

A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

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28/03/2024

Client: Tilbury Douglas Construction



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a	Final	20/03/24	IB	JB
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CONTENTS

1	Introduction	1
2	Site details and description	3
3	Review of Previous Reports to Date	4
4	Remediation Strategy	7
4.1	Revised conceptual model	7
4.1.1	Sources	7
4.1.2	Pathways	7
4.1.3	Receptors	7
4.2	Remedial Options Appraisal	8
4.3	Anticipated Remedial Works	8
5	Earthworks Phase Environmental Monitoring and Mitigation	9
5.1.1	Dust Mitigation	9
5.1.2	Vapour and Odours	9
5.1.3	Noise	9
5.1.4	Run-off into Drains	9
5.2	Contractors Responsibilities	9
5.2.1	Health and Safety	9
5.3	Asbestos Risk to Construction Workers	10
5.3.1	Complying with Control of Asbestos Regulations (CAR): Risk Assessments, Licensing and Training .	10
5.3.2	CAR Risk Assessments	10
5.3.3	Respiratory Protective Equipment (RPE)	11
5.3.4	Licensing	11
5.3.5	Training Requirements	12
5.3.6	Training vs. Competence.....	12
6	Contingency for any Unknowns	13
7	Clean Cover System	14
7.1.1	Requirements	14
7.1.2	Installation	14
7.1.3	Independence and Competence	14
7.1.4	Verification	14
8	Ground Gas Protection Verification Plan.....	15
8.1	Membrane Design	15
8.2	Membrane Specification	15
8.3	Verification Plan	15
8.4	Independence and Competence.....	16
8.5	The Inspection Regime.....	16
8.6	Inspection Timing and Frequency.....	17
9	Final Verification Report.....	18
9.1.1	Verification Report.....	18
10	Regulatory Approvals.....	19
11	References	20
	APPENDIX C – HUMAN HEALTH RISK ASSESSMENTS.....	24



APPENDIX D – Drawings.....	1
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Appendix A: Glossary of Terms

Appendix B: Qualitative and Quantitative Risk Assessment

Appendix C: Human Health Risk Assessments

Appendix D: Drawings



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

1 INTRODUCTION

SoilSafe was commissioned by Tilbury Douglas Construction to undertake a Remediation Strategy for a site referred to as Rochdale SEND School, Rochdale (the "Site"), located west of Heywood Sports Village, West Starkey Street, Heywood OL10 4TW.

This report has been produced in order to provide a detailed remediation scheme/strategy and method statement for the remediation works so that the site can be made suitable for its intended use by removing any unacceptable risks to human health. This report includes details on the anticipated works and provides method statements for these works in order to achieve the proposed remedial objectives/criteria presented through the report. Details of site management procedures including environmental monitoring and mitigation and the contractor responsibilities are given, as well as details of what should be included as part of the required verification report to verify the remedial works outlined in this document. As a result of the above objectives being achieved, this report is satisfactory to discharge the pre commencement contaminated land planning conditions.

It is understood that the proposed development comprises the Erection of a two-storey school building, with associated access, parking, refuse store, outdoor recreation facilities, landscaping and ancillary works. The development refers to the planning permission (Ref. 23/00852/PSID) associated with Rochdale Borough Council. A Materials Management Plan is currently being prepared to allow the safe and legal reuse of foundation and service trench soil arisings materials and the import of materials from other local sites. The MMP will be presented under separate cover; this report relates only to the remediation strategy for the site.

The ground investigation reports to date have carried out generic risk assessments for both the PAH / asbestos contamination and the ground gas risk assessment. It is considered, however, that the risks posed to this development are borderline and the site may benefit from some Detailed Quantitative Risk Assessments (DQRA). Furthermore, the majority of the peat soils will be removed from site and replaced with imported materials under a Hub and Cluster MMP. The sources for this imported material are not yet known; however, given that the material brought to a site for a hub and cluster MMP cannot increase the contamination risks at the site, there is a very real possibility that the contamination status of the site may improve and some or all of the elements of this remediation strategy may not be required. As such, this report is subject to the results of a ground gas DQRA and an asbestos DQRA (both of which may or may not be carried out and the decision of the client and in agreement with regulators). Should the decision be made to carry out one or both of the DQRAs, the results of will be submitted to the local authority and, if required, the Environment Agency. Should the results of said DQRA conclude that the residual risk to identified receptors is negligible, then a revised remediation strategy report will be submitted to the local authority.

