

Jersey Wharf

Remediation Strategy

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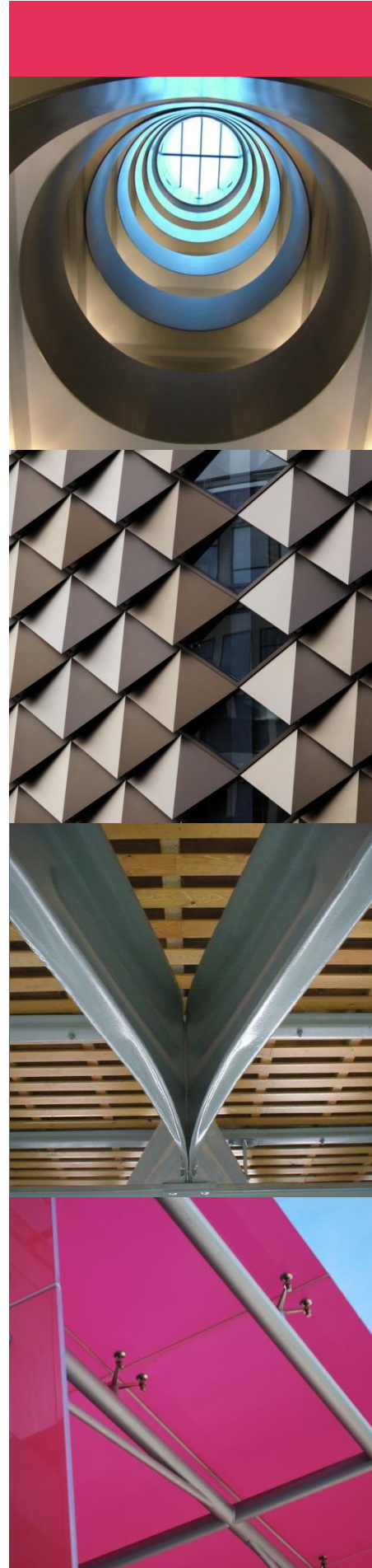
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Remediation Strategy

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Remediation Strategy

1.0 Introduction

This Remediation Strategy has been prepared by Curtins for Manchester Life Development Company 3 Ltd (the Client) to provide guidance with respect to remedial requirements for the proposed development site Jersey Wharf, Manchester, M4 6JW.

The proposed development on site comprises a construction of several structures comprising residential high-rise buildings with some commercial use to the ground floor.

The eastern section of the site has been characterised through site investigation undertaken by Curtins (Ref. 1) and E3P (Ref. 2). E3P previously carried out a ground investigation and report in 2019 for the eastern section of Plot C to provide preliminary characterisation of the geo-environmental and geotechnical site conditions. Curtins have undertaken a supplementary intrusive investigation in 2021 for the eastern section of the site and a further site investigation in 2023 to include the western section of the site which includes the existing building onsite.

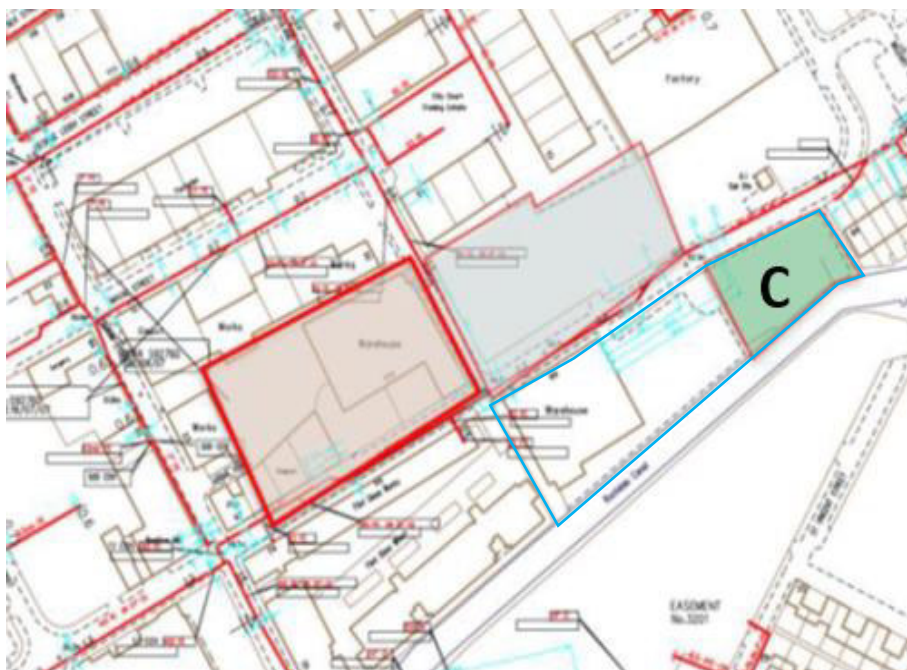


Figure 2.1 – Site Location Plan (Site Boundary shown in Blue).

The site hereby known as ‘Jersey Wharf’, is located off Jersey Street, Manchester M4 6JW. It must be noted that this Remediation Strategy refers only to Jersey Wharf. A site location plan is presented in *Figure 2.1* with the site boundary outlined in Blue.

The site is currently unoccupied, with the area in the east comprising fenced, vacant land and the west by a warehouse building previously occupied by Easy Equipment. The remainder of the site is occupied by tarmac car parking and a container. The site is bound by Jersey Street to the north and the Rochdale Canal to the south.

Remediation Strategy

1.1 Requirements of the Remediation Strategy

The Remediation Statement is to account for the following;

- A description of the materials likely to be encountered by the developer and their contractor/sub-contractors;
- Proposals for excavations with respect to the materials likely to be encountered;
- Revised risk ratings associated with ground contamination and primary pollutant linkages remaining;
- Recommendations for the specification of the cover of Made Ground soils in proposed soft landscaped areas;
- Recommendations for appropriate PPE and managing asbestos appropriately during construction;
- Recommendations for re-use of materials and use of a Materials Management Plan (MMP);
- A strategy a watching brief during earthworks and for handling potentially contaminative incidents.
- Proposals for the verification of remedial measures, including a regime for verification and chemical analysis of the cover layer material;

1.2 Definitions

In this document the following definitions apply,

- Contractor** Refers to the appointed contractor responsible for undertaking the remediation works.
- Site Manager** Refers to a representative of the appointed contractor resident on site.
- Engineer** Refers to a suitably qualified representative from Curtins, who would not normally be resident on site.

1.3 References

The Remediation Strategy has been prepared with reference to the following existing reports;

- **Reference 1:** Curtins (2021) Interpretive Geo-Environmental and Geotechnical Letter Report for Back of Ancoats, Plot C Ref. 076740-CUR-00-XX-RP-GE-003-V01
- **Reference 2:** Curtins (2023) Letter Report for back of Ancoats, Plot C Report Ref. 077879-CUR-00-XX-RP-GE-003-V01
- **Reference 3:** E3P (2020) Parcel C - Phase II Geo environmental Site Assessment Land at Jersey Street, Ancoats, Manchester Report Ref. 13-350-R3

2.0 Ground Conditions

The following sections present a summary of the ground conditions identified during the E3P 2019, Curtins 2021 and Curtins 2023 intrusive investigation. The exploratory hole logs are presented in *Appendix A*.

2.1 Surface Covering

The surface covering was either a concrete slab, concrete with a brick layer or tarmacadam to depths between 0.15 to 0.25m bgl, underlain by either granular or cohesive Made Ground with occasional cobbles.

Topsoil was encountered during the 2023 ground investigation within WS-C6 only to 0.20m bgl and was recorded as a brown slightly clayey sand with frequent rootlets.

2.2 Made Ground

Made Ground soils were recorded in all exploratory hole locations from ground level to a maximum depth of 2.50m bgl.

Made Ground descriptions were highly variable but generally the gravel consisted of ash, mudstone, concrete, glass, clinker and brick, and cobbles of brick. In R-C1A, TP-C2, TP-C4, WS-C6 and WS-C8 a strong hydrocarbon odour and sheen was encountered, which are located within the north and east of site.

