

Intended for
First Street (Developments) Limited

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PLOT 9 FIRST STREET, MANCHESTER

CONTAMINATED LAND DESK STUDY



Revision History

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1 INTRODUCTION

Ask (First Street) Ltd has appointed Ramboll UK Ltd for contaminated land and geotechnical services in relation to the development of Plot 9, First Street, Manchester. Plot 9 is part of a larger parcel of land formerly referred to as Plot 6/7. The new site boundary is an extension to the site area previously referred to as plot 9A. A site plan showing the current proposed planning application boundary is provided as Fig. 1 showing the current red line boundary and former proposed development areas.

This Contaminated Land Desk Study is an update to the desk studies previously prepared by Ramboll for the larger parcel of land (Plot 6/7) in 2017 (Ramboll (2017) *Contaminated Land Desk Study – Plot 6/7 First Street*, Ref.: 1620002943_CLDS_01, 24th February 2017) and Plot 9a (Ramboll (2018) *Contaminated Land Desk Study – Plot 9a First Street*, Ref.: 1620002943-RAM-05-XX-RP-Y-00001). It relates only to the western half of the former plot 6/7 site, reflecting the updated red line boundary, and has been updated with information from ground investigations that have been undertaken over the intervening period.

The former desk study (Ramboll, 2017) was itself written as an addendum to an earlier desk study report (Cundall, January 2016) and was followed by ground investigations undertaken in July 2016 by Cundall. However, the proposed end use for the site had changed since the preparation of these previous reports from public open space to a commercial office development. Since the issue of the previous desk study (Ramboll, 2017) plans for the proposed development have been revised further and now comprise a 10-storey building for office / commercial space with basement car parking, and external areas of hard landscaping.

Due to the changed end use proposals, the risk assessment and conclusion of the Cundall desk study report required updating for submission with the new planning application, and the previously issued *Contaminated Land Desk Study* (Ramboll, 2017) was therefore intended as an addendum to the Cundall desk study to reflect the proposed end use.

This updated report continues to build on the information contained in both the previous Cundall (2016) and Ramboll (2017) reports and remains therefore an addendum to the Cundall desk study, continuing to reflect the proposed end use, but has now been updated to reflect the revised red line boundary (effectively the western half of the wider parcel of land formerly referred to as Plot 6/7).

It includes:

- A brief review of the existing Cundall reports including the findings of the Cundall ground investigation from 2016 (as provided in the Ramboll 2017 and 2018 updates);
- A review of the findings of the Ramboll 2017 ground investigation (as reported in the Ramboll 2018 desk study update for plot 9a);
- A review of the findings of limited additional ground investigation works for waste classification completed since the production of the Ramboll 2018 desk study update for plot 9a; and
- A full Preliminary Risk Assessment for the currently proposed multi-storey office / commercial development.

2 REVIEW OF EXISTING REPORTS

The following reports have been reviewed:

- Cundall (2016) Plots 6 & 7 First Street – *Preliminary Geotechnical and Geo-Environmental Assessment*, Report No. 1011906.RPT.GL.003, January 2016;
- Geotechnical Engineering Ltd. (2016) *Plots 6, 7 & 8 First Street, Manchester – Factual Report on Ground Investigation*, Report ref. 31847, July 2016;
- Cundall (2016) *Plot 6 & 7 First Street Manchester – Geo-Environmental Assessment*, Report No. 1011906.RPT.GL.005, July 2016;
- Ramboll (2017) *Contaminated Land Desk Study – Plot 6/7 First Street*, Report Ref.: 1620002943_CLDS_01, February 2017;
- Ramboll (2018) *Plots 6 & 7 First Street, Manchester – Geotechnical and Contaminated Land Interpretative Report*, Report Ref: 1620002943-GCLIR-02, rev. 2, March 2018;
- Ramboll (2018) *Contaminated Land Desk Study – Plot 9a First Street*, Report Ref.: 1620002943-RAM-05-XX-RP-Y-00001 (rev 102); and
- Ramboll (2019) *Plot 9 First Street, Manchester – Waste Classification Letter Report*, 12/11/2019; ref 1620002943-RAM-05-XX-RP-Y-00002 (includes data for full plot 6/7 site area).

A summary of the relevant key points from these reports is provided below with a note in each section on further issues pertaining to the change in site end use or data gaps.

2.1 Cundall (2016) Preliminary Geotechnical and Geo-Environmental Assessment

The preliminary geotechnical and geo-environmental assessment comprises a standard contaminated land desk study and preliminary risk assessment as required for planning. However, the end use considered was open grass meadow, not the currently proposed multi-storey commercial development.

The report included a comprehensive site history which shows the site to have been developed with residential housing from 1848 to 1928 at which time the site became part of the India Rubber Works. The town plans show the western area of the site to be a scrap and material yard. The eastern area of the site is a steel truss roof structure with concrete floors and asbestos cladding. The 1962 town plan shows the western area of the site is a hot water bottle factory with a steel truss roof and asbestos cladding. By 1968 there was a coal pile in the western area of the site with a hose factory in the south-east. The site remained in a similar condition until 2006 when it is reported that the site was undeveloped. Surrounding land uses included gas works, rubber works, housing and industrial facilities.

The underlying geology is stated as being Made Ground overlying Glacial Deposits (Secondary A Aquifer) and Chester Pebble Beds (Principal Aquifer). There are historical river channels noted that run south-east to north-west through the site and are stated to be tributaries of the River Medlock. With the presence of historical river channels on site, there is also the potential for alluvial deposits to underlie parts of the site. Cundall state that there is potential for the historical infilled river channel beneath the site to be in hydraulic connectivity with the River Medlock

The site was found to have been bombed during World War II. A direct strike was recorded on 23rd December 1940. There are also High Explosive bombs and demolished buildings noted within 100m of the site. The Ordnance Survey map of 1948 shows the surrounding area to be vacant where residential housing once stood, suggesting that the site had been bombed.

No landfills were noted within 500m of the site.

Cundall concluded the risk to construction workers and site end users from the former gas works immediately north of the site was Low and the risk to the underlying Secondary A and Principal Aquifer was Very Low.

The risk from on-site Made Ground and contaminants from uncontrolled activities to construction workers through migration of ground gases, ingestion and inhalation of dust was deemed Moderate with the risk from direct contact as High.

The risk to the River Medlock and underlying aquifers was classified as Moderate to Low from groundwater impacted by mobile contaminants.

Note: The preliminary risk assessment was undertaken when the end use was intended to be public open space. As this is no longer the case the risk assessment needed to be revised.

2.2 Geotechnical Engineering Ltd. (2016) Factual Report on Ground Investigation

A ground investigation was undertaken by Ground Engineering Ltd. on the Plot 6/7 site (subsequently referred to as Plot 9A) and Plot 8 to the south of the site in April 2016.

The investigation comprised the following on Plot 6/7 (*i.e.*, Plot 9A):

- Five dynamic sample boreholes;
- Seven dynamic samples and rotary core boreholes;
- Three California Bearing Ratio tests; and
- 74 hand-excavated trial pits for asbestos screening.