It should be noted that this Remediation Strategy contains a Ground Gas Protection Verification Plan. At present, it is considered that the floor slab will be suspended cast *in situ* and a suitable membrane system will be supplied by a fully qualified specialist supplier and installer. At this early pre commencement stage of the development, detailed sections and drawings showing the design of the system have not been produced. This report will be updated with these detailed sections and drawings once these are made available. The updated report will be submitted to the local authority for review and comment.

The site is currently an area of unused grassland (a former sports pitch). The site is underlain by varying layers of Made Ground, underlain by Peat, between 0.35m and 3.00m bgl, comprising plastic to firm black and brown fibrous PEAT with wood fragments; over • Glacial Deposits (Glacial Till and Glaciofluvial Deposits) between 0.80m to >12.45m bgl, comprising soft sandy slightly gravelly CLAY, with occasional bands of clayey gravelly SAND of varying thickness. It is the intention of the client to remove all peat and replace with imported soils, some of which may comprise Made Ground. In addition, site won Made Ground soils may be used if deemed geotechnically suitable. The building will then be piled with a suspended floor slab.

Several phases of ground investigation have been undertaken at the site. It was identified within these reports that there is a low to moderate risk regarding asbestos and potential contaminated soils:

Human health:

- Asbestos fibres (<0.001%v/v of chrysotile) measured in soil samples in the Made Ground.
- Chloroethene (vinyl chloride) has been tested in the original investigation, all results were recorded as less than the laboratory limit of detection. It should be noted, the limit of detection is in excess of the GAC but Hydrock do not believe this poses a risk.
- Slightly elevated concentrations of Chloromethane (maximum value of 0.033mg/kg vs a GAC of 0.019mg/kg).

Plant growth:

- No exceedances.



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

Controlled Waters:

- Soil leachate and groundwater samples exceed WQT for Copper, Iron, Manganese, Ammoniacal Nitrogen, pH and petroleum hydrocarbons fractions, as an indicator of potential groundwater risk.

Ground gases or vapours:

- Moderate risk from ground gases and CS2 conditions apply.

Radon:

- The site is not in a Radon Affected Area.

Water supply pipes:

- This is a brownfield site and the presumption in the guidance is that barrier pipe will be used; however, the investigation and assessment has indicated no significant Contaminants of Concern and as such standard pipework may be suitable for the site following negotiations with the supply company.

The comments and opinions presented in this report are based on the desk study and ground conditions encountered during an intrusive investigation performed by SoilSafe Ltd and the laboratory determined chemical test results. There may be other conditions prevailing on the Site which have not been revealed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for any conditions not revealed by this investigation. Any diagram or opinion on the possible configuration of the findings is conjectural and given for guidance only. Confirmation of intermediate ground conditions should be undertaken if deemed necessary.

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A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

2 SITE DETAILS AND DESCRIPTION

Table 2-1 Current Site Overview.

Site name	Rochdale SEND School
Site address	Land North Of West Starkey Street, Heywood, ,
National Grid Reference	National Grid Reference SD 385123, 411132
Location description	The site is situated on a series of terraces on a hillside, with short slopes between different areas. The existing school building is at approximately 188 m OD, with a slope down to a terrace containing sports pitches to the southeast at approximately 185 m OD
Approximate Site area	The site is approximately 100m x 100m
Site shape	The site is irregularly shaped
Current land use	The site is an area of unused grassland, bordered to the north by sports pitches, to the east by Heywood Sports Village and a carpark, to the south by West Starkey Street and to the west by a row of trees and properties along Cedar Avenue. The site is flat-lying and available ordnance survey mapping shows the site to have an approximate elevation of 115m AOD. The land to the north and the east is around 1m higher. The site is currently owned by Rochdale Borough Council and site access is available through Heywood Sports Village.
Surrounding land uses	The surrounding area has seen residential, commercial and industrial development over the years. Of note, several cotton mills and associated reservoirs are shown to be present within 200m of the site from the late 1800's. From 1911 a 'refuse destructor' is present 150-200m to the northeast of site and filter beds and tanks are present 150m to the southeast, until 1929 when a tank is shown in vicinity. From 1929 the Moss Iron Works are shown adjoining the Times Cotton Mill, 250m to the southeast. From 1957 the Times Mill (now an Electrical Engineering company) and the Iron Works have expanded significantly, until 1984 when the iron works is redeveloped as a Supermarket. The current Heywood Sports Village replaces a previous swimming pool and sports village directly east of the site. More recently the site was an old football pitch.