Anthropogenic fragments typically comprise brick, concrete, ash, clinker, porcelain, terracotta and glass.

2.3 Natural Deposits

Superficial Soils

Glacial Till was recorded in exploratory holes where progressed through the Made Ground, from depths of between 1.40m and 3.00m bgl. Soils were predominantly cohesive with interbedded granular deposits encountered between 10.40m to 10.50m bgl. Cohesive deposits comprised of soft to firm, becoming stiff brownish grey slightly sandy slightly gravelly Clay or a firm light brown mottled light grey silty clay. Deeper cohesive deposits, below 14.00m bgl, were recorded as firm greyish brown slightly sandy gravelly Clay underlain by very stiff brown sandy Clay. The cable percussive boreholes investigated to depths in excess of 10m bgl, with a maximum proven depth of 18.50m bgl.

The interbedded granular deposits were encountered between 10.40 to 10.50m bgl and recorded as dense to very dense brown fine to coarse Sand.

Bedrock (Manchester Marl Formation)

The Manchester Marl Formation bedrock was encountered within R-C1A, recorded underlying the Glacial Till from 18.50m bgl (32.33m AOD). Mudstone was encountered from 18.50m bgl to 25.88m bgl

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which was overlying Sandstone. The Mudstone was described as a highly weathered extremely weak to weak brown thinly laminated Mudstone. Which appears to be highly weathered in the upper strata (recovered as stiff brown slightly sandy clay). Sandstone was described as medium strong to strong reddish brown and grey medium to coarse grained Sandstone to 29.60m bgl overlying an extremely weak reddish brown medium grained Sandstone.

3.0 Groundwater & Groundwater Contamination

3.1 Ground Contamination

E3P 2019

The E3P 2019 site investigation environmental chemistry results were compared with Generic Assessment Criteria for soils with respect to human health for a '*Residential end use*'. Several exceedances were identified including elevated metals and non-volatile TPH compounds, all within the Made Ground samples. Exceedances are summarised in 3.1A overleaf.

Table 3.1A – E3P Soil Environmental Chemistry Exceedances against Residential end use GACs

Determinant	Exploratory Hole ID	Depth (m bgl)	Concentration (µg/l)	GAC (µg/l)
Arsenic	TP117	1.60	40	37
Cadmium	TP116	0.80	18	17
Dibenzo(ah)anthracene	WS112	1.20	0.26	0.24

E3P submitted four samples for asbestos analysis of which one sample, WS112 at 1.20m bgl, was positive for asbestos. Results of asbestos quantification confirmed the concentration of asbestos at <0.001% w/w.

E3P have analysed the current risk to human health as a Moderate Risk which with mitigation can be reduced to Low. E3P mitigation recommendations included a 300mm cover system within landscaped areas, further assessment/mitigation of vapour risks and PPE for construction workers (Ref. 3).

In addition, E3P note that it is expected that the Made Ground would be mostly removed as part of enabling works and basement construction removing the much of the potential contamination source.

Curtins 2021 and 2023

During Curtins 2021 site investigation a programme of environmental chemistry testing was undertaken on soil samples obtained of the Made Ground (3 no.). Samples were tested for a broad suite of contamination as identified in the Interpretive Geo-Environmental and Geotechnical Letter Report (Ref. 1).

The Phase 2 investigation environmental chemistry results were compared with Generic Assessment Criteria for soils with respect to human health for a '*Residential without Home Ground Produce*' end use for a 6% w/w SOM for Made Ground. Several exceedances were identified from the Curtins 2021 and 2023 ground investigations and are summarised in Table 3.1C.

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Table 3.1C – Curtins 2021 and 2023 Environmental Chemistry Exceedances against Residential without Home Grown Produce 6% GACs

Determinant	Exploratory Hole ID	Depth (m bgl)	Concentration (mg/kg)	GAC (mg/kg)
Cyanide	TP-C4	1.30	1320	34
Arsenic	TP-C4	1.30	120	35
	WS-C4B	0.60	42	
	WS-C6	0.50	52	
		0.90	83	
	WS-C7	0.30	66	
		1.10	53	
	WS-C8	0.40	37	
Lead	TP-C4	1.30	1110	310
	WS-C4B	0.60	2010	
	WS-C6	0.50	6710	
		0.90	2280	
	WS-C7	0.30	316	
		1.10	363	
	WS-C8	0.40	2210	
Mercury	WS-C9	0.20	433	1
	WS-C6	0.50	1.73	
	WS-C7	0.30	2.08	
		1.10	1.04	
	WS-C8	0.40	1.14	
Benzo(a)anthracene	WS-C6	0.90	135	15
		0.50	7.41	3.2
Benzo(a)pyrene	WS-C6	0.90	78.3	
		0.50	8.66	4
Benzo(b)fluoranthene	WS-C6	0.90	83.5	
		0.90	190	32
Chrysene	WS-C6	0.90	190	32
Dibenzo(ah)anthracene	TP-C4	1.30	0.34	0.32

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Determinant	Exploratory Hole ID	Depth (m bgl)	Concentration (mg/kg)	GAC (mg/kg)
	WS-C4B	0.60	0.34	
	WS-C6	0.50	0.81	
		0.90	10.8	
	WS-C9	0.34	0.34	
Naphthalene	WS-C6	0.90	1470	13
Aro >C10-C12	WS-C6	0.90	3320	1200
Aro >C12-C16	WS-C6	0.90	5770	2500
Aro >C16-C21	WS-C6	0.90	9040	1900
Aro >C21-C35	WS-C6	0.90	10100	1900
TPH (Ali & Aro)	WS-C6	0.90	29100	1900

Concentrations of SVOC's and VOC's tested were recorded below laboratory limits of detection, with the exception of Dibenzofuran, Carbazole, 4-Nitrophenol, 2-Methylnaphthalene, Perylene, Benzene, Toluene, Ethylbenzene, m & p Xylene, o-Xylene, 1,3,5-Trimethylbenzene, and n-Butylbenzene. No GAC thresholds are available for these determinants, with the exception of 1,2,4-Trimethylbenzene, which was recorded below the relevant GAC threshold.

From the 2021 ground investigation loose insulation and loose fibres of Chrysotile and Amosite asbestos were positively identified in the Made Ground sample from WS-C4B at 0.60m bgl, recording 0.508% by weight. From the 2023 ground investigation asbestos fibres were positively identified during laboratory screening in two samples taken from WS-C7. Asbestos quantification has confirmed the asbestos was Chrysotile Board at a concentration of 0.836% and 0.074% within 0.30m and 1.10m bgl respectively. No asbestos containing materials (ACMs) were visually identified in the exploratory holes on site.

These findings are consistent with the first phase of investigation and previous recommendations for a clean cover system and mitigation of risk from vapours associated with hydrocarbon contamination was still noted to stand.

Accounting for both investigations the following risk ratings are assessed.

A **Moderate** risk rating was identified to end-users from inhalation or direct contact with several contaminants within shallow site soils a clean capping layer in soft landscaped areas.

A **Moderate** risk was identified to construction workers and adjacent residents was from soil dust inhalation or direct contact during construction works; owing to the presence of asbestos in shallow soils. An appropriate asbestos management measures should be put in place during construction which should include the provision of an asbestos management plan to mitigate risk to construction workers and adjacent residents.

3.2 Groundwater Contamination

E3P 2019

E3P collected three canal surface water samples for analysis from the Rochdale Canal in January 2020. No exceedances were identified against E3Ps criteria, the criteria was not provided.

E3P have undertaken a Tier 1 controlled waters risk assessment for leachate analysis and groundwater samples against the Drinking Water Standards (DWS). Within the leachate samples lead exceeded the DWS values within one sample (TP116 at 0.80m bgl).

No groundwater samples were obtained from the superficial or bedrock deposits beneath the site.

The risk to groundwater underlying the site (Secondary B aquifer) within the E3P report (Ref. 3) was considered Low on the basis that the site is underlain by low-permeable cohesive deposits and exceedances recorded were within Made Ground strata.

In addition, E3P note that it is expected that the Made Ground would be mostly removed as part of enabling works and basement construction removing the much of the potential contamination source.

