DTM	KM	CJG	25.04.22
P01DRAFT ISSUE FOR COMMENTS	KM	CJG	19.04.22

DO NOT SCALE OFF THIS DRAWING

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LeachRhodesWalker Architects

info@lrw.co.uk | www.lrw.co.uk
50 Deansfield Place Manchester M3 8LH

Manchester London Buchanan
+44 (0)161 633 0211 +44 (0)207 760 1363 +44 (0)121 850 4026

Project
ROCHDALE

Proposed title
ORRD-LRW-ZZ-ZZ-DR-A-00007

Scale project no
8148

Scale
1:500 @ A1

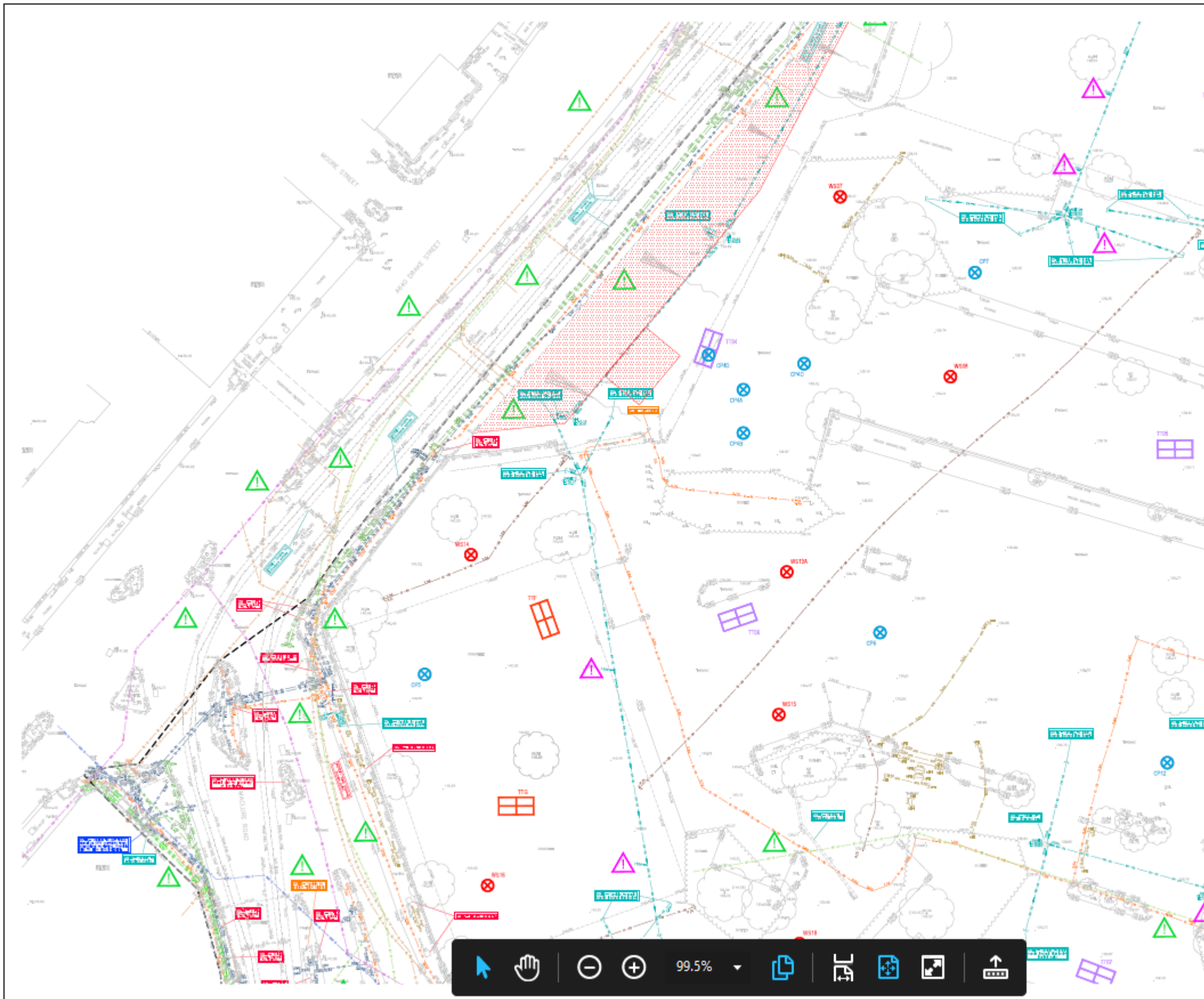
Date drawn
19.04.22

Scale
1:500 @ A1

Scale
1:500 @ A1

Appendix 1

Curtins Exploratory Hole Location Plan



GENERAL NOTES:

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3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. FOR GENERAL NOTES REFER TO DRAWING.

LEGEND:

- WS: DEVOTES WINDOW SAMPLE BOREHOLES UP TO 5.0m BGL
- CP: DEVOTES CABLE PERCUSSION BOREHOLES UP TO 30m BGL
- H: DEVOTES HAND EXCAVATED PIT TO 1.2m BGL
- TT1-TT18: DEVOTES TRIAL TRENCHES UP TO 3.0m BGL TO RECORD GROUND FLOOR SLAB THICKNESS AND INSPECT EXISTING FOUNDATIONS
- TT19-TT20: DEVOTES TRIAL TRENCHES UP TO 3.0m BGL TO LOCATE CANAL WALLS. REFER TO LOSS T19M TO T19M FOR EXTENT OF T19M TRIAL TRENCH. T20M TO T20M FOR T20M EXTENT AND T20M TO T20M FOR T20M EXTENT
- B: DEVOTES BOUNDARY
- AREA OF HIGH BOUNDARY INTO THE SITE

Rev	Description	Date	By	Check
V01	UPDATED TO INCLUDE ADDITIONAL / MOVED EXPLORATORY HOLE LOCATIONS	15/03/21	ND	SH
V02	ISSUED FOR INFORMATION	15/03/21	ND	SH

Currys
Market Research, 1700 Wilton Road, London, SE10 2DQ
020 725 1234
www.currys.co.uk