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

3 REVIEW OF PREVIOUS REPORTS TO DATE

The following reports are associated with previous works on site:

The following documents, reports etc have been provided to Hydrock by Tilbury Douglas on behalf of The Department for Education for use in the preparation of this report:

- Mott MacDonald. October 2019. 'SEN Schools North West – Heywood Geotechnical and Geo-environmental Desk Study', Ref: 410640-03-A (Mott MacDonald, 2019);
- Mott MacDonald. August 2020. 'HVA SEND Schools North West – Heywood – Geological Technical Note', Ref: N/A (Mott MacDonald, 2020);
- Geotechnics. July 2020. 'Heywood School, Rochdale Factual Report – Ground Investigation', Ref: 9228L/ea2 (Geotechnics, 2020); and
- Coal Authority, October 2021. Consultants Coal Mining Report. Heywood Sports Centre, OL10 4TW, Ref. 51002685361001, 01.10.21.
- Ellis Williams, October 2021, Preliminary Landscape Masterplan, Rochdale SEND, Ref. RSC-EWA-ZZ-ZZ-DR-L-79001, REV P4.
- Hydrock, October 2021 Coal Mining Risk Assessment (Ref: 19522-HYD-XX-XX-RP-GE-0001).

A summary of the report findings are presented below:

Table 3-1: Summary of Geotechnical and Geoenvironmental Ground Investigation Reports to date

Site Setting	The history of the site has been reviewed from historical OS maps at various scales (as presented in the provided Geotechnical and Geo-environmental Desk Study) to identify any previous land use on site or nearby that may pose a geo-environmental risk to the proposed scheme. In summary, the site appears not to have changed from fields shown on the earliest available maps from 1851, until circa 1956, when four rows of houses are shown under construction on the southern half of the site. The houses ran north-south from West Starkey Street. However, by 1977 the properties are no longer present and the site is part of a larger playing field. The site has not been developed in the subsequent years. The surrounding area has seen residential, commercial and industrial development over the years. Of note, several cotton mills and associated reservoirs are shown to be present within 200m of the site from the late 1800's. From 1911 a 'refuse destructor' is present 150-200m to the northeast of site and filter beds and tanks are present 150m to the southeast, until 1929 when a tank is shown in vicinity. From 1929 the Moss Iron Works are shown adjoining the Times Cotton Mill, 250m to the southeast. From 1957 the Times Mill (now an Electrical Engineering company) and the Iron Works have expanded significantly, until 1984 when the iron works is redeveloped as a Supermarket. The current Heywood Sports Village replaces a previous swimming pool and sports village directly east of the site. More recently the site was an old football pitch.
Geology	The superficial geology comprises Glaciofluvial Deposits (sand and gravel) present in the southwest and centre of the site with Glacial Till (clays, sands, gravels and cobbles) present over the remainder of the site. The solid geology comprises Pennine Lower Coal Measures Group, consisting of interbedded Mudstone, Siltstone, Sandstone and coal seams, of Carboniferous age. The Coal Mining Risk Assessment, states that two seams of coal (possibly the Arley Coal and Smith (Bottom Neddy) Coal), sub crop within 250m of the north-eastern corner of the site, with the one seam (possibly Smith Coal) being very close to the north-eastern corner of the site. The Arley Coal was formerly referred to as the Rowley Mine Coal. The abandonment plan (Ref 16820/6) shows the 'crop of the Royley Mine Coal' seam to the north east of the site area. A geological fault with a downthrow to the east, is located 300m to the west of the site. The ground conditions proven by a previous investigation (Geotechnics, 2020), comprise: • Made Ground (gravelly silty clayey SAND with cobbles) up to 0.90m bgl. • Peat (spongy fibrous PEAT with rootlets and plant remains) up to 0.80-2.60m bgl, increasing in thickness from southwest to northeast from 0.30 to 1.65m. • Alluvium (very soft to soft silty sandy gravelly CLAY grading to slightly sandy gravelly SILT) up to 5.50-7.00m bgl. • Interlayered Glacial Till (stiff sandy gravelly CLAY) and Glaciofluvial Deposits (medium dense gravelly silty SAND) to at least 12.50m bgl. As detailed in the previous report, the strata underlying the Peat and Made Ground has been classified as Alluvium. While a case can be made for classifying these clays as Alluvium, Hydrock believes this should be classified as Glacial deposits due to the unsorted nature of