Curtins 2023

During Curtins 2023 site investigation a programme of environmental chemistry testing was undertaken on groundwater samples (2 no.) obtained from monitoring wells.. Samples were tested for a broad suite of contamination as identified in the Interpretive Geo-Environmental and Geotechnical Letter Report (Ref. 1).

Table 3.2 – Curtins 2023 Groundwater Chemistry Exceedances against DWS/EQS

Determinant	Exploratory Hole ID	Concentration (µg/l)	EQS Screening Value (µg/l)	DWS Screening Value (µg/l)
Copper	BH6	50	1	2000
Zinc	BH6	14	10.9	5000
Anthracene	BH6	2.36	0.1	-
Benzo(a)pyrene	BH6	0.54	0.00017	0.01
Benzo(b)fluoranthene	BH6	0.54	50	0.1
Benzo(ghi)perylene	BH6	0.22	-	0.1
Benzo(k)fluoranthene	BH6	0.21	-	0.1
Indeno(123-cd)pyrene	BH6	0.24	-	0.1

These findings are consistent with the first phase of investigation and previous recommendations that the Made Ground would be mostly removed as part of enabling works and basement construction removing the source of the potential contamination.

Accounting for both investigations the following risk ratings are assessed.

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A **Low**-risk rating was identified to the nearest surface water feature and groundwater receptors considering the predominance of cohesive superficial soils beneath made ground on site acting to limit migration of contamination. Additionally, E3P concluded that the managed nature of the canal confirms that it is not in hydraulic continuity with other surface water features and aquifers beneath the site.

3.3 Ground Gas

E3P 2019

E3P have completed six gas monitoring visits between 9th December 2019 and 7th April 2022. The findings are summarised within the ground gas addendum letter (Ref.5).

The E3P report has stated the concentration of methane (CH₄) was at 0.1% v/v in all boreholes during all visits. Maximum Carbon dioxide (CO₂) was recorded at 1.8% v/v in WS106 on the sixth monitoring visit. A maximum flow was recorded at 6.9 l/hr within WS106 on the second visit however on evaluation it is likely due to a flooded borehole.

Boreholes WS101, WS106 and WS109 were flooded during all visits which is likely the result of the elevated CO₂ and flows. WS102 was not included within the monitoring period due to the well being reported as 'destroyed'.

The E3P report has concluded the GSV of none flooded wells is below <0.07 therefore the site is classified as a Characteristic Situation 1 (CS-1) and no ground gas protection measures are required.

Curtins 2023

Six gas monitoring visits were undertaken between 27th February and 27th March 2023. Barometric pressures ranging between 987 and 1024mb were recorded during the monitoring period.

Methane (CH₄) was recorded below the instrument's detection limit within all the monitoring wells. Carbon Dioxide (CO₂) recorded a maximum concentration of 5.6% v/v within WS-C7 during the second visit. Hydrogen Sulphide (H₂S) was not recorded in any boreholes. Carbon Monoxide (CO) was recorded in only the first monitoring visit at all three monitoring locations, between 10ppm (WS-C6 and WS-C7) and 14 ppm (WS-C9). The maximum peak air flow rate was recorded in WS-C9, at 56.6 on the third visit, reducing to a steady state air flow rate of 0.0 l/hr.

Boreholes WS-C6 and WS-C9 were flooded during all visits which is likely the result of the elevated CO₂ and flows.

The GSV of none flooded wells is noted as 0.006 l/hr, however Carbon Dioxide values were recorded greater than 5%v/v on multiple occasions within WS-C6 and WS-C7, therefore a Characteristic Situation 2 (CS2) gas regime, for which gas protection measures are required.

4.0 Conceptual Site Model

A conceptual site model (CSM) for the site has been developed as part of the E3P site investigation that was undertaken at the site and considered based on the current enabling works proposed.

The CSM details a number of pollutant linkages at the site, however, based on the risk assessments undertaken, the potential contaminant linkages (PCLs) listed in *Table 4.1* were identified as requiring remediation to enable the safe re-development of the site.

Table 4.1 – Potential Contaminant Linkages

PCL	Sources	Receptor	Potential Pathway	Remediation Recommended
1	Made Ground soils containing elevated concentrations of asbestos fibres/containing materials	On-site Construction workers Off-site Residents Passers-by	Direct contact, dermal uptake, soil and dust ingestion and inhalation	Appropriate PPE for construction staff and suitable asbestos management measures during construction
			Inhalation of dust and fibres (off-site)	Allow for provision of a suitable thickness of clean and inert cover in all areas of soft landscaping as part of future development works
2	Made Ground soils containing elevated concentrations of contamination	On-site Utilities	Migration through permeable strata and preferential pathways	A United Utilities Risk Assessment to be undertaken to determine requirement for barrier pipes
3	Elevated concentrations of soil gas (CO ₂) identified in site soils beneath proposed apartments	On-Site End Users (Residents) Future Maintenance Workers Staff Construction Workers	Vertical and horizontal migration through the superficial and bedrock deposits	Characteristic Situation 2 Gas Protection Measures
4	Volatile contaminants such as PAHs, hydrocarbons	On-site Construction workers Off-site Residents Passers-by	Inhalation of vapours. Migration through permeable strata and preferential pathways.	E3P have noted that contaminated locations may be excavated and removed from site, or treated on site.

Section 7.0 presents a strategy for handling unexpected contamination or contaminative incidents. It is further recommended that watching brief/periodic site visits are undertaken by a Geo-Environmental Engineer to record any unexpected contamination as outlined in Section 7.3.

5.0 Remedial Works

In this document the term 'remediation' is used to define specific works required to address potential issues arising from contamination in site soils and ground gases, with due account taken of the known history of the site and the proposed end-user.

With reference to the Conceptual Site Model and the potential contaminant linkages detailed in *Table 3.1* three remedial actions are recommended in order for the site to be brought up to a condition that is deemed 'suitable for use';

- **Remedial Action 1:** Appropriate PPE for all construction workers and suitable asbestos management measures.
- **Remedial Action 2:** Engineered capping to serve as physical barrier between Made Ground and site surface in soft landscaped areas preventing direct contact, dermal uptake and limiting the derivation of dust. Prohibitive access restrictions to be in place in areas which cannot be remediated to the specification outlined.
- **Remedial Action 3:** Provision of gas protection measures within all proposed buildings on site.
- **Remedial Action 4:** Delineation, excavation, and removal of VOC contaminated soils.
- **Remedial Action 5:** Delineation, and treatment of VOC contaminated soils on site.

Measures for dealing appropriately to unexpected contamination encountered on site and the recommendation for a watching brief (part time) by an Environmental Engineer during earthworks are outlined within Section 7.3.

5.1 Remedial Action 1 – Contamination and Asbestos Management During Construction

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk.

It has been assumed that any future construction works on site will be undertaken in compliance with these requirements to address PCL1 (*Table 4.1*).

CL:AIRE have published guidance to aid in the classification of remediation works on Asbestos Containing Soils (ACS) compliant with Control of Asbestos Regulations 2012 (CAR). This is detailed in CL:AIRE (2016) "Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry Guidance.

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Any works with asbestos containing soils are required to determine their classification in accordance with Control of Asbestos Regulations 2012. The specialist groundworks contractor is therefore to designate the works based on the investigation results but utilising their own additional testing and delineation if they deem it to be required. Subsequently the specialist groundworks contractor is to compile a method statement to establish an appropriate management, monitoring and supervisory procedure for the movement of soils as part of the required cut and fill (earthworks) operations. The specialist remediation contractor is to be responsible for management and record keeping as detailed in their method statement document.

Where, from the site investigations, materials are known to contain asbestos fibers good practice (JIWG CAR-Soil and CAR 2012) prescribes such material to be segregated to ensure materials would not cross-contaminate other soils and to reduce the risk of further fiber release to site workers.

Section 3.1 above should be consulted together with Curtins Exploratory Hole Plan Drawings in *Appendix A* (Ref. EHLP_Ancoats_B V01) for the locations, depths and concentrations asbestos was identified during the E3P and Curtins Ground Investigations (Ref. 1, 2 and 3).