SUITABLE FOR INFORMATION **S2**

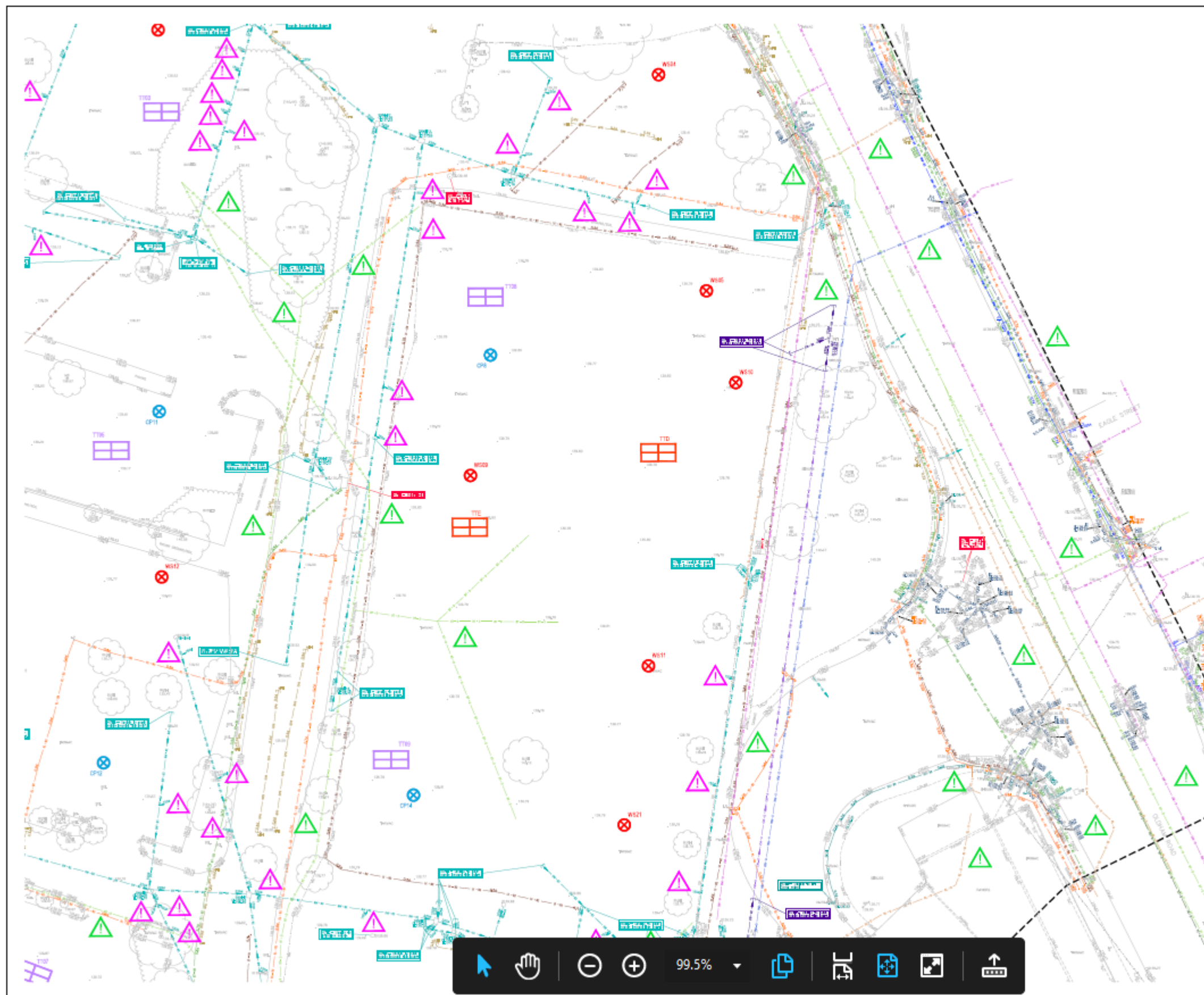
NEIGHBOURHOOD, ROCHDALE

PROPOSED EXPLORATORY HOLE LOCATION PLAN SHEET 2

Rev	Date	Quantity	Created By	Checked By
AT	15/03/21		N. HILL	S. HIDE

Scale: 1:200

Property	Original	Issue	Level	Type	Risk	Category/Function	Rev
075882 - CUR - 00 - XX - DR - GE -						005	V03



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3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
4. FOR GENERAL NOTES REFER TO DRAWING.

WS DEVOTES WINDOW SAMPLE BOREHOLES UP TO 0.45m BGL
 CP DEVOTES CABLE PERCUSSION BOREHOLES UP TO 30m BGL
 HC DEVOTES HAND EXCAVATED PIT TO 1.20m BGL
 TTD DEVOTES TRIAL TRENCHES UP TO 0.45m BGL TO RECORD GROUND FLOOR SLAB THICKNESS AND SUPPORT EXISTING FOUNDATIONS
 TTD DEVOTES TRIAL TRENCHES UP TO 0.45m BGL TO LOCATE CANAL WALLS. REFER TO LOSS TRENCH TO TRENCH FOR EXTENT OF TTD TRIAL TRENCH. TTD TO TTD FOR TTD EXTENT AND TTD TO TTD FOR TTD EXTENT
 SAK DEVOTES SOAKAWAY
 DEVOTES AREA OF TTD BOUNDARY INTO THE SITE

REV	DESCRIPTION	DATE	BY	CHECKED
1	ISSUED FOR INFORMATION	15/02/21	N/A	SH
2	ISSUED FOR INFORMATION	15/02/21	N/A	SH

curtins
 Market Strategy, 17/18 Wilbur Street, Rochdale, M20 2PL
 0161 224 1234
 rochdale@curtins.com
 www.curtins.com

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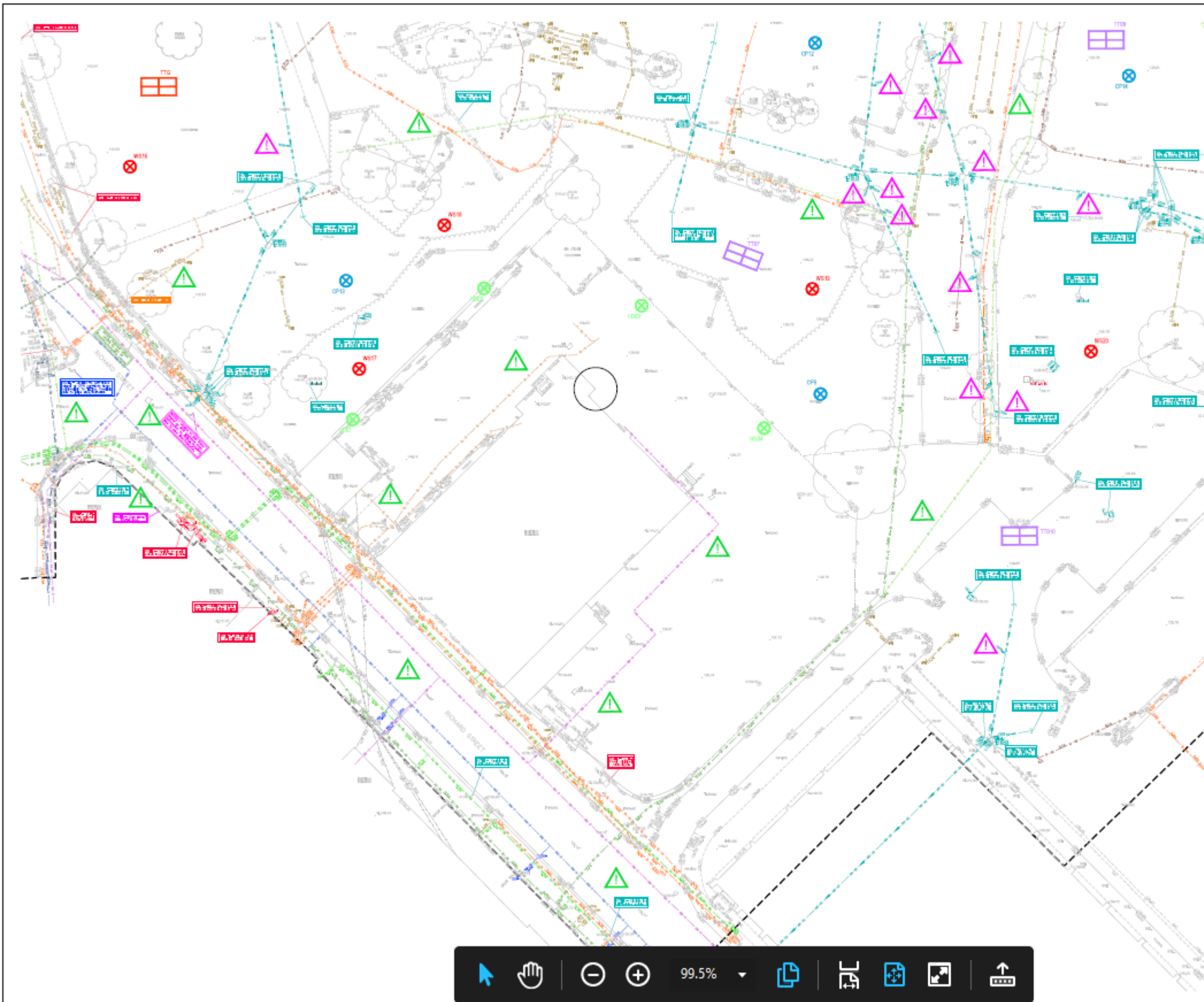
NEIGHBOURHOOD, ROCHDALE