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

Geology and Hydrogeology	the clays encountered and the published BGS mapping information The shallow ground conditions were described as soft and loose, with Peat being particularly susceptible to settlement via consolidation and compression. The Glacial Till and Glaciofluvial Deposits present on site are classed by the Environment Agency as a Secondary undifferentiated Aquifer and are likely to provide a minor/very limited base flow contribution to the River Roch to the northwest. The Pennine Lower Coal Measures is classified as a Secondary A Aquifer and is inferred to provide minor base flow contribution to surface water bodies on a regional basis. The site is not in any Source Protection Zone and there are no active licensed groundwater abstractions within 250m of the site. The environmental data report indicates a potential for groundwater flooding of property situated below ground level and to occur at the surface. In the previous investigation, groundwater was struck at 10.70 - 10.90m bgl within Glaciofluvial Deposits and was recorded at 9.60 – 9.90m bgl across six monitoring visits. The primary natural drainage feature is the River Roch approximately 350m to the northwest, flowing east to west. Reference to the Environment Agency web site shows the site is located within the catchment of the North West River Basin District, with the specific river water body being the Roch Spodden to Irwell. The current (2019 cycle 2) overall status under the Water Framework Directive is 'moderate'. There are no licensed surface water abstractions within 250m of the site.
Soil Contamination – Human Health	The screening exercise has identified asbestos and chloromethane in Made Ground, and Peat concentrations above the GAC. These are considered further below to assess if the exceedance may be acceptable with respect to the proposed development. The phrase 'further assessment' does not necessarily mean that the soil is 'contaminated' or not fit for use. No Asbestos Containing Materials have been identified visually. However, there were a number of exploratory hole locations where asbestos fibres (<0.001%/v of chrysotile) have been detected in the Made Ground, which requires further consideration. Guidance on the assessment of risk associated with asbestos in soils was published by CIRIA C733 in 2014. This proposed a semi-quantitative risk assessment methodology for asbestos, based on potential for inhalation of airborne fibres. As many factors affect the potential magnitude of fibre inhalation in addition to concentration, it is not practicable to derive generic screening criteria for asbestos concentrations in soil. Risk factors applicable to this site are considered below: • No visible evidence of asbestos materials was noted in the exploratory holes, suggesting that asbestos materials are present only as very minor constituents in the soil. • Where asbestos was identified by laboratory testing, the concentration was assessed as being less than the limit of detection (0.001%). • Only chrysotile (white) asbestos fibres were identified. Chrysotile is the least hazardous of the three principal asbestos forms, most commonly associated with asbestos cement products. • Although the impacted soils might be excavated and disturbed, with consequent potential for fibre release during groundworks, future disturbance is likely to be minimal due to the requirement to import a clean topsoil/subsoil growing medium (proposed 450mm) or hardstanding cover. • The materials in which asbestos was identified were of mixed composition but included some clay content. The likelihood of asbestos fibres being released from cohesive materials is less than might be the case for loose material such as sand /silt. Overall, the risk associated with the identified presence of asbestos is considered to be low. However, mitigation will be required to ensure risks to site users remains negligible.
Soil Contamination – Controlled Waters	The EQS/DWS have been exceeded for a number of chemicals of potential concern in both the leachate samples (Made Ground and Peat) and groundwater sample from the Glaciofluvial Deposits. In the Made Ground the EQS was exceeded for ammoniacal nitrogen, pH and the DWS was exceeded for iron and pH. In the Peat, EQS was slightly exceeded for copper. In the Glaciofluvial Deposits the EQS was exceeded for manganese and ammoniacal nitrogen, as well as the petroleum hydrocarbon fractions Aliphatic >EC8-EC10 to >EC12-EC16 and Aromatic >EC10-EC12 to >EC21-EC35. The DWS was exceeded for manganese and the petroleum hydrocarbon fractions Aliphatic >EC8-EC10 to >EC12-EC16 and Aromatic >EC10-EC12 to >EC21-EC35 (see below). Whilst there are exceedances of the water quality targets, excluding the petroleum hydrocarbons, these are considered not to represent a significant risk of pollution of Controlled Waters for the following reasons: • Many of the exceedances are only slight; • Chemicals such as ammonium are likely to be related to the long-term degradation of organic materials found in the clays and silts of the Made Ground, Peat or Glacial Deposits;