Concentrations of asbestos fibers encountered within the Made Ground soils by E3P was relatively low at <0.001% w/w. However Curtins 2021 and 2023 ground investigations identified asbestos between 0.074 to 0.836% w/w.

Materials containing asbestos >0.1% w/w would be classed as hazardous waste.

Good practice prescribes that any fragments or asbestos containing materials where identified should be picked where possible and to be kept separated in line with those from any soil arisings. This is typically carried out by picking visible fragments at the point of excavation. Such operations are carried out by suitably qualified staff, wearing disposal overalls (type 5/6), gloves and fine dust (FPP3) masks in combination with adoption of dust suppression techniques and monitoring or other applicable methods as recommended by the Asbestos Management Specialist. The qualified staff are to be trained in the identification of asbestos at source. The qualification and competencies of all operatives undertaking monitoring and calibration documentation of equipment should be provided to the Engineer.

Existing Made Ground should not be crushed or in any way treated due to risk of asbestos fibre release. It may be possible to use Made Ground soils as general fill subject to in situ trial tests and where managed appropriately by the Method Statement compiled by the Asbestos Management Specialist.

5.2 Remedial Action 2 – Engineered Capping

The primary PCL identified at the site relates to the direct contact, dermal uptake, soil and dust ingestion and inhalation of asbestos fibres in soil and soils and soil derived dust (PCL 1, *Table 4.1*).

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The potential for exposure to asbestos fibres is highest within soft landscaped areas where receptors (maintenance staff and public) at the site are most likely to come in contact with the contaminated Made Ground soils. Drawings are included within *Appendix A*.

Hardstanding, including the building footprints, vehicular tarmac, pedestrian tarmac and concrete and block paving are considered sufficient to break the potential contaminant linkage, PPL 1, detailed in *Table 3.1* and therefore no specific remediation measures, above activities required for construction, are considered necessary if and where these are installed at the site.

For all soft landscaped areas, a clean cover layer is recommended. It is therefore recommended that verified clean capping, comprising a minimum total thickness of 600mm is incorporated in general soft landscaping areas. This is to be made up of a minimum 150mm imported topsoil and 450mm of sub-soil. Additionally, a high visibility warning geotextile break layer is to be installed beneath the clean cover system. Additionally, landscaped areas which will incorporate planted trees will require a more substantial clean cover layer, comprising a minimum thickness of 900mm. This is to be made up of a minimum 150mm imported topsoil and 750mm of sub-soil.

This is anticipated to provide adequate protection of human health with consideration of likely exposure and is in accordance with Manchester City Council's Planning & Contaminated Land Technical Guidance (2021) and should be incorporated in all proposed soft landscaped areas.

5.3 Remedial Action 3 – Ground Gas Protection Measures

The primary Potential Contaminant Linkage (PCL) identified at the site relates to the acute risk of explosion and/or asphyxiation of property and end-users through the vertical and horizontal migration of hazardous gases (asphyxiating) from soil gas sources as identified in PCL3 (*Table 3.1*) into proposed apartment buildings on site.

Based on the findings of the ground gas monitoring undertaken as part of Curtins 2023 Ground Investigation (Ref. 2) carbon dioxide was identified as the primary hazardous gases. It is considered that the site should be classified as Characteristic Situation 2 and therefore ground gas protection measures are required to mitigate the risk to the property and end-users.

It is recommended that the building type is classified as *Type C Commercial* building, in accordance with BS;8485:2015 +A1:2019 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

On this basis, a **minimum protection score of 2.5 points** should be achieved in non-ventilated areas as a minimum, in accordance with BS 8485. A minimum of two types of protection are required from i) a structural barrier, ii) ventilation measures, iii) gas membrane.

The chosen protection elements at the time of writing were understood to include a i) sub-floor void (1.5 points) and ii) gas membrane (2 points).

5.3.1 Gas Membrane Specification

Where a gas resistant membrane is adopted, it must meet all the following criteria:

- i) Sufficiently impervious to methane and carbon dioxide with a methane gas transmission rate $<40.0 \text{ ml/day/m}^2/\text{atm}$ (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method);
- ii) Capable after installation of providing a complete barrier to the entry of the relevant gas;
- iii) Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- iv) Sufficiently strong to withstand in service stresses (e.g. due to ground settlement if placed below a floor slab);
- v) Sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools);
- vi) Chemically resistant to degradation by other contaminants that might be present; and
- vii) Verified in accordance with CIRIA C735.

If the above criteria are met (as set out within BS8485) then a gas resistant membrane, that is correctly installed and verified, can achieve *2 points*.⁹

It is recommended that an appropriately experienced and qualified workforce is employed to install gas protection systems. Installers should hold relevant qualifications such as Cskills Awards L2 NVQ diploma for the installation of gas membranes.

Any changes to the proposed protection measures outlined above should be made with reference to BS 8485.

It is recommended that an appropriately experienced and qualified workforce is employed to install gas protection systems. Installers should hold relevant qualifications such as Cskills Awards L2 NVQ diploma for the installation of gas membranes.

5.4 Remedial Action 4 – Delineation, excavation, and removal of VOC impacted soils areas from site.

A PCL identified at the site relates to the inhalation exposure to site end users from elevated concentrations of the semi-volatile contaminants in soil and soil derived dust

During the intrusive investigation, volatiles and semi-volatile PAHs was recorded above 'Residential' thresholds in WS112, WS-C4B, WS-C6, WS-C9, and TP-C4 at depths of between 0.34 and 1.30m bgl.

The potential for exposure of volatile-impacted soil to take place is greatest in gardens and areas of soft landscaping. There is also potential for exposure through the building footprint to site end users from volatilisation and inhalation if a hydrocarbon-resistant membrane is not installed.

Remediation Strategy

Remedial measures for the Naphthalene-impacted soils are detailed in *Table 4.1*.

Table 5.4 – *Excavation and Removal of VOC and semi volatile Impacted Soils*

Impacted Soils	Further Remedial Measures Required	Rationale
WS112 – 1.20m bgl WS-C4B – 0.60m bgl WS-C6 – 0.50m bgl WS-C6 – 0.90m bgl WS-C9 – 0.34m bgl TP-C4 – 1.30	The material centred around these locations are excavated (approximately 7.00m x 5.00m) to 1.50m depth and the material removed from site to a suitably licenced facility.	Remove potential for exposure of receptors via direct contact with and volatilisation and inhalation of Naphthalene in shallow Made Ground soils.

The excavation of the VOC impacted soils is to be supervised by the Engineer, with soil samples from the sides and base of the excavation to be collected and sent to environmental chemical analysis to confirm no elevated levels of Naphthalene remain in the soils in this area.

5.5 Remedial Action 5 – Delineation, and treatment of VOC contaminated soils

In-Situ Treatment of Soils

On-site treatment of contaminants is often a useful methodology for a variety of contaminants. In addition, in-situ treatment is often most economically viable for heavy or gross contamination. Areas of free phase contamination have been encountered within the unsaturated zone, with limited gross contamination encountered within the saturated zone (i.e. groundwater)/dissolved phase contamination. Investigations to date suggest that if sources of mobile contamination are present in the unsaturated zone these are likely to be localised and associated with former structures. As such, the treatment of site wide soils has the potential to remove the dissolved phase sources of contamination on-site with any localised mobile contamination being constrained to a limited site area and may be deemed sufficient to warrant the adoption of in-situ treatment techniques.

It is considered that any re-use of site soils will be subject to compliance with Waste Management Legislation/Permitting and Definition of Waste: Code of Practice (DoWCoP) guidance.

A specialist remediation contractor should be contacted to understand feasibility and discuss potential for treatment.

Ex-Situ Treatment of Soils

Notwithstanding the above, the ex-situ treatment of gross contamination hotspots (notably within southern central boundary and north-eastern area) is considered viable within these such areas where present in the unsaturated zone. Any such treatment on-site would be subject to an odour assessment and any re-use on-site would be subject Detailed Quantitative Risk Assessment (DQRA) to inform the potential risk to future site users.