Ground conditions encountered comprised:

- Made Ground of varying thickness across the site;
- Glaciofluvial deposits of gravel, clay and sand;
- Glacial Till to the west of the site;
- Chester Pebble Beds – completely weathered bedrock which is underlain by more competent bedrock.

2.3 Cundall (2016) Geo-Environmental Assessment

Following the Ground Investigation by Ground Engineering Ltd. (noted above) Cundall provided an interpretation of the Ground Investigation in July 2016.

Due to constraints on site including the presence of site cabins and stockpiled materials for the Plot 5 development, parts of the site were inaccessible and therefore, no data was available in these areas.

Downhole magnetometer surveys by UXO contractors were undertaken at every intrusive position due to the historical UXO activity on site identified within the Preliminary Geotechnical and Geo-environmental Assessment. No UXO or UXO related artefacts were encountered.

The ground conditions identified comprised hard surfaces overlying granular and cohesive Made Ground. This was underlain by alluvium in three locations at the site with alluvium in one location described as PEAT which was encountered between 3.60m bgl (below ground level) to 4.10m bgl (firm, dark brown or black, fibrous peat with abundant roots). Obstructions were also noted across the site with concrete slabs in place from relict structures.

A preliminary ground gas risk assessment was undertaken based on two rounds of ground gas monitoring undertaken in May 2016. There were five ground gas monitoring wells at three locations across the site with shallow and deep wells within the Made Ground and

glaciofluvial deposits at CP/RC111 and CP/RC117a. No wells were installed within the peat or alluvium which could be a potential source of gas.

The chemical data was screened assuming a public open space land use. This interpretation of the data was no longer considered to be applicable given the proposed commercial land use scenario.

Asbestos was identified in 38 of the 84 samples analysed. Of these 38 samples, 10 contained asbestos above the laboratory detection limit of 0.001%. The largest concentration was identified at 2.698% (above the hazardous waste threshold of 0.1%) in the north-western area of the site in the location of the former hot water bottle factory. As the site is now to be developed with excavations to take place for foundations, piling, etc., there is a risk that construction workers and adjacent site users will come into contact with asbestos fibres during construction. It was considered that additional sampling was required in the areas where access was not previously possible. It was also recommended that further assessment was required, and the results taken forward into remediation strategies and verification reports.

There were two samples of Made Ground analysed for Waste Acceptance Criteria (WAC) analysis. No waste assessment was undertaken on the chemical data to determine the classification of the materials on site.

Note: As the development is now to be multi-storey commercial blocks, it was considered that a more detailed ground gas assessment was required to include additional ground gas wells installed within the Made Ground, alluvium and deep geology in the areas of the proposed building footprint and a minimum six rounds of ground gas monitoring over an approximately two-month period. In addition, reassessment of the ground contamination data was required to provide an assessment of risks to future site users of the building. The investigation undertaken previously was also limited in extent due to obstructions on site. Additional data was also considered to be required from those areas that were not accessible during the previous investigation.

There was no assessment for buried water pipes, as at the time of writing the report there were no plans for potable water pipes on site; this was therefore also considered to require updating. The data obtained from the ground investigation did not include chemical analysis appropriate for a water supply pipe assessment and so additional investigation and analysis was also considered to be required in the location of the potable water supply once the location of such pipes is confirmed.

It was also considered that a waste classification assessment will be required for all materials taken off-site.

2.4 Ramboll (2017) Contaminated Land Desk Study

This document is updated by this current report.

2.5 Ramboll (2018) Geotechnical and Contaminated Land Interpretative Report

A further phase of ground investigation designed by Ramboll was undertaken by TerraConsult Ltd. in November 2017. The purpose of this investigation was to ascertain the ground conditions in the areas within Plot 6/7 (including Plot 9A) that were previously inaccessible, and to delineate the extent of any possible buried historical channels in the central area of the site. The ground investigation comprised the following elements:

- 21 hand-dug inspection pits;
- Seven window sample exploratory holes;
- 20 rotary percussive probe-holes (without coring) to prove the sandstone bedrock; and
- Four machine-excavated trial pits.

Ground conditions encountered comprised:

- Hard surfacing comprising concrete slab, locally reinforced or black asphalt at thicknesses of 0.1 to 0.4m;
- Granular Made Ground between 0.5 and 3.7m thick comprising sandy fine to coarse gravel of brick, concrete and charcoal with clinker, ash and clay, or gravels of slag, crushed red brick, sandstone or limestone;
- Cohesive Made Ground between 0.5 and 2.3m thick comprising sandy gravelly silt with gravel of brick, charcoal, flint and brick, or soft to firm sandy gravelly clay with frequent brick, or slightly sandy peat with rare organic material;
- Alluvium comprising soft slightly gravelly sandy clay, or firm fibrous peat, or clayey fine and medium sand at thicknesses of 1.3 to 3.0m;
- Glaciofluvial deposits of slightly gravelly fine to coarse sand with gravel of sandstone, siltstone and coal and some clay inclusions between 0.8 and 4.3m thick;
- Glacial Till comprising stiff slightly sandy slightly gravelly clay between 1.0 and 2.8m thick;
- Weathered bedrock between 0.4 and 3.0m thick, recovered as very dense, rarely slightly clayey, fine and medium sand, locally tending to extremely weak fine to medium sandstone; and
- Bedrock from 25.2 to 21.5mAOD comprising extremely weak sandstone with occasional thin (0.01-0.50m thick) laterally discontinuous layers of extremely weak mudstone and rare clasts of mudstone.

The human health assessment concluded that there were no exceedances of the GAC from either the Cundall (2016) or Ramboll (2018) sets of ground investigation data. The only contaminant identified of potential concern for a commercial end use was asbestos. A total of 48 samples were analysed for asbestos and asbestos fibres were identified in seven, four <0.001%, one at 0.001%, one 0.002% and one sample contained asbestos at a concentration of 0.007%. The Made Ground was considered to be similar across the site and it was therefore assumed that all Made Ground on site may be similarly impacted with asbestos at the low concentrations identified.

There were exceedances of the conservative GAC for polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons (TPH) and certain metals in groundwater. Impacts were typically at low concentrations and distributed throughout the Made Ground. Metals and PAHs were identified at very low concentrations in the groundwater samples analysed suggesting a minor impact. The impacts were not considered to pose a significant risk to the nearby surface water receptors. Marginally elevated TPH concentrations were assessed as likely representing a minor on-going impact to the underlying groundwater from leaching of contaminants from Made Ground.

The ground investigation identified the following potentially significant pollutant linkages that were considered to require further consideration and potential remedial action:

- Asbestos in Made Ground across the site;
- Hydrocarbons and SVOCs in soils above water supply pipe threshold for PE pipe;
- Ground gases; elevated methane and carbon dioxide concentrations indicated Characteristic Situation 2 was the most appropriate classification; and
- Potential additional impacts, e.g., beneath site cabins and in proximity to the gas main where access was restricted, or unexpected / unidentified contamination which may be encountered during works.