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

	• The inland waters EQSs for copper, manganese, are based on the bioavailable fraction and because bioavailability has not been calculated for these metals, the assessment is conservative as it assumes 100% bioavailability; and • The Pennine Lower Coal Measures Secondary A Aquifer is separated from the Made Ground and Peat above it by more than 10m of low-permeability clay. The River Roch, is in turn separated from the site by a distance of 350m. There is currently no explanation for the hydrocarbon content of the groundwater sample from BH0102, as no visual or olfactory evidence of petroleum hydrocarbons, has been noted within the surrounding soils in BH102 or in any of the surrounding exploratory holes. This discovery will be subject to additional testing to rule out either cross-contamination or a laboratory reporting error. On 13/01/2022 the monitoring well at BH102 was developed and a sample of the groundwater was collected for chemical analysis. There was no visual or olfactory evidence of contamination on the water that was purged or sampled from BH102. The chemical analysis results of the groundwater show all hydrocarbons to be below the limit of detection. On this basis, and given that there has been no viable source of hydrocarbons identified on site it would be justified to suggest that the elevated concentrations identified in the previous investigation is a result of possible cross-contamination or a laboratory reporting error. No further consideration to petroleum hydrocarbons in groundwater is required.
Ground Gas Risk Assessment	computed GSV for carbon dioxide indicates CS2 conditions, with methane classifying as CS1. As such, given the frequently detected concentrations of carbon dioxide above 5% in the peat deposits in addition to the sensitivity of the site redevelopment as a school facility, it would be appropriate the classify the site as Characteristic Situation 2. Within the PLCM flow rate and steady methane concentrations remained below the limit of detection, and steady carbon dioxide concentrations did not exceed 0.2%. Peak carbon monoxide was recorded at 108ppm in RO01 on one occasion, however the steady levels ranged between 5ppm and 14ppm. As such the computed GSV for carbon dioxide and methane indicates CS1 conditions. Peak carbon monoxide was detected at 108ppm on one occasion in the PLCM, however this is considered to be a spurious reading resulting from the groundwater level exceeding the response zone, hence the steady carbon monoxide on the same occasion falling to 7ppm. On the basis that the computed GSV for the PLCM is CS1 and that mitigation measures are required for all new buildings commensurate with CS2 Conditions due to gassing peat deposits then no uplift from CS2 conditions are considered necessary. Mitigation of the risk from ground gases needs to be undertaken in accordance with BRE 414, CIRIA 665, BS 8485:2015 +A1:2019, CIRIA C735. In accordance with BS 8485:2015 +A1:2019, the design of gas protection measures needs to be undertaken in accordance with the Characteristic Situation and the building type: • The site is classified as Characteristic Situation 2. • The school is classified as a type C building, as such requires 2.5 points of protection.



4 REMEDIATION STRATEGY

4.1 REVISED CONCEPTUAL MODEL

The revised conceptual site models taken from the Hydrock Ground Investigation Report (Ref: 19522-HYD-XX-XX-RP-GE-0002) outlines the source-pathway-receptor linkages identified for the site. The below conceptual site model was produced:

4.1.1 Sources

- Human Health: Presence of low level asbestos within Made Ground soils.
- Carbon dioxide from biodegradable matter in the Peat.
- TPH in soils in the northeast of the site.