PROPOSED EXPLORATORY HOLE LOCATION PLAN SHEET 3

REV	DATE	DESIGNED BY	CHECKED BY	APPROVED BY
1	15/02/21	N/A	N/A	N/A

Scale: 1:200

Project: 075882 - CUR - 00 - XX - DR - GE - 006 - V03



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3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
4. FOR GENERAL NOTES REFER TO DRAWING.

WSH DENOTES WINDOW SAMPLE BOREHOLES UP TO 545m BGL

CP DENOTES CABLE PERCUSSION BOREHOLES UP TO 30m BGL

HD DENOTES HAND EXCAVATED PIT TO 10m BGL

TTT+TTD DENOTES TRENCHES UP TO 15m BGL TO RECORD GROUND FLOOR SLAB THICKNESS AND INSPECT EXISTING FOUNDATIONS

TTT+TTD DENOTES TRENCHES UP TO 15m BGL TO LOCATE CANAL WALLS. REFER TO LOSS TITM TO TTRF FOR EXTENT OF TRENCH. TITM TO TTRF FOR TTRF EXTENT AND TITM TO TTRF FOR TTRF EXTENT

SADW DENOTES SCAVENGEWAY

Denotes AREA OF HIGH BOUNDARY INTO THE SITE

NO	UPDATED TO INCLUDE ADDITIONAL / MOVED EXPLORATORY HOLES FOLLOWING WORKS	05/02/21	NO	SH
NO	ISSUED FOR INFORMATION	15/02/21	NO	SH
Rev	Description	Date	By	Draw

Urban Strategy, Urban Design, Architecture, Landscape Architecture, Engineering, Planning, Project Management, Construction Management, Environmental Management, Heritage Management, Infrastructure Management, Transport Management, Water Management, Waste Management, Energy Management, Health and Safety Management, Information Management, Quality Management, Risk Management, Sustainability Management, Social Management, Cultural Management, Creative Management, Digital Management, Data Management, Analytics Management, Artificial Intelligence Management, Blockchain Management, Cloud Management, Cybersecurity Management, IoT Management, Robotics Management, Automation Management, AI Management, VR Management, AR Management, MR Management, XR Management, Extended Reality Management, Immersive Management, Virtual Management, Augmented Management, Mixed Management, Reality Management, Digital Management, Data Management, Analytics Management, Artificial Intelligence Management, Blockchain Management, Cloud Management, Cybersecurity Management, IoT Management, Robotics Management, Automation Management, AI Management, VR Management, AR Management, MR Management, XR Management, Extended Reality Management, Immersive Management, Virtual Management, Augmented Management, Mixed Management, Reality Management

SUITABLE FOR INFORMATION

NEIGHBOURHOOD, ROCHDALE

PROPOSED EXPLORATORY HOLE LOCATION PLAN SHEET 4

Rev	Date	Drawn By	Designed By	Checked By
01	15/02/21	N. HILL	S. HIND	S. HIND
Scale	1:200	Original	Scale	Scale
Project No	075882 - CUR - 00 - XX - DR - GE - 007 - V03	Level	Type	File