These impacts were considered to require further consideration in accordance with the methodology outlined in the CL:AIRE (2011) *Waste Code of Practice*. Impacts were identified in Made Ground which have the potential to leach and impact the groundwater directly beneath the site.

The ground investigation interpretative report made the following recommendations:

- There is likely to be a requirement for a piling risk assessment to address any potential increase in risk to the aquifer which the development may cause during works;
- A remedial strategy document for the proposed development will be required to address all remaining identified contamination issues;
- Earthworks at the site are recommended to be undertaken in accordance with an appropriate Material Management Plan (MMP) in accordance with the CL:AIRE (2011) *Waste Code of Practice*. All material was considered to be suitable for reuse on site in accordance with an appropriately designed MMP; and
- A part-time watching brief by an appropriately qualified environmental consultant was recommended, with subsequent validation sampling in accordance with the methodology outlined in the MMP, to allow an independent verification report to be prepared for the development.

These recommendations are relevant to the Plot 9 area as well as the remainder of the Plot 6/7 site area (*i.e.*, the further development plots 10a and 10b) for which the ground investigation and assessment was undertaken.

2.6 Ramboll (2018) Contaminated Land Desk Study Plot 9a

This document is updated by this current report.

2.7 Ramboll (2019) Waste Classification Letter Report.

Additional data was collected across the former Plot 6/7 (now plots 9 and 10) site area to inform proposals for a basement. As part of this, it was intended to collect additional samples for waste classification purposes. Due to issues during site works, only very limited additional data was collected.

This report concluded:

A total of three out of 55 samples were classified as hazardous. Based on the available information, the likely waste classification of soils underlying the development are as follows:

- *Localised area of elevated metals (namely copper, lead and zinc) within the Made Ground around WS106B2 and WS043 likely to be classified as hazardous;*
- *Asbestos impacted soils around AOP6-7C4 in the north-west and AOP6-7O1 in the east are likely to be classified as hazardous; there is a potential for additional asbestos impacts in particular in these areas. Material in these areas should be subject to visual inspection and impacted soils segregated;*
- *Remaining made ground likely to be classified non-hazardous;*
- *Alluvial and glacial deposits likely to be classified as non-hazardous (however this is based on only four samples);*
- *Alluvial deposits unlikely to be suitable for disposal at an inert landfill due to organic content; and*
- *Glacial deposits likely to be suitable for disposal at an inert landfill.*

3 REVISED GROUND CONTAMINATION RISK EVALUATION

The information presented in the previous reports has been collated and evaluated to develop an initial conceptual model for the site. Further details of the legislative context and background to assessment methodologies are provided in Appendix 1.

3.1 Potential Sources

The potential contamination sources are summarised in Table 3.1.

Table 3.1 Potential Sources

Source	Contaminants
On-site	
Former industrial use of the site; metals and hydrocarbons were detected above GAC during previous ground investigations, but only asbestos was detected above GAC in the most recent phase of investigation, however hydrocarbons and SVOCs were identified in soils above water supply pipe threshold for PE pipe.	Metals, hydrocarbons, asbestos, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs)
Asbestos – amosite, crocidolite and chrysotile identified in Made Ground across the site during previous phases of investigation with max. concentration of 2.69% at 0.75mbgl in the north-western area of the site, and based on the most recent investigation, Made Ground on the entire site is considered likely to be impacted with asbestos at low concentrations.	Asbestos - amosite, crocidolite and chrysotile
Car parking	Metals, hydrocarbons, PAHs
General historical development	Metals, hydrocarbons, asbestos
Potential for infilled voids in the underlying sandstone or infilled historical river channels.	Metals, hydrocarbons, PAHs
Ground gases from either Made Ground or natural superficial deposits, e.g., peat deposits or infilled river channel. Monitoring by Cundall (2016) identified depleted O ₂ and CO ₂ up to 2.1%, and in the most recent phase of investigation peak CH ₄ and CO ₂ concentrations were recorded as 1.5% and 9.3% respectively, with the site classified as Characteristic Situation 2.	Ground gases
Off-site	
Gaythorne Gas Works immediately north of the site (since remediated and redeveloped)	Metals, hydrocarbons, asbestos
Rubber works east of the site	Metals, hydrocarbons, asbestos, VOCs, SVOCs (semi-volatile organic compounds), PAHs
Timber yard and saw mills north-west of the site.	Metals, hydrocarbons, asbestos, VOCs, SVOCs (semi-volatile organic compounds), PAHs
Rubber works storage buildings south of the site with cloth cutting and slitting works beyond.	Metals, hydrocarbons, asbestos, PAHs
Coal yard, engineering and printing works south of the site.	Metals, hydrocarbons, asbestos, PAHs

3.2 Potential Receptors

The site-specific receptors that could potentially be affected by the contamination hazards are summarised in Table 2.

Table 3.2: Potential Receptors

Receptor	Details
Onsite	
Construction workers; Future site users; Maintenance workers	Proposed use: ground plus 10 storey commercial building, including a single level basement, with approx. 100% hardstanding. Small areas of soft landscaping may be included likely as raised planters.
Underlying aquifer	Superficial deposits classified as Secondary A Aquifer. Bedrock aquifer classified as Principal Aquifer.
Construction materials	Buildings materials used below ground, e.g., foundations, basement and services.
Flora/fauna	Very limited areas of soft landscaping are proposed at this stage. The landscaping will be predominantly hardstanding, with minimal/occasional raised planters.
Offsite	
Local watercourses	River Medlock approximately 80m NW before it is culverted to the north of the site. Not in hydraulic connectivity as it is wholly culverted.
Adjacent site users and structure	Commercial buildings, car parking, hotels.

3.3 Potential Pathways

In order for the potential contaminants to pose a risk to the identified receptors, there has to be a viable pathway for the contaminant. The potential pathways are summarised in Table 3.3.

Table 3.3 Potential Pathways

Receptor	Pathway	Comments
Human health, fauna	Direct contact with contaminated soils	Direct contact pathways are likely to be limited following development as hard cover is proposed across the entire site. There is a potential risk to construction workers who are likely to be exposed to Made Ground that is known to contain elevated concentrations of certain determinands, despite being present below GAC for a commercial development.
Human health and fauna	Inhalation of dusts, vapours and fibres	Inhalation of dusts and vapours will be limited following development as hard cover is proposed across the entire site. The site has been classified as Characteristic Situation 2, meaning that protective measures are likely to be required. Organic material and hydrocarbon impacts identified in soils and groundwater have the potential to generate ground gases which have the potential to migrate and build-up in buildings and confined spaces, e.g., the proposed single-level basement. Inhalation of fibres is unlikely to occur following development as hard cover is proposed across the entire site, however construction workers are likely to be working in close proximity to Made Ground soils known to contain asbestos, and as all Made Ground soils on site are considered likely to contain asbestos at low concentrations, risks to construction workers from inhalation of respirable fibres remain and should be