6.0 Specification for Site Won and Imported Soils

This section outlines the required chemical testing specification that the proposed engineered capping must meet to satisfy Remedial Action 2 along with a chemical testing specification. This does not cover general fill materials as it is anticipated this will be covered within the earthwork specification.

6.1 Sourcing of Materials

Off-Site Sources

It is anticipated that materials may be imported to the site for use in constructing the clean engineered capping across the site's soft landscaping areas. It is strongly recommended that materials are sourced from reputable suppliers and comprise materials that have been suitably processed to produce standardised materials.

It is not recommended that materials are imported directly from 'donor' development sites. Imported material will also require verification testing to ensure suitability for reuse, and it is strongly advised that the Contractor undertake their own independent verification testing if accepting material from a third party, rather than relying on supplier reports.

It is anticipated that crushed hardcore stone and brick may be imported for use in earthworks such as in construction of piling mat.

On-Site Sources

Based on the findings of the Site Investigation, it is considered highly unlikely that the general shallow Made Ground could be considered 'uncontaminated', 'clean' or 'suitable' material for re-use as a subsoil or topsoil in soft landscaped areas due to the presence of asbestos fibres at a number of locations across the site, as well as due to the physical natures of the existing site soils.

6.2 Imported Topsoil

Imported Topsoil will invariably be required and should be supplied and placed in accordance with the Architects' specification but generally it is anticipated that all topsoil will be a minimum of 150mm thick in proposed soft landscaped areas (as part of the 600mm overall layer thicknesses as detailed in *Section 5.0*. Where topsoil is imported, it is to be 'Multipurpose' in accordance with BS 3882:2015 'Specification for Topsoil and Requirements for Use'.

The topsoil should also be confirmed to be 'suitable for use' as per the analysis outlined in *Section 6.4*.

6.3 Imported Subsoil

Where imported subsoil is required as part of the growing medium this can be cohesive or granular but should be free-draining and confirmed to be 'suitable for use' as per the analysis outlined in *Section 6.4* and compliant with BS 8601:2013 'Specification for subsoil and requirements for use'.

6.4 Chemical Composition of Soils

All materials used in capping should not contain concentrations of contaminants that present an unacceptable risk to the health of future site occupants or off-site receptors.

The Contractor shall be responsible for demonstrating that imported material is 'clean' and therefore suitable for use as part of the engineered capping or else as fill material. This will include the recovery of samples for laboratory testing from both the material source and verification testing of material following delivery to site. The required testing frequencies for materials source types are detailed below. Other sources may be applicable, however testing frequencies shall be confirmed with the Engineer prior to acceptance.

Table 6.4.1 – Environmental chemistry testing frequency for imported soils

Source	Testing Frequency
Imported Topsoil/Subsoil (Greenfield/ Manufactured)	On Site Verification: One sample every 200m ³ used (or a minimum of 4 No. samples whichever is greater), testing to be undertaken once material is imported to site.
Imported Topsoil/Subsoil (Remediated/ Brownfield/ Unknown)	On Site Verification: One sample every 50m ³ used (or a minimum of 4 No. samples whichever is greater), testing to be undertaken once material is imported to site.

The environmental chemistry testing requirements are as *Table 6.4.2*. Additions to the suite and frequency of sampling may be required based on the source of the imported materials. For example, if the imported Topsoil is not naturally sourced, e.g. recycled soil, further chemical determinants may be added to the chemical analysis suite at the discretion of the Engineer.

Table 6.4.2 – Environmental chemistry analysis suite for imported soils.

Suite Reference	Environmental Chemistry Analysis
Greenfield, Brownfield or Manufactured Soils	Total metals: Arsenic, cadmium, chromium, chromium VI, lead, mercury, selenium, copper, nickel, zinc, water soluble boron; pH Soil Organic Matter Asbestos Screening Polycyclic Aromatic Hydrocarbons by GC-MS (Detection Limit 0.1mg/kg for each compound) Total Petrol Hydrocarbons (Full TPHCWG analysis – aromatic/aliphatic split, Detection Limit 0.01mg/kg for each banding C5 to C10 and 1mg/kg for bandings above C10)

Assessment criteria: Concentrations of the above determinants shall not exceed the 'Residential without Home Grown Produce' screening criteria (contained within Appendix B).

Definition of 'clean': Where ALL concentrations are less than these values the soils shall be defined as 'clean'.

Soil organic matter (SOM): A review of the thresholds may be made for specific soil sources whereby the Soil Organic Matter has typically ranged between 0.7 and 8.2%.

6.5 Validation of Capping Thickness in Soft Landscaped Areas

Confirmatory analysis outlined previously is required to confirm the suitability of the capping layer.

Evidence that the specified depth of capping has been provided will be required.

Evidence could either be in the form of topographic surveys at the base of excavations together with material order sheets (geo-textiles) and the final finish levels or hand excavated trial pits advanced in areas where material has been placed.

The pits shall be excavated to the base of the interface between the existing Made Ground and the engineered capping layer with the granular break layer clearly visible.

A photographic record of the hand excavated trial pits would also be required in accordance with the best practice examples.

7.0 Strategy for Handling Potentially Contaminated Soils and Contaminative Incidents of site

7.1 Contaminated Soils

Surplus soils to be removed from site, which have been identified as unsuitable for re-use should be loaded onto a lorry, covered securely and transported directly to the landfill facility.

Where stockpiling is unavoidable, the stockpile should be located on an impermeable membrane and be covered also with a low permeability membrane at the end of each working day. Where soils are wet when excavated, measures should be taken to ensure there is no runoff from the soils onto the surrounding soils.

Duty of Care: Under his duty of care, the Principal Contractor shall ensure the proper and safe disposal of waste from each site after it has been passed on to another party. In this respect details of the landfill facility to be used and the company disposing of the waste with regard to hazardous and non-hazardous waste shall be provided to the Site Manager. Copies of Consignment Notices for special waste and Waste Transfer Notes for hazardous and non-hazardous waste shall be kept on site for review by Curtins Consulting.

7.2 Contaminative Incidents

It is possible that some below ground features / structures exist that have not been recorded on plans and have not been encountered during the ground investigation works or demolition works. It is possible that further unknown/unrecorded substructures (e.g. fuel tanks) may exist which if ruptured may release materials that could contaminate the surrounding soils and groundwater (petroleum hydrocarbons, solvents, for example). In the unlikely event that this occurs an outline strategy is detailed below.

Where such a tank/pipework is damaged during excavation and the contents are released into the surrounding soil, the tank/pipework should be immediately pumped dry into another suitable container and a trench with a low permeability base formed around the tank/pipework to prevent seepage laterally and to collect the contaminant. Where groundwater is encountered in the trench, it should be pumped into a suitable container and tested for the contaminant. All soils affected shall then be tested and removed from site as appropriate.

Where the damage is caused to the underside of a tank and seepage is vertical, the contaminants may present a risk of polluting the groundwater. In this instance and subject to the findings of a risk assessment boreholes may be required to probe and intercept the contaminant. The contaminant will then be pumped into suitable containers.

Remediation Strategy

The procedure outlined in *Section 7.3* should also be adhered too and the Engineer shall approve all proposals for such remediation.

7.3 Unexpected Contamination & Watching Brief

In the event that material is revealed on the site of a nature that does not accord with the previously observed and recorded descriptions the following procedure is to be complied with.

- a) Cease and make safe all excavations in this location and report observations to the Site Manager.
- b) The Site Manager is to notify the Engineer.
- c) Under guidance of the Engineer take representative samples of the suspect materials and forward to a suitably accredited laboratory for analysis.
- d) Manchester City Council and if relevant the Environment Agency are to be kept fully informed of any such occurrences. Manchester City Council must agree the strategy for dealing with unexpected contamination before works continue in that area.
- e) Await Engineers instructions with respect to re-commencement of the works and or removal from of suspect material to a suitably licensed disposal facility (following guidance outlined in *Section 8.1* above).

It is recommended that in addition to the above a 'watching brief' for unexpected contamination is undertaken. It is recommended that this includes periodic site visits undertaken by the engineer during the groundworks phase such during site preparation, removal of contaminated soils from site as well as visiting site as soon as potential contamination is observed by the contractor. Records of any unexpected contamination must be included within the Remediation Completion Report.