Appendix 2

Revised Conceptual Site Model by Curtins

Phase 2 Ground Investigation

Qualitative Risk Assessment

Generic Quantitative Risk Assessment

Detailed Quantitative Risk Assessment or Remedial Action

- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data, a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Generic Qualitative Risk Assessment			Comments	Action
Identified Source	Pathway(s)	Receptor(s)	Consequence	Likelihood of Occurrence	Risk Rating		
Limited significant sources of contamination identified during the ground investigation. Made Ground was encountered typically 1.5-3m thick, with 6m encountered in CP02 in the northern area. Table 5.7 details the exploratory holes that recorded Made Ground with ash and clinker gravel, natural organic-rich soils, or Made Ground soils with a hydrocarbon odour. Made Ground soils across the site were recorded to contain anthropogenic material such as concrete, brick, slate, wood, ash, clinker, glass and rare coal, plastic and metal	Direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation (indoor & outdoor air)	Site end users (Residential with private gardens)	Medium Human Health Risk	Likely	Moderate	Comparison of the shallow soil results has recorded elevated concentrations of Arsenic, Lead, Zinc, TPHs and PAHs above <i>Residential with home grown produce</i> in sixteen Made Ground samples of thirty-five samples tested in the area of the proposed low-rise housing. Elevated concentrations of VOCs above the limit of detection were also recorded in the seven of the ten Made Ground soil samples tested. Nine Made Ground soil samples recorded Chrysotile and/or Amosite asbestos (loose fibres), with four of these recording 0.001-0.026%	Suitable thickness of clean and inert capping in all private gardens and areas of soft landscaping, underlain with a geotextile membrane to break the source-pathway-receptor link. Picking of Asbestos Containing Materials as part of enabling works. Contractors should have an Asbestos Management Plan in place to include appropriate health & safety and environmental precautions during groundworks.
		Site end users (Residential apartments)		Likely	Moderate	Comparison of the shallow soil results has recorded elevated concentrations of Arsenic, Lead, TPHs and PAHs above <i>Residential without home grown produce</i> in ten Made Ground samples of twenty-eight samples tested in the area of the apartments. Elevated concentrations of SVOCs above the limit of detection were also recorded in the three Made Ground soil samples tested. Seven Made Ground soil samples recorded Chrysotile asbestos (loose fibres), with one recording 0.002%. While Chrysotile cement type material (0.312%) was recorded in one location.	Suitable thickness of clean and inert capping in all areas of soft landscaping, underlain with a geotextile membrane to break the source-pathway-receptor link. Picking of Asbestos Containing Materials as part of enabling works. Contractors should have an Asbestos Management Plan in place to include appropriate health & safety and environmental precautions during groundworks.
	Soil dust ingestion/inhalation produced during construction	Construction and maintenance workers	Medium	Low Likelihood (Standard Health & Safety precaution likely to be used by workers)	Moderate / Low	Made Ground soils across the site have elevated concentrations of metals, TPHs and PAHs. Hydrocarbon odours were observed as detailed in the exploratory hole logs. Of the sixty-three Made Ground soil samples tested, sixteen positively identified asbestos fibres with five recording 0.001-0.026%. ACM was positively identified in one soil sample.	Picking of Asbestos Containing Materials as part of enabling works. Contractors should have an Asbestos Management Plan in place to include appropriate health & safety and environmental precautions during groundworks.
	Vertical and horizontal migration of soluble phase contamination through superficial deposits and bedrock.	Controlled Waters (Groundwater) Secondary A Aquifer in Glaciofluvial and Alluvium Deposits, underlain by Secondary Undifferentiated Aquifer in Glacial Till.		Unlikely	Low	No evidence of free product or gross contamination was evident during the ground investigation. No potable groundwater abstraction points or SPZ within 1km. Samples of groundwater collected from the Cable Percussion boreholes installed within the natural superficial strata record only slightly elevated concentrations of sulphate and nickel when compared against the Drinking Water Standards.	No further action required.
	Vertical and horizontal migration of soluble phase contamination through groundwater.	Controlled Waters (Surface Water) Nearest surface water feature is River Roch 221m north with River Quality C. No abstraction points within 1km.		Unlikely	Low	No evidence of free product or gross contamination was evident during the ground investigation. Significant distance to nearest surface water feature. No surface water abstraction points within 1km.	

Identified Source	Conceptual Site Model		Generic Qualitative Risk Assessment			Comments	Action
	Pathway(s)	Receptor(s)	Consequence	Likelihood of Occurrence	Risk Rating		
Potential ground gas generation from Made Ground containing organic/putrescible content on site and off site. Peat recorded in WS02 and TT01, while organic-rich superficial soils were recorded in eleven other exploratory holes, mainly on the western side of the site, and WS11 and WS21 on the eastern side.	Ground gas & vapour migration and Inhalation. Vertical and horizontal migration through existing service corridors and the underlying superficial deposits.	Site end users (Residential apartments and Low Rise Residential Housing)	Medium Human Health Risk	Low likelihood	Moderate/Low	Elevated carbon dioxide concentrations (>5.0% v/v) recorded in WS07, WS09, WS11 and WS19 during monitoring period. Methane concentrations recorded below limit of detection throughout monitoring period, except for WS07 on visits 2 (0.2% v/v) and 4 (0.4% v/v). Steady state air flow rates of <0.1 l/hr recorded in all monitoring wells throughout the monitoring period. Monitoring data obtained prior to earthworks on site. Changes to the gas regime of the site may occur following completion of earthworks. Preliminary Characteristic Situation Zoning Plan included in Appendix A.	Allowance for CS-2 protection measures in line with BS8485 guidance in selected areas. Refer to Preliminary Characteristic Situation Zoning Plan (Appendix A) for locations where protection measures are required. Required protection can be achieved with appropriately detailed reinforced concrete ground slabs and the provision of an appropriate gas resistant membrane. Risk assessment to be updated following completion of a post-Enabling Works ground gas monitoring programme.

Appendix 3

Curtins Adopted Soil Generic Assessment Criteria

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM



Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POB _{adj}	Public park POB _{adj}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10 ¹² 22	85 ¹² 150	1.8 2.2	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 21	6 21	1.8 170	33 40	7.7 21	220 250
Lead	200	310	80	2,300	530	1,300
Mercury (elemental)	1	1	26	26	16	26 ¹³ [30]
Mercury (inorganic)	170	240	90	3600	120	240
Nickel	130 ¹²	180 ¹²	53 ¹¹	980 ¹²	230	800
Vanadium	410	1,200	91	9000	2000	5000
Copper	2400	7100	520	63000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32 ¹² 37	35 ¹² 40	43 ¹² 40	640 ¹² 640	79 79	170 170
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk-banded hydrocarbons - TRHCWG method						
EC ₁₆ - EC ₂	42	42	730	3200	570000	95000
EC ₂ - EC ₉	100	100	2300	7800	600000	150000
EC ₉ - EC ₁₀	27	27	320	2000	13000	14000
EC ₁₀ - EC ₁₂	130	130	2200	9700	13000	21000
EC ₁₂ - EC ₁₅	1100	1100	11000	59000	13000	25000
EC ₁₅ - EC ₂₈	65000	65000	250000	1600000	250000	450000
EC ₂₈ - EC ₄₄	65000	65000	250000	1600000	250000	450000
Aromatic risk-banded hydrocarbons - TRHCWG method						
EC ₂₉ - EC ₇	70	370	13	26000	56000	76000
EC ₇ - EC ₉	130	860	22	56000	56000	87000
EC ₉ - EC ₁₀	34	47	8.5	3500	5000	7200
EC ₁₀ - EC ₁₂	74	250	13	16000	5000	9200
EC ₁₂ - EC ₁₅	140	1800	23	36000	5100	10000
EC ₁₅ - EC ₂₁	260	1900	45	28000	3800	7600
EC ₂₁ - EC ₂₈	1100	1900	370	28000	3800	7800
EC ₂₈ - EC ₄₄	1100	1900	370	28000	3800	7800
Aliph + Arom EC >44-70	1600	1900	1200	28000	3800	7800
Aromatic						
Benzene	0.08	0.3	0.017	28	72	90
Ethyl benzene	65	170	16	520 ¹³ [17000]	520 ¹³ [24000]	520 ¹³ [17000]
Toluene	120	610	22	860 ¹³ [59000]	860 ¹³ [56000]	860 ¹³ [87000]
Xylenes ¹⁴	41	53	28	480 ¹³ [59000]	480 ¹³ [10000]	480 ¹³ [17000]
Phenol	180	310	66	760 ¹⁴ [31000]	760 ¹⁴ [10000]	760 ¹⁴ [7600]
Polyaromatic Hydrocarbons (PAH)						
Naphthalene	2.3	2.3	4.1	190	4900	1200
Acenaphthylene	170	2900	28	83000	15000	29000
Acenaphthene	210	3000	34	84000	15000	29000
Fluorene	170	2800	27	63000	9900	20000
Phenanthrene	95	1300	15	22000	3100	6200
Anthracene	2400	31000	380	520000	74000	150000
Fluoranthene	280	1500	52	23000	3100	6300
Pyrene	620	3700	110	54000	7400	15000
Benz(a)anthracene	7.2	11	2.9	170	29	49
Chrysene	15	30	4.1	350	57	93
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1	13
Benzo(k)fluoranthene	77	110	37	1200	190	370
Benzo(a)pyrene	2.2	3.2	0.97	35	5.7	11
Indeno(1,2,3cd)pyrene	27	45	9.5	500	82	150
Dibenz(a,h)anthracene	0.24	0.31	0.14	3.5	0.57	1.1
Benzo(ghi)perylene	320	360	290	3900	640	1400
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00064	0.00077	0.00055	0.059	3.5	4.8
Trichloroethene (TCE)	0.016	0.017	0.041	1.2	120	70
1,1,1,2-Tetrachloroethane	1.2	1.5	0.79	110	1400	1500
Tetrachloroethene (PCE)	0.18	0.18	0.65	19	1400	810
1,1,1-Trichloroethane	8.8	9	4.8	660	140000	57000