Receptor	Pathway	Comments
		mitigated with the use of appropriate risk assessments, method statements, PPE and RPE, etc.
Flora	Direct contact with impacted soils and root uptake	This will be limited following development as hard cover is proposed across the majority of the site. There remains a potential for contact in any open landscaped areas, if any such areas are proposed.
Water environment	Leaching and vertical migration of soil impacts to groundwater	Although the Made Ground soils on site are known to contain elevated concentrations of certain determinands, albeit at concentrations below the GAC for a commercial development, as the site is to be 100% hardstanding there is no potential for rainfall infiltration, leaching and contaminant migration.
Water environment	Migration of contaminants via groundwater to surface watercourses and underlying aquifer	The geology underlying the site comprises significant thicknesses of alluvial material (including clayey fine and medium sand) and glaciofluvial material comprising gravelly fine to coarse sand up to 4.3m in thickness, overlying glacial till and Chester Pebble Beds of sandstone. The sands and gravels and sandstone bedrock are all likely to be highly permeable and as such will allow infiltration of rainfall and any leachate generated into the sandstone aquifer at depth. The glacial till is likely to provide some protection to the underlying aquifer; however, the till is only 1.0m thick in parts, and has been confirmed to a max. thickness of 2.8m and is itself slightly sandy and gravelly and cannot therefore be relied upon to prevent the downward migration of potential contamination. However, as the local area has been industrialised since the mid-1800s any contamination is considered likely to have already infiltrated the bedrock.
Buildings and structures	Damage to building materials or services through direct contact with contaminants or through contaminant migration	Hydrocarbons and SVOCs have been identified in Made Ground soils above the water supply pipe threshold for PE pipes; a site-wide Design Sulphate Class of DS-2 and an Aggressive Concrete Environment Classification (ACEC) of AC-1s is considered appropriate. For piled foundations where oxidation is unlikely to occur the Total Potential Sulphate (TPS) does not need to be considered and the concrete classification of DS-2 ACEC AC-1s is considered appropriate for the site.

3.4 Qualitative Risk Assessment

Potential pollutant linkages are identified using the source-pathway-receptor framework detailed above. An assessment of the potential significance of each linkage is then made by consideration of the likely magnitude and mobility of the source, the sensitivity of the receptor and nature of the migration/exposure pathways.

This qualitative hazard assessment has been undertaken in accordance with NHBC and Environment Agency, 2008. Further details of which are provided in Appendix 1 including definition of risk categories.

Table 3.4 summarises the pollutant linkages and risk ratings associated with the proposed development.

Table 3.4: Preliminary Risk Assessment

Hazard/Pollutant	Pathway	Receptor	Potential Severity	Probability of Risk	Level of Risk
Asbestos in Made Ground Maximum concentration of 2.69% at 0.75mbgl in the north-western area of the site during previous phases of investigation, and based on the most recent data, Made Ground across the entire site is likely to be impacted with asbestos at low concentrations.	Dermal contact Ingestion/ inhalation of soils/dusts/ fibres	Construction workers	Severe	Likely	HIGH*
		Future site users	Severe	Unlikely	LOW/MODERATE
		Adjacent site users (during construction)	Severe	Likely	HIGH
		Adjacent site users (post construction)	Severe	Unlikely	LOW/MODERATE
Potential metals, hydrocarbons, PAHs, VOCs, SVOCs in Made Ground from historic industrial site use A number of organic and inorganic determinands have been identified at elevated concentrations in Made Ground, albeit below the GAC for a commercial development.	Dermal contact Ingestion/ inhalation of soils/dusts	Construction workers	Medium	Likely	MODERATE*
		Future site users	Medium	Unlikely	LOW
		Adjacent site users	Medium	Unlikely	LOW
	Inhalation of volatiles	Future site users	Medium	Low	LOW/MODERATE
	Leaching and migration	Aquifer	Medium	Low	LOW/MODERATE
	Leaching and migration	Surface Water Courses	Medium	Low	LOW/MODERATE
	Direct contact	Building Materials	Medium	Low	LOW/MODERATE
Ground gases Cundall (2016) identified depleted O₂ and CO₂ up to 2.1%; the most recent phase of investigation identified peak CH₄ and CO₂ concentrations as 1.5% and 9.3% respectively.	Ground gas migration	Construction workers	Medium	Likely	MODERATE*
		Future site users	Medium	Likely	MODERATE
Potential impact to site from migration of mobile contaminants (e.g., VOCs, hydrocarbons) from off-site historical industrial sources.	Groundwater or ground gas migration	Construction workers Future site users	Medium	Low	LOW/MODERATE

NOTES

Assessment completed assuming no remediation/mitigation in place.

Should the development proposals alter significantly a review of this risk assessment may be required. In particular if wider or new areas of landscaping / open areas are planned.

* Given the use of appropriate PPE and on-site health and safety precautions, risk to site development workers would be reduced to LOW.

3.5 Summary of Potentially Significant Pollutant Linkages

Table 3.5 below summarises the pollutant linkages requiring further consideration through intrusive ground investigation works (*i.e.*, the phase of ground investigation designed by Ramboll and undertaken by TerraConsult Ltd. in November 2017).

Table 3.5: Potential Pollutant Linkages Requiring Further Investigation

Hazard/Pollutant	Pathway	Receptor	Level of Risk
Asbestos in Made Ground	Dermal contact Ingestion/ inhalation of soils/dusts/ fibres	Construction workers	HIGH*
		Adjacent site users (during construction)	HIGH
Potential metals, hydrocarbons, PAHs, VOCs, SVOCs in Made Ground	Dermal contact Ingestion/inhalation of soils/dusts	Constructions workers	MODERATE*
	Leaching and migration	Aquifer and surface watercourses	LOW/MODERATE
	Direct contact	Building materials	LOW/MODERATE
Ground gases	Ground gas migration	Construction workers Future site users	MODERATE
Potential impact to site from migration of mobile contaminants from off-site historical industrial sources.	Groundwater or Ground gas migration	Construction workers Future site users	LOW/MODERATE

* Given the use of appropriate PPE and on-site health and safety precautions, risk to site development workers would be reduced to low.

4 CONCLUSIONS & RECOMMENDATIONS

The historical use of the site as a rubber works with historical plans showing asbestos-clad buildings means that there is the potential for asbestos to be present in the Made Ground on site. Cundall confirmed the presence of widespread asbestos (amosite, chrysotile, and crocidolite) across the site with a maximum concentration of 2.69% in the north-western area of the site, and based on this and the Ramboll 2018 investigation data, Made Ground across the entire site is considered likely to be impacted with asbestos at low concentrations.

As the site is currently proposed to be developed with a ground plus 10-storey commercial development with very limited soft landscaping, the risk to future site users from asbestos has been assessed as LOW to MODERATE, due to the severity of any pollutant linkage being realised. However, the risk to construction workers and adjacent site users during construction has been assessed as VERY HIGH and HIGH respectively, as there is potential to disturb ground and disperse asbestos fibres.

The presence of organic deposits like peat in the underlying alluvium, or from the potential infilled channels, means there is a potential for the generation of ground gases. A commercial building is proposed for the site, including a single-level basement, and the risk to future site users and construction workers from ground gases migrating into and building-up in confined spaces has therefore been assessed as MODERATE.