7.4 Health & Safety

This section details health and safety requirements associated with contaminated land, but does not seek to cover all aspects to be managed by the Contractor under CDM Regulations and detailed in Method Statements.

The works are likely to generate soils, dust, groundwater and other materials that may be impacted with petroleum hydrocarbons and other related chemicals. The Contractor shall incorporate in its health and safety plan provisions for protecting personnel from physical and chemical hazards associated with these materials. The health and safety plan should also incorporate personnel decontamination requirements and facilities.

Remediation Strategy

Contractor Method Statements

The Contractor is required to prepare method statements relating to the separate tasks highlighted and provide these to the client or Principal Designer along with the Engineer for review prior to the commencement of the related works.

The Contractor shall induct all its employees and subcontractors into the relevant aspects of their health and safety plan and method statements prior to each employee and/or subcontractor commencing works on site.

No works shall commence until the clients' nominated Principal Designer has approved the task specific method statement.

Explosion Risk

Of primary concern is the potential for explosion throughout the proposed removal works, including the associated pipework removal.

An explosion could be caused through the introduction of an ignition source to vapours which are potentially present within the volatile contaminated soils. Soils in these areas should be treated as containing vapour rich voids and therefore potentially explosive until proven otherwise.

This assumption drives every aspect for the safe removal and destruction of the tanks.

Excavation & Other Works

Before commencement of any excavation or other works, the following minimum precautions should be observed:

- Clearance of other services;
- Appropriate 'Danger' notices displayed and exclusion 'work' zone enforced;
- Exclusion of ignition sources within the work zone;
- Provision of a water supply hose/mist to damp down the immediate area to reduce the risk of spark generation (moderated to minimise contaminant migration); and
- Exclusion of personnel from the immediate worksite except for those directly involved with the phase of works.
- The above listed precautions do not override other precautions that will need to be covered by the Contractor's overall Health and Safety Plan, aspects such as firefighting, PPE, excavation stability/shoring (if required) etc.

7.5 Environmental Controls

Environmental Controls are the responsibility of the Contractor. However, in general this section details specific requirements for potentially contaminated soils, and is not intended to cover all aspects to be managed by the Contractor and detailed within their Method Statements.

Remediation Strategy

Without limiting the Contractor's obligations, it shall be their responsibility to comply with all applicable laws, regulations and rules relating to potential contamination with particular regard to:

- Surface water run-off;
- Airborne particulates/vapours/odour; and
- Control of spillage.

Method statements are to be provided to the Engineer and should incorporate the environmental management measures pertaining to the above factors, with further detail given below.

Surface Water Run-Off

The Contractor is responsible for ensuring that site surface water run-off does not leave the site.

The Contractor is to provide for necessary surface water diversion systems as required to keep the construction area free from excess surface or groundwater that may interfere with the works.

All personnel engaged by the Contractor should be trained in response techniques (e.g. use of absorbent materials, etc.) to ensure that any surface water run-off with fuel leakage impact or associated potentially contaminated soil is managed appropriately.

7.6 Airborne Particles/Vapour/Odour

The Contractor is responsible for the implementation of dust suppression in work areas, using water or other means of suppression that are not considered harmful to the environment. The Contractor should also set out procedures for the mitigation of any potential odours that may arise from exposed contaminated soils that could affect off-site users (adjacent residents).

7.7 Control of Spillage

During the phase of works, any type of spillage (including fabricating, hydraulic oils, fuels and/or other materials) should be immediately contained, removed and disposed of, with any further surrounding areas cleaned.

8.0 Verification

Validation visits shall be undertaken by an appropriately qualified environmental engineer throughout the construction phase to ensure that the requirements of the Remediation Strategy have been implemented at the site. This includes periodic visits/watching brief during groundworks. It is anticipated records of the following will be taken during the below phases of work:

- Placement of the requisite depths of clean capping material in required areas of proposed soft landscaping and in existing tree root protection zones;
- Documentation of general works including records from watching brief, asbestos management procedures during the works and records of contaminative incidents and any unexpected contamination;
- On delineation and removal of contaminated soils from site for off-site disposal;
- On treatment of contaminated soils to be kept on site; and
- Installation of gas protection measures.

All associated documentation pertaining to the above will be supplied to the Engineer and incorporated within a Completion Report.

Confirmatory analysis is required to confirm the suitability of any imported material, the results of which will be included within the Completion Report. Any additional, confirmatory testing will also be included herein.

Verification through either hand excavated trial pits or comparison of reduced and final level surveys will all be included within the Completion Report to confirm the provision of a requisite depth of clean capping.

The frequency and timing of visits by Curtins shall be determined following confirmation of the construction phase programme and the chosen protection elements.

To verify the gas protection measures, it is assumed that the following will be undertaken:

- An appropriately experienced and qualified workforce is employed to install gas protection systems. Installers should hold relevant qualifications such as Cskills Awards L2 NVQ diploma for the installation of gas membranes.

The following verification records should therefore be obtained by the specialist installer contractor/on site staff:

- Photographic log of installation and testing if undertaken, of gas protection measures (ventilation/gas membrane).
- Internal inspection and verification records including any discrepancies and non-conformities in accordance with CIRIA C735.

The above records should be reviewed by an independent third party/Curtins which should include visits to site to provide a secondary visual verification.

Remediation Strategy

Where specialised installation staff are not used a revision to this plan/schedule will likely be required and validation visits potentially increased.

9.0 Reporting

A Completion Report will be required on completion of the works confirming that the remedial works have been completed satisfactorily. The report will contain information including the following:

- Confirmation that the capping has been installed as specified within the various proposed soft landscaped areas, including capping thickness validation records and photographs;
- Confirmation of imported capping materials suitability for soft landscaped areas including environmental chemistry testing results;
- Records of delineation works for contaminated soils including chemical testing certificates, photographic records;
- Records of treatment works undertaken on contaminated soils.
- Records of waste transfer notes and consignment notes for contaminated material disposed of off-site.
- Details and documentation of asbestos management measures utilised during the works;
- Confirmation that the remediation has been undertaken satisfactorily and in accordance with the Remediation Statement;
- Confirmation that the remediation objective has been achieved (see *Section 5.0*);
- Details of any unexpected contamination encountered on site and appropriate measures taken to respond;
- Revised conceptual model showing no potentially significant contaminant linkages remain at the site;
- Confirmation that the gas protection system has been installed as specified and the required points of protection are met, verified through a visual inspection with associated photographic record. This should include inspection and review of site records on the ventilation measures and or gas membrane; and
- Specification and details of the gas membrane used where applicable.

It should be noted that the above list does not include the requirements of an Earthworks Completion report and Materials Management Completion report (where soils are re-used under an MMP) which are also likely to be required in addition to the above remediation completion report.

Appendix A – Drawings & Specifications

- *Curtins Exploratory Hole Location Plan, Jersey Wharf, Plot C, Manchester, Ref. 077879-CUR-00-XX-DR-GE-80002*
- *E3P Exploratory Hole Location Plan, Jersey Street, Drawing No. 004*
- *PRP, Proposed Ground Floor Plan, Jersey Wharf, Ref. JWA-PRP-A1-GR-DR-A-002100-RevA*



EXISTING BOREHOLES

-  EXISTING CURTINS BOREHOLES
-  EXISTING CURTINS TRIAL HOLES
-  EXISTING E3P BOREHOLES
-  EXISTING E3P TRIAL HOLES

CURTINS 2023 BOREHOLES

-  CURTINS WINDOWLESS SAMPLE BOREHOLES

Rev:	Description:	Date:	By:	Chkd:
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Structures - Civils - Environmental - Infrastructure - Transport Planning - Sustainability - Expert Advisory Services
Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status:

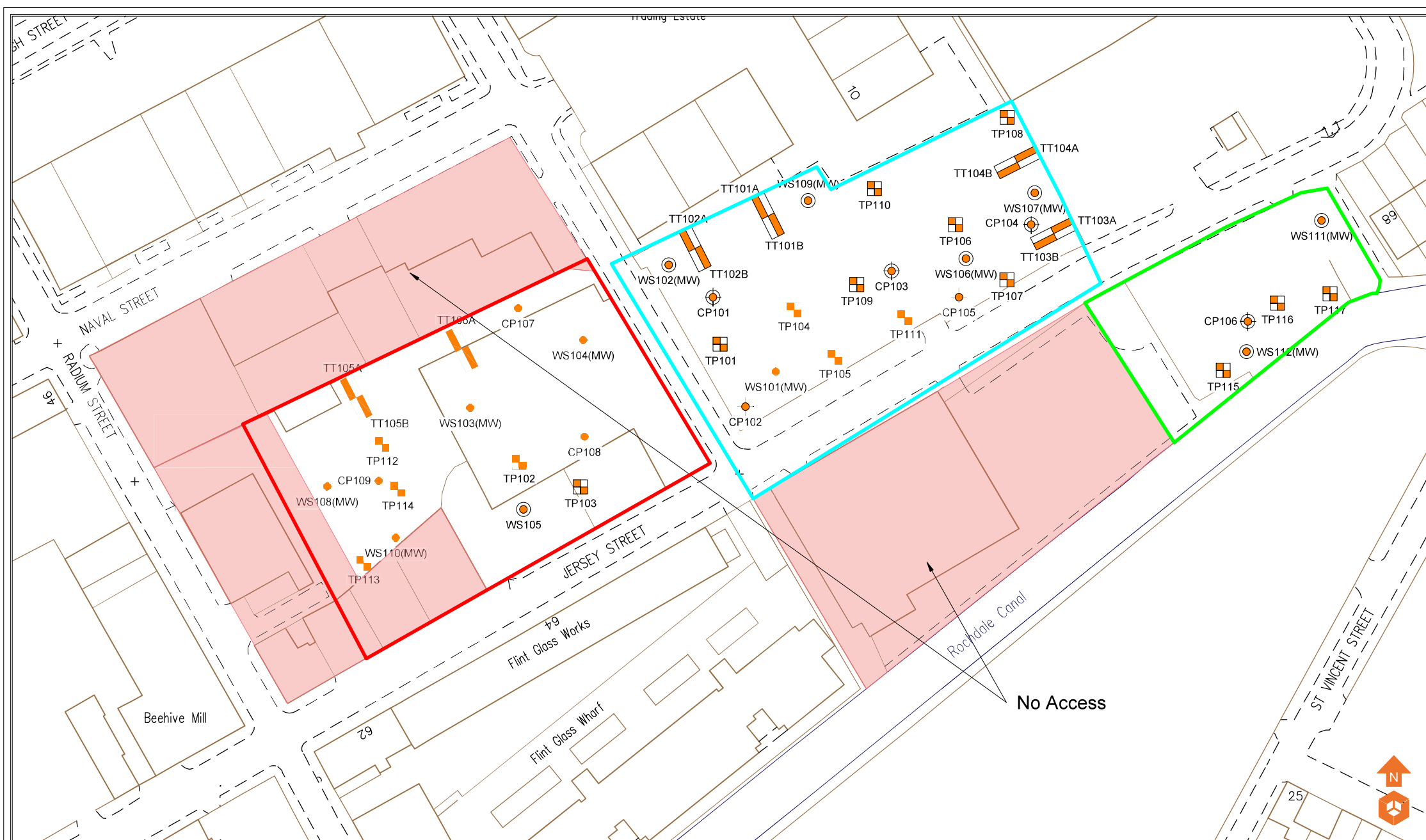
INFORMATION

Project:
JERSEY WHARF, PLOT C, MANCHESTER

Drg Title:
EXPLORATORY HOLE LOCATION PLAN

Scale: NTS	Size: A3	First Issue: 14/03/2022	Drawn: JL	Checked: RA
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Drg No: 077879-CUR-00-XX-DR-GE-80002	Rev: P01
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- Location Symbols
- Approximate Window Sample Probehole Location
 - Approximate Trial Pit Location
 - Approximate Site Trench Location
 - No Access
 - Parcel A
 - Parcel B
 - Parcel C

Notes:					
P1	-	22.11.2019	DRAFT	CB	RJW
Phase	Revision	Date	Issue	Drawn	Checked

Client:	
Manchester Life	
Job Title:	
Jersey Street	

Job No:	13-729	Date:	22.11.2019
Drawing No:	004	Scale:	NTS
Drawing Title:		Exploratory Hole Location Plan	

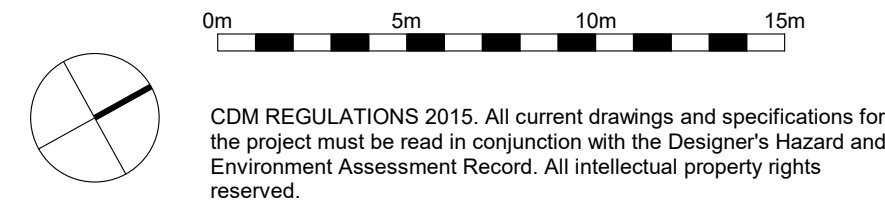


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- SITE BOUNDARY
- ELECTRIC CABLE
- SEWER LINE



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Rev	Date	Description
A	29.04.2022	Issued for planning

Dwn	Ckd	Drawn	SK
SK	AH	Checked	AH
		Date	11/15/21
		Scale @ A1	1 : 200

Jersey Wharf - Ancoats
(BA9225)
Proposed Ground Floor Plan

Project	Origin	Volume	Level	Type	Role	Number
JWA - PRP - A1 -	GR - DR - A -	002100				
Revision	Status					
A -	PLANNING ISSUE -					