- Notes**
- All values above are in mg/kg
 - Numbers in bold are SQVs or GAC that are derived based on SQV report input parameters, numbers in *italics* are *SHLs*, numbers in ***bold-italics*** are based on *ECI/SGS/CLARE* numbers & input parameters and *predicted numbers are CGLs*
 - Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
 - Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
 - For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalow change to more conservative bungalow setting in computer model
 - For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, with living space changes setting in model accordingly
 - For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLIA 1.04 model from 50 to 100µg m⁻²
 - Based on vapour extraction limit as suggested by EA/[] model values
 - Lowest of o-, m- and p-xylene
 - Based on comparison of inhalation exposure with inhalation TDI
 - Based on comparison of oral, dermal, and inhalation exposures with the oral TDI
 - Based on a comparison of oral and dermal exposures with oral TDI (see only)
 - As
 - As
 - NA



Appendix 4

Enabling Works Summary Drawings

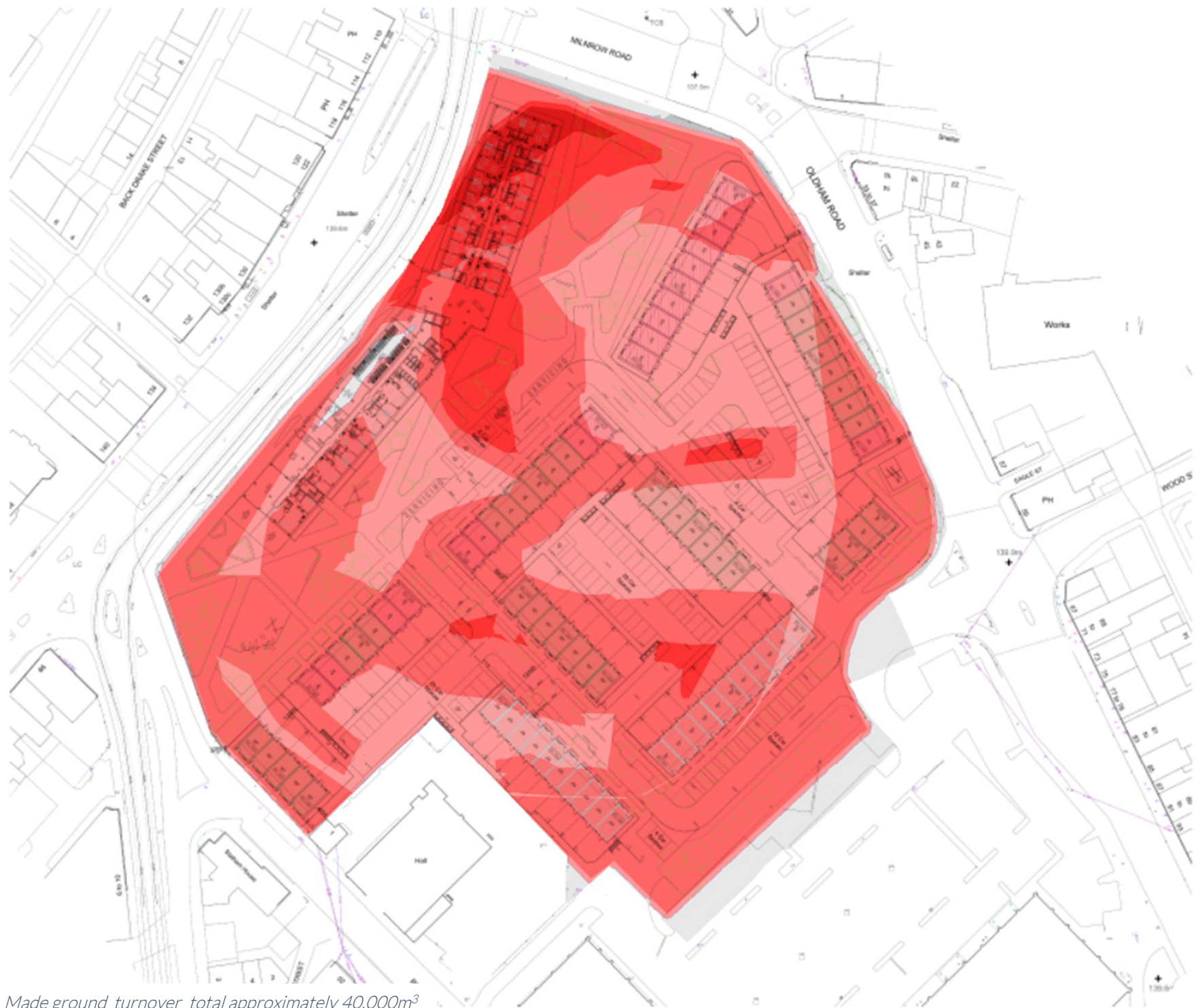


Figure 1 Made ground turnover total approximately 40,000m³

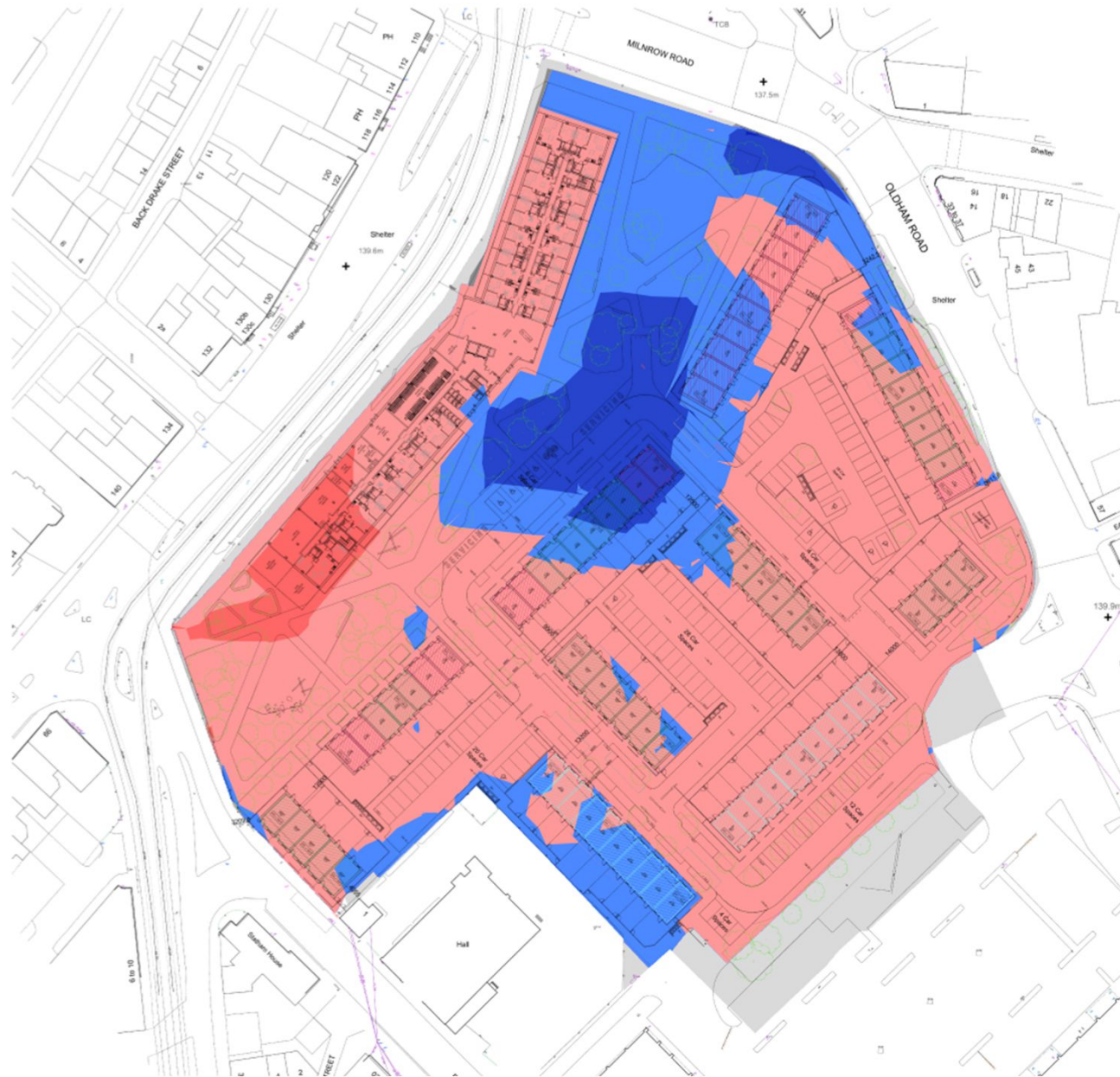


Figure 2 Cut/fill modelling to reduced levels shows a surplus of circa 5,300m³. LK Remediate will offset this by generating materials suitable for re-use above reduced levels.



Figure 3: Lift hardstanding and slabs to stockpile, circa 2,900m³.



Figure 4: Strip sub-base and break out relic foundations to stockpiles, circa 6,200m³.



Figure 5: Construction of 600mm piling mats using circa 5,050m³ site-generated aggregates.

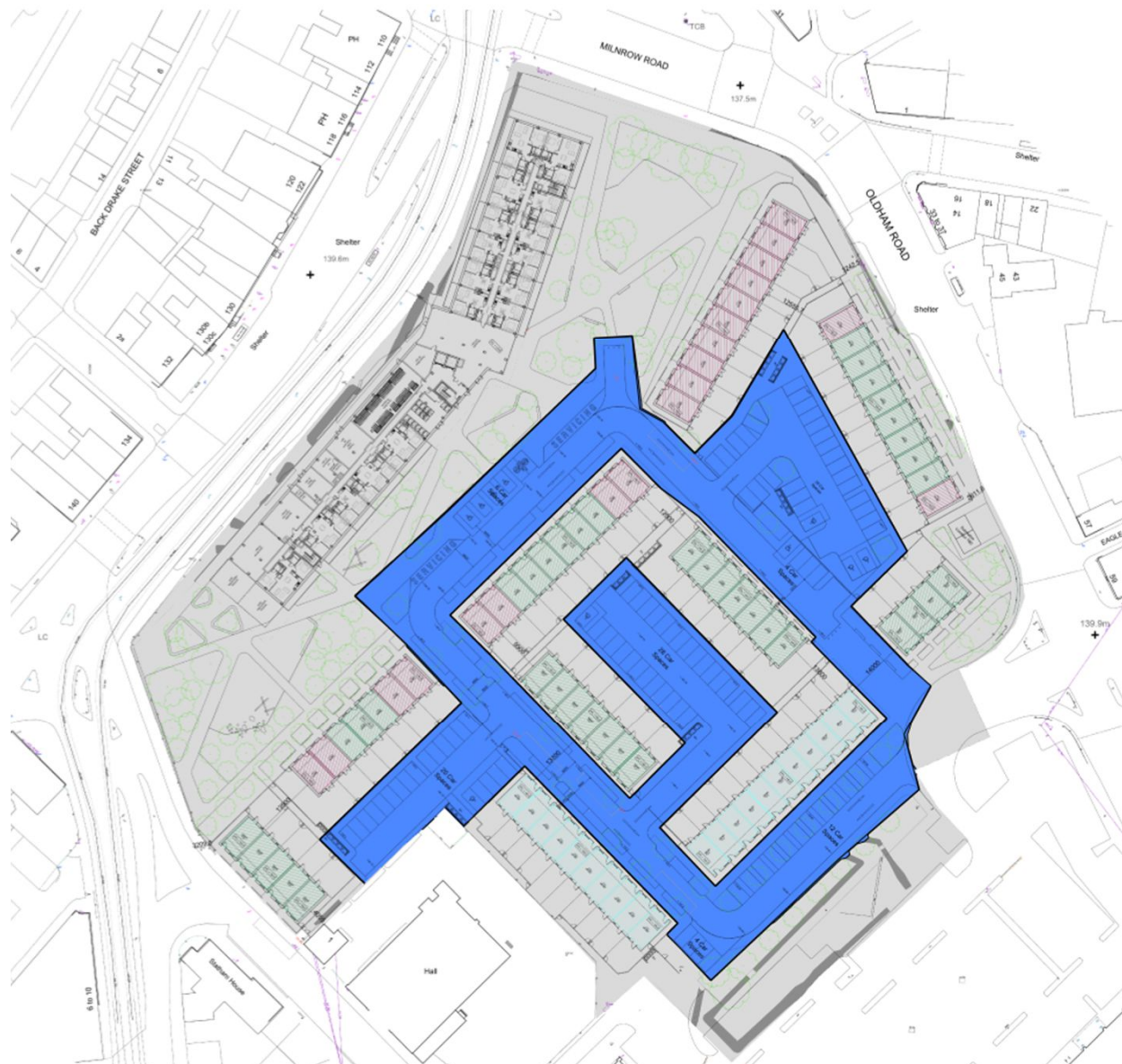


Figure 6: Approximately 1,700m³ of site-generated aggregates will be needed to bring road footprints to 470mm below finished road level.