There is also a potential risk to future site users from any volatile contaminants in the sub-surface and to the underlying aquifer from any mobile contaminants.

The Cundall Preliminary Assessment identified that the site was struck by a German bomb on 23rd December 1940, and there were several strikes in close proximity to the site. Although no unexploded ordnance (UXO) was encountered during either the Ground Engineering Ltd. (2016) or Ramboll (2018) ground investigations, there remains a risk of UXO on the site that will need to be considered for piling operations and any other intrusive work. The merits of a more detailed desk-based assessment of the risks associated with UXO can be assessed in the later stages of the project.

The following recommendations are made, based on those made in Ramboll (2018):

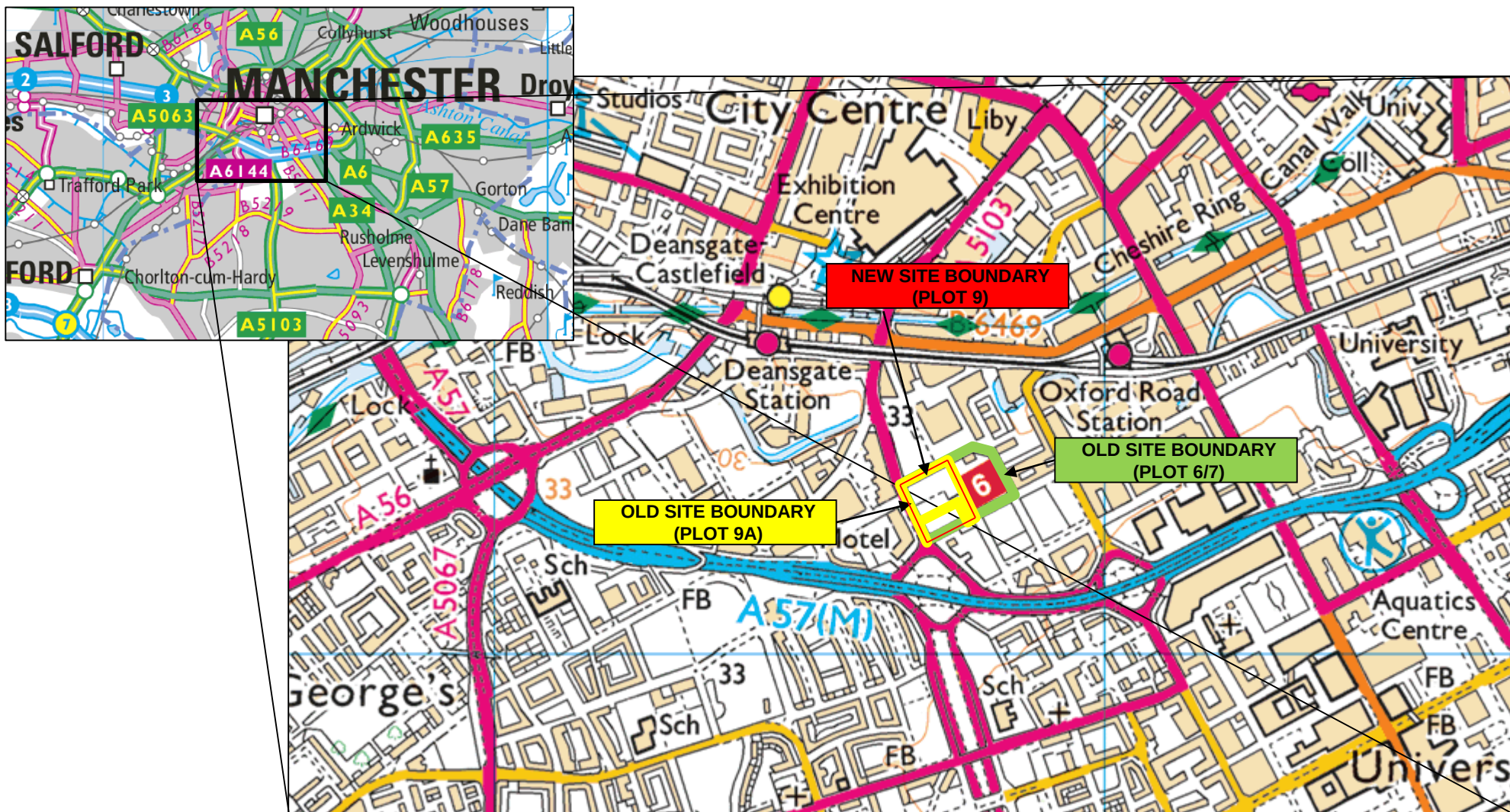
- There is likely to be a requirement for a piling risk assessment to address any potential increase in risk to the aquifer which the development may cause during construction works. Consultation with the Environment Agency should be undertaken to clarify expectations in this regard for this area;
- A remedial strategy document for the proposed development will be required to address all remaining identified contamination issues; and
- Earthworks at the site are recommended to be undertaken in accordance with an appropriate Material Management Plan (MMP) in accordance with the CL:AIRE (2011) *Waste Code of Practice*. All material is suitable for reuse on site in accordance with an appropriately designed MMP.

The remedial strategy and Material Management Plan documents should include details on, *inter alia*:

- Site-specific details relating to the asbestos impacts identified. Asbestos-impacted soils are considered unsuitable for use at shallow depth in areas of soft landscaping;
- A contingency for any additional impacts not yet identified which may be encountered during works including for consultation with an appropriately qualified environmental consultant, stockpiling and additional chemical testing / assessment prior to re-use;
- General sampling and analysis requirements for reuse of materials on site;
- Sampling and analysis requirements for waste classification of any materials to be disposed off-site.

A part-time watching brief by an appropriately qualified environmental consultant is recommended, with subsequent validation sampling in accordance with the methodology outlined within the Material Management Plan. This will allow an independent verification report to be prepared which is likely to be required after construction works are complete.

5 DRAWINGS



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Project: **Plot 9, First Street, Manchester**

Status:

Description:

Date **19.11.2019**

Title: **Site Location Plan**

Scale: NTS

Date: **19.11.2019**

Drawn: **CC**

Checked: **HC**

Figure No: 1

Rev:

6 APPENDICES

APPENDIX 1

LEGISLATIVE CONTEXT AND METHODOLOGIES

1. LEGISLATIVE CONTEXT

1.1.1. England

The regime for contaminated land was set out in Part 2A (ss.78A-78YC) of the Environmental Protection Act 1990 (EPA), as inserted by S.57 of The Environment Act 1995 and came into effect in England on 1st April 2000 as The Contaminated Land (England) Regulations 2000 (SI 2000/227). These regulations were subsequently revoked with the provision of The Contaminated Land (England) Regulations 2006 (SI 2006/1380) (as amended), which came into force in August 2006, and consolidated the previous regulations and amendments. Revised statutory guidance ("the Guidance") for local authorities on how to implement the regime, including the decision-making process on whether land is contaminated land in the legal sense, has been published by Defra and entered into force in April 2012.

Under Part 2A of the EPA Section 78A(2), "contaminated land" is defined as "land which appears... to be in such a condition, by reason of substances in, on or under the land, that –

- a) significant harm is being caused or there is a significant possibility of such harm being caused; or
- b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused".