PRP

Appendix B – ‘Residential’ Screening Criteria for Imported Materials

Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	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 49	7.7 21	220 250
Lead	200	310	80	2,300	630	1,300
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130⁽¹⁰⁾	180⁽¹⁰⁾	53⁽¹¹⁾	980⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	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						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₆	160	160	3900	12000	600000	180000
EC ₅₋₆ - EC ₈	530	530	13000	40000	620000	320000
EC ₅₋₈ - EC ₁₀	150	150	1700	11000	13000	21000
EC ₁₀₋₁₀ - EC ₁₂	760	770	7300	47000	13000	24000
EC ₁₂₋₁₂ - EC ₁₆	4300	4400	13000	90000	13000	26000
EC ₅₋₁₆ - EC ₃₅	110000	110000	270000	1800000	250000	490000
EC ₃₅₋₃₅ - EC ₄₄	110000	110000	270000	1800000	250000	490000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₇	300	1400	57	86000	56000	92000
EC ₅₋₇ - EC ₈	660	3900	120	180000	56000	100000
EC ₅₋₈ - EC ₁₀	190	270	51	17000	5000	9300
EC ₁₀₋₁₀ - EC ₁₂	380	1200	74	34000	5000	10000
EC ₁₂₋₁₂ - EC ₁₆	660	2500	130	38000	5000	10000
EC ₅₋₁₆ - EC ₂₁	930	1900	260	28000	3800	7800
EC ₂₁₋₂₁ - EC ₃₅	1700	1900	1600	28000	3800	7900
EC ₃₅₋₃₅ - EC ₄₄	1700	1900	1600	28000	3800	7900
Aliph + Arom EC >44-70	1900	1900	3000	28000	3800	7900
Aromatic						
Benzene	0.33 0.87	1.0 3.3	0.07 0.18	95 98	73 140	110 230
Ethyl benzene	350	840	90	2800⁽⁸⁾ [66000]	2800⁽⁸⁾ [25000]	2800⁽⁸⁾ [27000]
Toluene	610	2700	120	4400⁽⁸⁾ [190000]	4400⁽⁸⁾ [56000]	4400⁽⁸⁾ [100000]
Xylene ⁽⁹⁾	230	290	160	2600⁽⁸⁾ [32000]	2600⁽⁸⁾ [43000]	2600⁽⁸⁾ [31000]
Phenol	420	520	280	3200⁽¹⁴⁾ (38000)	3200⁽¹⁴⁾ (10000)	3200⁽¹⁴⁾ (9300)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	13	13	24	1100	4900	3000
Acenaphthylene	920	6000	160	100000	15000	30000
Acenaphthene	1100	6000	200	100000	15000	30000
Fluorene	860	4500	160	71000	9900	20000
Phenanthrene	440	1500	90	23000	3100	6300
Anthracene	11000	37000	2200	540000	74000	150000
Fluoranthene	890	1600	290	23000	3100	6400
Pyrene	2000	3800	620	54000	7400	15000
Benz(a)anthracene	13	15	13	180	29	62
Chrysene	27	32	19	350	57	120
Benzo(b)fluoranthene	3.7	4.0	3.9	45	7.2	16.0
Benzo(k)fluoranthene	100	110	130	1200	190	440
Benzo(a)pyrene	3.0 5.0	3.2 5.3	3.5 5.7	36 77	5.7 10	13 21
Indeno(123cd)pyrene	41	46	39	510	82	180
Dibenzo(ah)anthracene	0.3	0.32	0.43	3.6	0.58	1.4
Benzo(ghi)perylene	350	360	640	4000	640	1600
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.0014	0.0015	0.0018	0.12	3.5	5.4
Trichloroethene (TCE)	0.075	0.08	0.21	5.7	120	120
1,1,1,2 Tetrachlorethane	6.4	8.2	4.4	560	1400	2100
Tetrachlorethane (PCE)	0.90	0.92	3.6	95	1400	1500
1,1,1 Trichlorethane	39	40	240	3000	140000	100000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs**
- Soil organic matter (SOM) is assumed to be 6% - 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 bungalows 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, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 <u>21</u>	6 <u>21</u>	1.8 <u>170</u>	33 <u>49</u>	7.7 <u>21</u>	220 <u>250</u>
Lead	<u>200</u>	<u>310</u>	<u>80</u>	<u>2,300</u>	<u>630</u>	<u>1,300</u>
Mercury (elemental)	1	1	26	26	16	26 ⁽⁸⁾ [30]
Mercury (inorganic)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 <u>79</u>	170 <u>170</u>
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₆	78	78	1700	5900	590000	130000
EC ₆ - EC ₈	230	230	5600	17000	610000	220000
EC ₈ - EC ₁₀	65	65	770	4800	13000	18000
EC ₁₀ - EC ₁₂	330	330	4400	23000	13000	23000
EC ₁₂ - EC ₁₆	2400	2400	13000	82000	13000	25000
EC ₁₆ - EC ₃₅	92000	92000	270000	1700000	250000	480000
EC ₃₅ - EC ₄₄	92000	92000	270000	1700000	250000	480000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₇	140	690	27	46000	56000	84000
EC ₇ - EC ₈	290	1800	51	110000	56000	95000
EC ₈ - EC ₁₀	83	110	21	8100	5000	8500
EC ₁₀ - EC ₁₂	180	590	31	28000	5000	9700
EC ₁₂ - EC ₁₆	330	2300	57	37000	5100	10000
EC ₁₆ - EC ₂₁	540	1900	110	28000	3800	7700
EC ₂₁ - EC ₃₅	1500	1900	820	28000	3800	7800
EC ₃₅ - EC ₄₄	1500	1900	820	28000	3800	7800
Aliph + Arom EC >44-70	1800	1900	2100	28000	3800	7800
<i>Aromatic</i>						
Benzene	0.16	0.49	0.035	50	72	100
Ethyl benzene	150	380	39	1200⁽⁸⁾ [35000]	1200⁽⁸⁾ [24000]	1200⁽⁸⁾ [22000]
Toluene	270	1300	51	1900⁽⁸⁾ [110000]	1900⁽⁸⁾ [56000]	1900⁽⁸⁾ [95000]
Xylene ⁽⁹⁾	98	120	70	1200⁽⁸⁾ [14000]	1200⁽⁸⁾ [42000]	1200⁽⁸⁾ [23000]
Phenol	290	420	140	1500⁽¹⁴⁾ (35000)	1500⁽¹⁴⁾ (10000)	1500⁽¹⁴⁾ (8300)
<i>Polycyclic Aromatic Hydrocarbons (PAH)</i>						
Naphthalene	5.6	5.6	10	460	4900	1900
Acenaphthylene	420	4600	69	97000	15000	30000
Acenaphthene	510	4700	85	97000	15000	30000
Fluorene	400	3800	67	68000	9900	20000
Phenanthrene	220	1500	38	22000	3100	6200
Anthracene	5400	35000	950	540000	74000	150000
Fluoranthene	560	1600	130	23000	3100	6300
Pyrene	1200	3800	270	54000	7400	15000
Benz(a)anthracene	11	14	6.5	170	29	56
Chrysene	22	31	9.4	350	57	110
Benzo(b)fluoranthene	3.3	4.0	2.1	44	7.2	15
Benzo(k)fluoranthene	93	110	75	1200	190	410
Benzo(a)pyrene	2.7	3.2	2	35	5.7	12
Indeno(123cd)pyrene	36	46	21	510	82	170
Dibenzo(ah)anthracene	0.28	0.32	0.27	3.6	0.57	1.3
Benzo(ghi)perylene	340	360	470	4000	640	1500
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00087	0.001	0.001	0.077	3.5	5
Trichloroethene (TCE)	0.034	0.036	0.091	2.6	120	91
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800
Tetrachlorethane (PCE)	0.39	0.4	1.5	42	1400	1100
1,1,1 Trichlorethane	18	18	110	1300	140000	76000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs
- Soil organic matter (SOM) is assumed to be 2.5% - 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 bungalows 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, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	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 49	7.7 21	220 250
Lead	200	310	80	2,300	630	1,300
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	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 - TPHCWG method						
EC ₅₋₅ - EC ₆	42	42	730	3200	570000	95000
EC ₆₋₆ - EC ₈	100	100	2300	7800	600000	150000
EC ₈₋₈ - EC ₁₀	27	27	320	2000	13000	14000
EC ₁₀₋₁₀ - EC ₁₂	130	130	2200	9700	13000	21000
EC ₁₂₋₁₂ - EC ₁₆	1100	1100	11000	59000	13000	25000
EC ₁₆₋₁₆ - EC ₃₅	65000	65000	260000	1600000	250000	450000
EC ₃₅₋₃₅ - EC ₄₄	65000	65000	260000	1600000	250000	450000
Aromatic risk banded hydrocarbons - TPHCWG method						
EC ₅₋₅ - EC ₇	70	370	13	26000	56000	76000
EC ₇₋₇ - EC ₈	130	860	22	56000	56000	87000
EC ₈₋₈ - EC ₁₀	34	47	8.6	3500	5000	7200
EC ₁₀₋₁₀ - EC ₁₂	74	250	13	16000	5000	9200
EC ₁₂₋₁₂ - EC ₁₆	140	1800	23	36000	5100	10000
EC ₁₆₋₁₆ - EC ₂₁	260	1900	46	28000	3800	7600
EC ₂₁₋₂₁ - EC ₃₅	1100	1900	370	28000	3800	7800
EC ₃₅₋₃₅ - 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⁽⁸⁾ [17000]	520⁽⁸⁾ [24000]	520⁽⁸⁾ [17000]
Toluene	120	610	22	860⁽⁸⁾ [59000]	860⁽⁸⁾ [56000]	860⁽⁸⁾ [87000]
Xylene ⁽⁹⁾	41	53	28	480⁽⁸⁾ [69000]	480⁽⁸⁾ [41000]	480⁽⁸⁾ [17000]
Phenol	180	310	66	760⁽¹⁴⁾ (31000)	760⁽¹⁴⁾ (10000)	760⁽¹⁴⁾ (7600)
Polycyclic Aromatic 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(123cd)pyrene	27	45	9.5	500	82	150
Dibenzo(ah)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 Tetrachlorethane	1.2	1.5	0.79	110	1400	1500
Tetrachlorethane (PCE)	0.18	0.18	0.65	19	1400	810
1,1,1 Trichlorethane	8.8	9	48	660	140000	57000

Notes

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- 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 bungalows 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, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
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- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

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