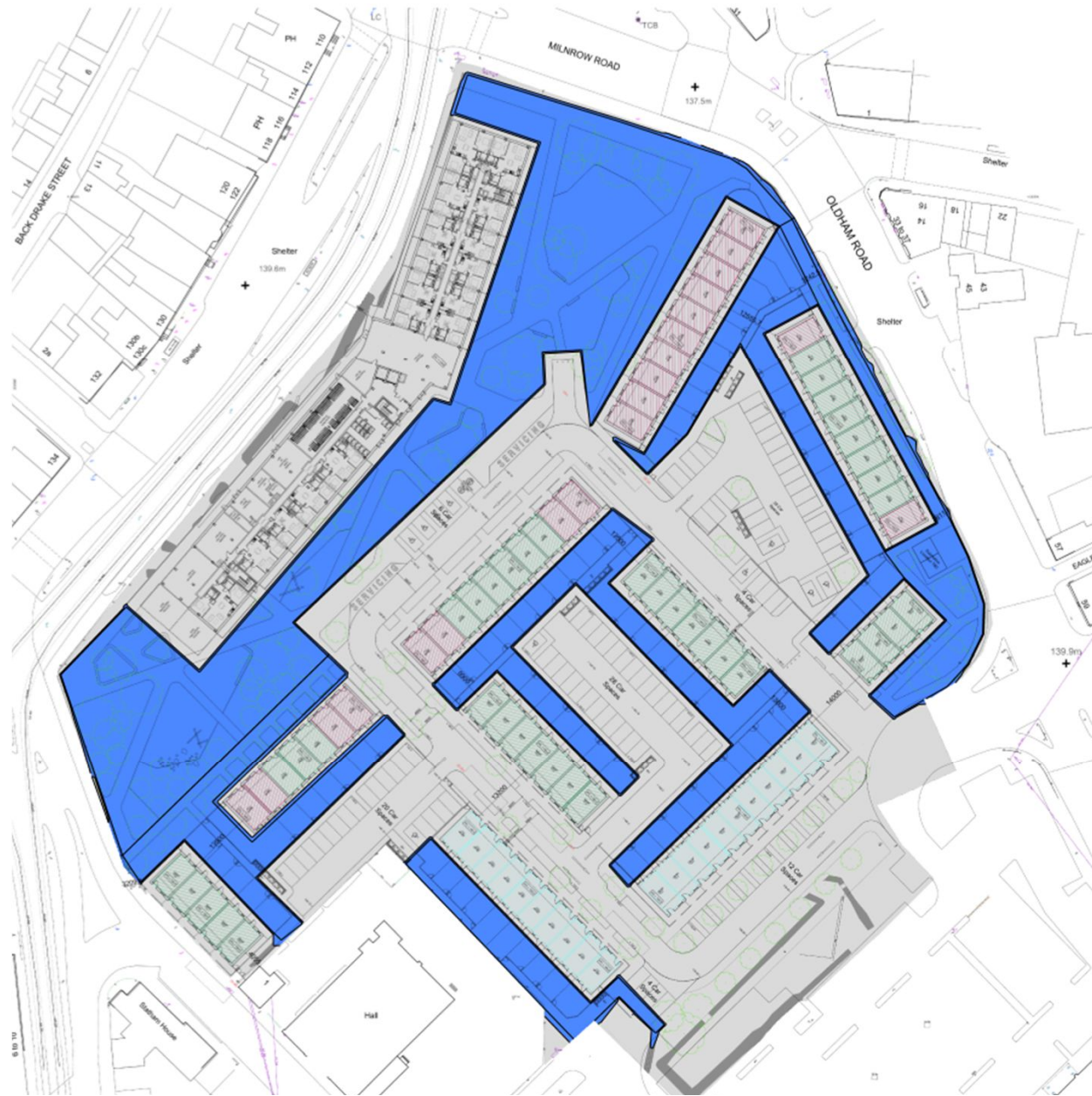


Figure 7: Approximately 4,000m³ of site-generated subsoil would be needed for placement in rear gardens and soft landscaping. The volume to be temporarily stockpiled, stockpile locations and areas to be left low for construction arisings are to be agreed upon with the construction team.

Appendix 5

Re-use and Acceptance Criteria

Neighbourhood, Rochdale

Table A5.1 - Soil Acceptance Criteria for Soils to be Used in Cover Layer

(Imported Soil or Site Won Soils)

Determinant	Acceptance Criteria (mg/kg) Residential wHP ^a	Acceptance Criteria (mg/kg) Residential woHP ^b	Acceptance Criteria (mg/kg) POS ^{resi} ^c	Source
Asbestos	Not Detected	Not Detected	Not Detected	
Metals and Metalloids				
Arsenic	37	40	79	DEFRA C4SLs
Barium	-	1300	-	CL:AIRE (2010)
Beryllium	1.7	1.7	2.2	LQM/CIEH S4UL
Boron	290	11000	21000	LQM/CIEH S4UL
Cadmium	22	150	220	DEFRA C4UL
Chromium (III)	910	910	1500	LQM/CIEH S4UL
Chromium (VI)	21	21	21	DEFRA C4SL
Copper	2400	7100	12000	LQM/CIEH S4UL
Lead	200	310	630	DEFRA C4SLs
Mercury – Elemental	1.2	1.2	16	LQM/CIEH S4UL
Mercury – Inorganic	40	56	120	LQM/CIEH S4UL
Mercury – Methyl	11	15	40	LQM/CIEH S4UL
Nickel	180	180	230	LQM/CIEH S4UL
Selenium	250	430	1100	LQM/CIEH S4UL
Vanadium	410	1200	2000	LQM/CIEH S4UL
Zinc	3700	40000	81000	LQM/CIEH S4UL
Polyaromatic Hydrocarbons (USEPA 16) – At 1% Soil Organic Matter				
Acenaphthene	210	3000 (57.0) ^{sol}	15000	LQM/CIEH S4UL
Acenaphthylene	170	2900 (86.1) ^{sol}	15000	LQM/CIEH S4UL
Anthracene	2400	31000 (1.17) ^{vap}	74000	LQM/CIEH S4UL
Benzo(a)anthracene	7.2	11	29	LQM/CIEH S4UL
Benzo(a)pyrene	5.0	5.3	10	DEFRA C4SL
Benzo(b)fluoranthene	2.6	3.9	7.1	LQM/CIEH S4UL
Benzo(ghi)perylene	320	360	640	LQM/CIEH S4UL
Benzo(k)fluoranthene	77	110	190	LQM/CIEH S4UL
Chrysene	15	30	57	LQM/CIEH S4UL
Di-benzo(a,h)anthracene	0.24	0.31	0.57	LQM/CIEH S4UL
Fluoranthene	280	1500	3100	LQM/CIEH S4UL
Fluorene	170	2800 (30.9) ^{sol}	9900	LQM/CIEH S4UL
Indeno(1,2,3-cd)pyrene	27	45	82	LQM/CIEH S4UL
Naphthalene	2.3	2.3	4900	LQM/CIEH S4UL
Phenanthrene	95	1300 (36.0) ^{sol}	3100	LQM/CIEH S4UL
Pyrene	620	3700	7400	LQM/CIEH S4UL
BTEX - At 1% Soil Organic Matter				
Benzene	0.87	3.3	140	DEFRA C4SL
Toluene	130	880 ^{vap}	56000	LQM/CIEH S4UL
Ethylbenzene	47	83	24000	LQM/CIEH S4UL
Xylenes ^f	56	79	41000	LQM/CIEH S4UL
Total Petroleum Hydrocarbons (LQM Banding) – At 1% Soil Organic Matter				
Aliphatic EC5 – EC6	42	42	570000(304) ^{sol}	LQM/CIEH S4UL
Aliphatic >EC6 – EC8	100	100	600000	LQM/CIEH S4UL
Aliphatic >EC8 – EC10	27	27	13000	LQM/CIEH S4UL