1.1.2. Wales

The regime for contaminated land was set out in Part 2A (ss.78A-78YC) of the Environmental Protection Act 1990 (EPA), as inserted by S.57 of The Environment Act 1995 and came into effect in Wales on 1st July 2001 as The Contaminated Land (Wales) Regulations 2001 (WSI 2001/2197, W.157). These regulations were subsequently revoked with the provision of The Contaminated Land (Wales) Regulations 2006 (SI 2006/2989 W.278), which consolidated the previous regulations and amendments and added in provisions regarding radioactive contaminated land. These regulations came into force on 10th December 2006 and were accompanied by statutory guidance published by the Welsh Assembly Government in December 2006 ('the Guidance') for local authorities on how to implement the regime. The 2006 statutory guidance was replaced by the Contaminated Land Statutory Guidance - 2012 (WG19243), issued by the Welsh Government.

Under Part 2A of the EPA Section 78A(2), "contaminated land" is defined as "land which appears... to be in such a condition, by reason of substances in, on or under the land, that –

- a) significant harm is being caused or there is a significant possibility of such harm being caused; or
- b) pollution of controlled waters is being, or is likely to be caused" (Section 86 of the Water Act 2003 remains only partially implemented in Wales).

1.1.3. Scotland

The regime for contaminated land was set out in Part 2A (ss.78A-78YC) of the Environmental Protection Act 1990 (EPA), as inserted by S.57 of The Environment Act 1995 and came into effect in Scotland on 14th July 2000 as The Contaminated Land (Scotland) Regulations 2000 (SSI 2000/ 178). These regulations were subsequently revoked with the provision of The Contaminated Land (Scotland) Regulations 2005 (SSI 2005 /658), which came into force in April 2006 and consolidated the previous regulations and amendments and were accompanied by statutory guidance published by

the Scottish Government in May 2006 ('the Guidance') for local authorities on how to implement the regime.

Under Part 2A of the Environmental Protection Act 1990, "contaminated land" is defined in the Contaminated Land (Scotland) Regulations 2005 (as amended) as land which appears to the local authority to be in such a condition, by reason of substances in, on or under the land, that:

- a) significant harm is being caused, or there is a significant possibility of such harm being caused; or
- b) significant pollution of the water environment is being caused or there is a significant possibility of such pollution being caused.

1.1.4. Northern Ireland

The regime for Contaminated Land in Northern Ireland was set out in the Waste and Contaminated Land (Northern Ireland) Order 1997 (as amended). Part 3 of the Waste and Contaminated Land (Northern Ireland) Order 1997 contains the main legal provisions for the introduction of a contaminated land regime in Northern Ireland, but the regime is not yet in operation. It is noted that the Contaminated Land (Northern Ireland) Regulations 2006 and associated statutory guidance were published in draft for consultation in 2006, but have yet to be finalised. Under Part 3 of the 1997 Order, contaminated land is defined as,

"any land which appears to a district council in whose district it is situated to be in such a condition, by reason of substances in, on or under the land, that -

- (a) significant harm is being caused or there is a significant possibility of such harm being caused; or
- (b) pollution of waterways or underground strata is being, or is likely to be, caused.

"Significant harm" is defined in the draft guidance on risk based criteria and must be the result of a "pollutant linkage", which may be assessed using qualitative risk assessment models. The presence of a pollutant linkage relies on the Source-Pathway-Receptor concept, where all three factors must be present and potentially or actually linked for a potential risk to exist.

1.1.5. The Channel Islands

There is no formal contaminated land regime in the Channel Islands, as they are not part of the UK, and as such they usually adopt either the English or French legislation or create their own.

1.1.6. Isle of Man

There is no formal contaminated land regime in the Isle of Man, and they usually adopt a best 'practice approach' from a European country of choice on this basis.

1.1.7. Risk assessment Framework

"Significant harm" or "significant pollution of controlled waters" is defined in the Guidance on risk based criteria and must be the result of one or more relevant 'contaminant linkages' relating to the land.

The presence of a contaminant linkage relies on the Source-Pathway-Receptor concept, where all three factors must be present and potentially or actually linked for a potential risk to exist. For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source - a substance that is capable of causing pollution or harm;
- A receptor - something which could be adversely affected by the contaminant;
- and

- A pathway - a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

The Environment Agency Contaminated Land Report CLR 11 Model Procedures for the Management of Land Contamination provides the technical framework for structured decision making about land contamination. CLR 11 advocates a phased approach to risk assessment comprising:

- Preliminary Risk Assessment (PRA) – desk study and qualitative assessment
- Generic Quantitative Risk Assessment (GQRA) – assessment of contaminant concentrations against generic assessment criteria.
- Detailed Quantitative Risk Assessment (DQRA) – detailed site specific risk assessment and development of site-specific assessment criteria.

Each of these phases follows the same basic steps but adds site specific details and further certainty into the assessment as the stages progress. The basic steps are:

- Hazard identification and hazard assessment – development or refinement of the source-pathway-receptor conceptual model, and identification of potential pollutant linkages.
- Risk Estimation – qualitative risk estimation predicting magnitude and probability of potential consequences that may arise as a result of a hazard.
- Risk Evaluation – deciding whether a risk is unacceptable.

2. RISK ESTIMATION

An assessment of environmental risks is made for each potential pollutant linkage identified.

Risk estimation has been completed in accordance with the guidance provided in:

- NHBC and Environment Agency 2008. Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66: 2008.

The following is taken directly from NHBC/EA 2008. The key to the classification is that the designation of risk is based upon the consideration of both:

- a) the magnitude of the potential consequence (*i.e.*, severity) [takes into account both the potential severity of the hazard and the sensitivity of the receptor];
- b) the magnitude of probability (*i.e.*, likelihood) [takes into account both the presence of the hazard and receptor and the integrity of the pathway].

Table 1: Classification of Consequence (after NHBC/EA 2008)

Category	Definition
Severe	Highly elevated concentrations likely to result in “significant harm” to human health as defined by the EPA 1990, Part 2A, if exposure occurs. Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.
Medium	Elevated concentrations which could result in “significant harm” to human health as defined by the EPA 1990, Part 2A if exposure occurs. Equivalent to EA Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.
Mild	Exposure to human health unlikely to lead to “significant harm”. Equivalent to EA Category 3 pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.

* For these purposes, disease is to be taken to mean an unhealthy condition of the body or a part of it and can include, for example, cancer, liver dysfunction or extensive skin ailments. Mental dysfunction is included only insofar as it is attributable to the effects of a pollutant on the body of the person concerned.

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Table 2: Classification of Probability (after NHBC/EA 2008)

Category	Definition
High Likelihood	There is pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place, and is less likely in the shorter term.
Unlikely	There is pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard.

Table 3: The Classification of Risk (after NHBC/EA 2008)

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very high	High	Moderate	Low
	Likely	High	Moderate	Moderate/ Low	Low
	Low Likelihood	Moderate	Moderate/ Low	Low	Very low
	Unlikely	Moderate/ Low	Low	Very low	Very low

Very high risk

There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.

High risk

Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.

Moderate risk

It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.

Low risk

It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

Very low risk

It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.

No potential risk

There is no potential risk if no pollution linkage has been established.

3. GQRA METHODOLOGIES

In order to assess the significance of the chemical concentrations recorded, generic assessment criteria (GAC) must be selected. The GAC are screening concentrations which are used initially for direct comparison to the measured site concentrations.

The GAC are defined based on the critical receptors identified at the site. Receptors are considered in relation to:

- Human health receptors (e.g., site users);
- The water environment (e.g., groundwater and surface water).

Potential risks to human health are considered primarily using measured concentrations of chemicals in soil. Potential risks to the water environment are considered primarily using soil leachate and groundwater concentrations as indicative of the potentially mobile fraction of any soil impact.

Additional receptors may be relevant dependent on the site e.g., flora/fauna, water supply pipes, buried concrete.

3.1. Human Health Assessment

3.1.1. Initial Screening Assessment

In accordance with current UK guidance on legislation including Part 2A of the Environmental Protection Act 1990 and based on the principles of risk assessment, Ramboll Environ (REH) has derived generic assessment criteria (GAC) for interpretation of soil and groundwater chemical analysis. The Ramboll Environ GAC are considered to be threshold based screening concentrations, at which a significant risk is not considered to be present to the relevant receptors.

The Ramboll Environ REH GAC for soil assessment are based on the generic scenarios outlined in the Contaminated Land Exposure Assessment (CLEA) methodology and guidance documents (incorporating Science Reports SC050021/SR2 (January 2009), SR3 (January 2009), SR4 (September 2009) and the SGV reports (2009)). The generic scenarios include inhalation, ingestion, dermal contact of soil and dust as pathways for commercial and residential scenarios; as well as ingestion of homegrown produce for residential with gardens scenario. In addition, REH GAC have also been derived for the two Public Open Space land uses defined in C4SL guidance (outlined below).

The GAC have been calculated by use of two proprietary risk assessment models (CLEA Version 1.071 and the American Society for Testing Materials Risk Based Corrective Action RBCA Tool Kit Version 2.6 for Chemical Releases) which have been altered, where necessary, to reflect the current UK approach to human health risk assessment as set out in the Contaminated Land Report (CLR) 11 and the CLEA guidance documents. The physiochemical data has been taken from or derived using the methodology detailed in SR7 (November 2008) and SGV reports (2009), where feasible. The toxicology data has been taken from the current published EA toxicology documents. We have referred to all current publications and guidance issued up until 1st May 2016.

Reference has been made to the Defra-funded research project (SP1010), which developed a methodology to derive Category 4 Screening Levels (C4SLs) for six contaminants (benzo-a-pyrene, cadmium, arsenic, benzene, hexavalent chromium and lead). SP1010 provides technical tools and advice to be developed to help regulators and others to conform to the requirements of revised Part 2A Statutory Guidance. The C4SLs are therefore less conservative than GAC developed in accordance with published CLEA guidance as they describe a low risk as opposed to minimal risk scenario. However,

consistent with the developed GAC, sites below the C4SLs are within Category 4 (lowest risk category) and therefore considered suitable for use.

Defra's SP1010 Policy Companion document (DEFRA, Dec 2014) states that where a C4SL value has been derived for a contaminant where a Soil Guideline Value (as published by the EA 2009) exists, it is anticipated that risk assessors will use the C4SL value in line with Part 2A Statutory Guidance. In the absence of a suitable C4SL, risk assessors should identify and select appropriate GAC in accordance with established good practice. On this basis, Ramboll Environ has adopted the use of C4SLs however minimal risk assumptions have been applied in-house REH GAC for other contaminants of concern within our screening assessments.

The C4SLs for the six compounds published, are based on a sandy loam soil with 6% soil organic matter (SOM). The 6% SOM and sandy loam soil type is not considered by Ramboll Environ to be realistic of 'typical' UK soil conditions, and EA guidance ('Using Soil Guideline Values' EA, 2009) states that at 6% SOM, GAC may not be sufficiently protective (i.e. the values are too high to be sufficiently certain that they describe land where there is no risk to human health or the risk is negligible). For the Ramboll Environ GAC, all the C4SL inputs have been used apart from the SOM and soil type, which were amended to 1% and sand; thereby ensuring a suitably conservative Ramboll Environ GAC appropriate for most soils and Made Ground encountered in the UK. It is noted that none of the screening criteria used in the UK, including the C4SLs, have a statutory basis.

Ramboll Environ also attended the Land Quality Management and Chartered Institute of Environmental Health workshop for the collaborative development of 'Suitable 4 Use Levels' (S4ULs) and reference has been made to their publication 'The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015'.

Review of additional UK organisation guidance including Contaminated Land: Applications in Real Environments (CL:AIRE) and partners GAC, including addendums up until 10 April 2012 has also been made. Soil Guideline Values (EA/DEFRA, 2009) may also be referred to if relevant. Finally, where necessary, other published sources of (non-UK) information, such as the RBCA V2.6 database has also been reviewed.

Contaminant concentrations below the adopted GAC are not considered to present a significant risk to identified receptors and therefore are not considered to warrant further study. Contaminants which are recorded at concentrations above their respective GAC are considered to present a potential risk to identified receptors and resultantly these determinants are subject to further assessment.

3.1.2. Contaminant Distribution Assessment

Concentrations above the GAC are considered further in relation to vertical and lateral distribution across the site and through statistical analysis, where appropriate. This analysis is used to define 'averaging areas' within which contamination concentrations and distribution are considered likely to be similar.

For each averaging area, where appropriate, statistical analysis is then used to calculate a 'representative' concentration for each contaminant within that area and identify possible outliers of the underlying distribution of contaminant concentrations. This analysis is completed in accordance with CIEH 2008 guidance.

The initial statistical tests are used to calculate the 95% probability that the true population mean falls below the critical concentration (GAC). In practise, this involves comparing the 95th Upper Confidence Limit of the true population mean with the GAC. The Maximum Value test is then used to identify whether the maximum concentration is likely to lie outside of the assumed distribution trend and as such would represent an outlier of the general population of data across the site. Outliers above the GAC may represent localised contaminant hotspots and require further consideration.

Constituent non-detects are conservatively assigned a value equal to the reported analytical laboratory limit of detection. Any identified true outliers are excluded from the datasets used in calculation of the 95%UCL value.

3.2. Assessment for the Water Environment

Assessment of risks to water resources is completed in general accordance with guidance provided in the Environment Agency 2013, Groundwater Protection Principles and Practice (GP3) for England and Wales and with reference to SEPA guidance WAT-PS-10-01 in Scotland.

Generic assessment criteria for waters must be selected to assess potential risks to the identified environmental receptors.

In the absence of relevant published water assessment criteria, the potential risk to human health from contaminated surface and groundwater and the potential risk to the aquatic environment from entry of pollutants (either directly or via a groundwater pathway) has been assessed using commonly accepted UK guidelines including the Water Supply (Water Quality) (England) Regulations 2000 (known as the Drinking Water Standards, or DWS) and the Environmental Quality Standards (EQS) defined in European legislation such as the Water Framework Directive (WFD) (2000/60/EC).