Aliphatic >EC10 – EC12	130 (48) ^{vap}	130 (48) ^{vap}	13000	LQM/CIEH S4UL
Aliphatic >EC12 – EC16	1100 (24) ^{sol}	1100 (24) ^{sol}	13000	LQM/CIEH S4UL
Aliphatic >EC16 – EC35	65000 (8.48) ^{sol}	65000 (8.48) ^{sol}	250000 ^g	LQM/CIEH S4UL
Aliphatic EC35 – EC44	65000 (8.48) ^{sol}	65000 (8.48) ^{sol}	250000 ^g	LQM/CIEH S4UL
Aromatic EC5 – EC7	70	370	56000	LQM/CIEH S4UL
Aromatic >EC7 – EC8	130	860	56000	LQM/CIEH S4UL
Aromatic >EC8 – EC10	34	47	5000	LQM/CIEH S4UL
Aromatic >EC10 – EC12	74	250	5000	LQM/CIEH S4UL
Aromatic >EC12 – EC16	140	1800	5100	LQM/CIEH S4UL
Aromatic >EC16 – EC21	260	1900	3800 ^g	LQM/CIEH S4UL
Aromatic >EC21 – EC35	1100	1900	3800 ^g	LQM/CIEH S4UL
Aromatic >EC35 – EC44	1100	1900	3800 ^g	LQM/CIEH S4UL
Other (at 1% SOM)				
Phenol	280	750	760 ^{dir h}	LQM/CIEH S4UL
Vinyl Chloride	0.0064	0.015	7.8	DEFRA C4SL
Trichloroethene (TCE)	0.0093	0.0097	76	DEFRA C4SL
Tetrachloroethene (PCE)	0.31	0.32	3,200	DEFRA C4SL
1,2-Dichloroethane	0.11	0.16	300	DEFRA C4SL

*To be agreed with the Planning Authority

LQM/CIEH (2015) S4UL – Nathanial, C.P. et al (2015), The LQM/CIEH S4ULs for Human Health Risk Assessment Land Quality Press, Nottingham.

DEFRA C4SL Category 4 Screening Levels, SP1010, Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document, Dec 2014

- a. RwHP = Residential with homegrown produce
- b. RwoHP = Residential land use without homegrown produce
- c. POS_{resi} = Public Open Space near residential housing
- d. Sol – Generic Assessment Criteria (GAC) exceed the solubility saturation limit which is presented in brackets
- e. Vap - GAC exceed the vapour saturation limit which is presented in brackets
- f. Xylenes – Most health protective value of o-xylene, m-xylene and p-xylene selected
- g. Oral, dermal and inhalation exposure compared with oral HCV
- h. S4ULs based on a threshold protective of direct skin contact with phenol

Remedial Criteria for Soils Excavated and Re-Used Below Formation Level

In accordance with Section 6.1.3 of the Remediation Strategy, soils to be re-used are to be sampled and tested either in-situ ahead of the works or from stockpiles during excavation and processing of soils.

The Contractor is to determine a suitable and representative sampling frequency based on the volumes of soils/ground materials to be excavated and re-used as part of the enabling works and cut and fill operation. Samples will be tested (as a minimum) for pH, metals, PAHs, TPH, sulphate, sulphide, cyanide and asbestos (screening, identification and quantification). The sampling and testing frequency and suite of analysis will be detailed in the MMP to be produced by the Contractor.

The criteria for soils to be re-used below the formation level comprise:

- a) Removal (as far is practicable) of any visible asbestos containing material, if excavated materials are to be mechanically screened and/or crushed (this is to prevent any further contamination of ground materials by asbestos fibres). This should form part of the asbestos management plan to be implemented at the site by the remedial/enabling works contractor. Asbestos containing materials also to be removed from the site surface to prevent crushing by machinery tracking across the site and fibres being spread across the site.

Soil asbestos fibre concentration will not be greater than 0.1% w/w unless the contractor demonstrates through further risk assessment that such soils are suitable for use below the recommended simple cover system (i.e. break layer with 600mm clean soils (as per above Table A5.1) in garden areas or 300mm clean soils in landscaped areas).

- b) The concentration of the inorganic Contaminants of Concern (CoC) in the Made Ground (including PAHs and heavy metals) to be statistically within the range of the currently recorded concentrations as detailed in the Curtins Site Investigation Report. Identification of higher concentrations of these contaminants does not necessarily preclude the use of the soils but additional testing and assessment may need to be undertaken by the Contractor in accordance with the Contractors Discovery Strategy and MMP to demonstrate materials are suitable for re-use below buildings/hardcover/clean cover layer.
- c) For TPH, Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) the concentration in soils needs to be below the assessment criteria as listed in Curtins SI Report:
 - For areas below the apartment blocks this is 'Residential without home grown produce' end use thresholds (GAC) as listed in Section 7.2 of the Curtins Phase 2 Report
 - For areas below low rising housing with private gardens this is 'Residential with home grown produce' end use thresholds (GAC), as listed in Section 7.3 of the Curtins Phase 2 Report.
 - For Public Open Space (POS) the criteria for POS as stated in Table A5.1 above

NB. The reason for this is that the current Remedial Strategy only breaks the direct contact pathways and does not mitigate for indirect inhalation of soil vapour.