Minimum reporting values are also considered for hazardous substances for assessment of risks to groundwater resources in order to comply with the requirements of the guidance to 'prevent' input of hazardous substances to groundwater.

4. GROUND GAS RISK ASSESSMENT

Ground gas risk is characterised using guidance provided in the following:

- CIRIA C665, 2007. Assessing risks posed by hazardous ground gases to buildings. (Supersedes CIRIA 659).
- NHBC / RSK, 2007. Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. Report Ed 4.
- BS8485: 2015 Code of practice for the characterization and remediation from ground gas in affected developments.
- BS8576:2013. Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)

The risk posed by a gas regime is assessed initially by calculating a Gas Screening Value using a combination of the gas flow rate and recorded concentrations of carbon dioxide and methane. This Gas Screening Value is then used in combination with the maximum recorded gas concentrations to determine the site's Characteristic Situation (CIRIA 665 – all site uses except low rise residential) or Traffic Light Classification (NHBC/RSK 2007 low rise residential sites only). Table A below outlines the method for defining the Characteristic Situation as detailed in CIRIA 665 and Table B outlines the method for defining the Traffic Light classification as detailed in NHBC/RSK 2007.

Table A: Proposed method for classifying gassing sites (after CIRIA C665 2007)

Characteristic Situation	Risk classification	Gas screening value of CH ₄ or CO ₂ (l/hr) ^a	Additional limiting factors	Typical source of generation
1	Very low risk	<0.07	Typically methane ≤ 1% and/or carbon dioxide ≤ 5%. Otherwise consider increase to Situation 2	Natural soils with low organic content. "Typical" Made Ground
2	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to Characteristic Situation 3	Natural soil, high peat/organic content. "Typical" Made Ground
3	Moderate risk	<3.5	-	Old landfill, inert waste, mineworking flooded
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mineworking -susceptible to flooding, completed landfill, inert waste (WMP 26B criteria)
5	High risk	<70	-	Mineworking unflooded inactive with shallow workings near surface
6	Very high risk	>70	-	Recent landfill site

^a Gas screening value = gas concentration (%) x measured borehole flow rate (l/hr)

Table B: Proposed method for classifying gassing sites (after NHBC/RSK 2007)

Traffic Light	Methane ¹		Carbon Dioxide ¹	
	Typical Maximum Concentration ⁵ (%v/v)	Gas Screening Value (GSV) ^{2,4,6} litres per hour	Typical Maximum Concentration ⁵	Gas Screening Value (GSV) ^{2,3,4,5}

			(%v/v)	litres per hour
Green				
Amber 1	1	0.16	5	0.78
Amber 2	5	0.63	10	1.56
Red	20	1.56	30	3.13

The CIRIA, NHBC and BS8485 guidance documents are then used to determine requirements for gas protection measures based on the site classification.

5. WATER SUPPLY PIPES

The assessment has been completed in accordance with the current UK guidance:

- Water UK. Jan 2014. Contaminated Land Assessment Guidance.
- UKWIR UK Water Industry Research Ltd, 2010. Guidance for Selection of Water Supply Pipes to be used in Brownfield Sites.

This guidance provides threshold concentrations for different pipe material for various chemical groups.

The pipeline materials considered by the guidance are PE, PVC, wrapped steel, wrapped ductile iron or copper pipe and barrier pipe. PE and PVC are assessed using threshold concentrations for various chemical groups including volatile organic compounds (VOC) with tentatively identified compounds (TICs), semi-volatile organic compounds (SVOC) with TICs, and mineral oils. Wrapped steel, wrapped ductile iron and copper pipe are assessed using corrosive properties.

Regional water companies may have adopted additional more stringent thresholds which they apply locally, thus consultation with the water authority must always be completed prior to final determination of water supply pipe materials.

6. WASTE CLASSIFICATION

The main steps in classifying waste are:

1. Is it really a waste or can it be reused, recycled or recovered?
2. If the material is not to be utilised in some way and it is waste then classify to ascertain if hazardous or non-hazardous. In order to do this, guidance regarding the definition and classification of hazardous waste is utilised, the two main documents being EA, 2015 'Technical Guidance WM3: Waste Classification - Guidance on the classification and assessment of waste' and the European Waste Catalogue (EWC 2002).
3. Use the results of this initial waste classification to follow one of the following routes:

Hazardous			Non-Hazardous		
Pre-treat the waste.			Thought likely to be inert: (e.g. insoluble and inorganic in nature)	Thought unlikely to be inert: (e.g. may contain peat or other high organic content material)	
Complete WAC (Waste Acceptance Criteria) testing to determine class of landfill it can go to or any requirement for further pre-treatment if WAC fails.			Complete WAC test to determine class of landfill it can be disposed to		-
Pass stable non-reactive hazardous WAC: dispose of at SNRHW landfill.	Pass hazardous WAC: dispose of at hazardous landfill.	Fail: further remedial action required	Pass: dispose of at inert landfill	Fail: dispose of at non-hazardous landfill	Dispose to non-hazardous landfill (no WAC testing required by WM3).

The landfill regulations (Environment Agency, 2011 Treatment of Waste for Landfill) prescribe that hazardous waste requires pre-treatment prior to disposal to landfill. This may include physical sorting at the point of production on site, by sorting of waste soils into separate stockpiles of eg topsoil, made ground and natural gravels.

6.1. Methodology

In terms of the EWC, the soil to be excavated from this site for disposal is classed as 'Soil and Stones containing Dangerous Substances' (EWC Code 170503) or 'Soil and Stones other than those mentioned in EWC Code 170503' (EWC Code 170504). As such it is what is known as a 'Mirror Entry waste' and needs to be assessed against Threshold Levels for certain dangerous substances in order to confirm whether it needs to be classified as hazardous (170503) or non-hazardous (170504).

Data from site soil chemical testing have been assessed to classify the site soils. The assessment has been undertaken using HazWasteOnline TM, a web-based tool for classifying waste. The software utilises Environment Agency guidance and European regulations to classify samples in line with current requirements.

The assessment provided in this report fulfils the requirement of step 2 above, and allows classification of the site soils and hazardous or non-hazardous.

Asbestos: The Hazardous Waste (England and Wales) Regulations 2005 requires that any waste having an asbestos content greater than 0.1% weight/weight (w/w) be classified as Hazardous Waste. Any waste with an asbestos content of less than 0.1% w/w can be classified as non-hazardous waste, unless there are other contaminants present which would make the waste hazardous.

Where fibrous asbestos is present at concentrations greater than 0.001%, these can be considered to pose a risk to human health and must be dealt with as hazardous soils for disposal purposes.

Where the asbestos is deemed to be of a fibrous nature the Health and Safety Executive (HSE) require that the handling of the material is undertaken by a suitably licensed company. The Carriage of Dangerous Goods (etc.) Regulations 2009 (CDG2009) applies in this instance.