4.1.2 Pathways

- Dermal contact, ingestion and inhalation of contaminated dust and fibres.
- Migration through soils or groundwater to indoor air.
- Direct contact

4.1.3 Receptors

- Future users of the Site.
- End users of new buildings (asphyxiation).
- Plastic pipes
- Site investigation, demolition and construction staff and future underground service maintenance workers from hazardous short-term exposure.



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

Table 9.1 – Revised conceptual; Site Model

Pollutant linkage				
	Source	Pathway(s)	Receptor(s)	Qualitative risk assessment
1	Human Health: Presence of Asbestos and PAHs within Made Ground soils.	Dermal contact, ingestion and inhalation of contaminants including contaminated dust migration during construction.	Future site users (School)	Mild x Unlikely = Negligible Risk
			Current site users (site visitors)	Mild x Unlikely = Negligible Risk
			Adjacent site users (commercial and residential)	Mild x Unlikely = Negligible Risk
			Construction, site investigation, demolition and future workers	Medium x Unlikely = Low Risk
2	Carbon dioxide from biodegradable matter in the Peat.	End users of new buildings (asphyxiation).	Future site users (School)	Medium x Unlikely = Low Risk
3	TPH in soils in the northeast of the site.	Direct Contact	Plastic Pipes	Medium x Unlikely = Low Risk

This CSM is subject to the results of a ground gas DQRA and an asbestos DQRA, the results of which will be submitted to the local authority. Should the results of said DQRA conclude that the residual risk to identified receptors is negligible, then a revised remediation strategy report will be submitted to the local authority.

4.2 REMEDIAL OPTIONS APPRAISAL

Three options have been assessed in order to break the pollutant linkage at the site:

- 1) The removal of **widespread** sources of the contamination would involve excavating Made Ground soils in the vicinity of the proposed soft landscaped area and removing to landfill. Given the costs and sustainability issues, this option is not considered the most appropriate.
- 2) The removal of the human health pathways associated with the identified contamination would involve the installation of a clean cover system in all landscaped areas and is considered to be the most viable option.
- 3) Installation of barrier pipe in the northeast of the site is considered to be the most economic and sustainable option for the final pollutant linkage.

4.3 ANTICIPATED REMEDIAL WORKS

As alluded to in the introduction to this report, the following Remediation Strategy has been devised in order to make the site safe and suitable for redevelopment. This is subject to the results of a ground gas DQRA and an asbestos DQRA, the results of which will be submitted to the local authority. Should the results of said DQRA conclude that the residual risk to identified receptors is negligible, then a revised remediation strategy report will be submitted to the local authority.

Based upon the findings of the site investigation by others and the proposed development plans, the following Remediation Strategy has been devised in order to make the site safe and suitable for redevelopment.

- General site clearance.
- Removal of all peat soils and replacement with imported soils under MMP (separate to this report).
- Placement of barrier pipe in the northeast of the site.
- Installation of ground gas protection measures.
- Implementing a 600mm thick clean cover system in areas of soft landscaping to YALPAG specification.



5 EARTHWORKS PHASE ENVIRONMENTAL MONITORING AND MITIGATION

In order to mitigate the environmental impacts of the works on nearby residents and sensitive areas, a programme of measures should be implemented during the remediation works.

5.1.1 Dust Mitigation

Appropriate measures shall be implemented at all times during the remediation works, to minimise dust emissions. Soils should be dampened down, as necessary, and activity should be minimised in extremely windy conditions to prevent dust nuisance. An adequate supply of water shall be maintained on site at all times to allow for dust suppression activities to be carried out at short notice.

When dusty material is being loaded onto trucks, extra care should be taken to ensure that the drop height is minimised. Trucks should be suitably covered when leaving the site with contaminated material to prevent dust migration.

The amount of disturbed surfaces left exposed for significant time periods should be minimised. Stockpiles of fine or loose materials should be tamped down or covered to reduce the production of dust. Traffic both entering and working on the site shall obey a maximum speed limit of 5mph.

5.1.2 Vapour and Odours

Based upon the absence of any observations of recorded significant olfactory evidence of contamination during the of site investigation works, excavations across much of the site are not considered likely to give rise to significant odour problems. During any remedial works, the Supervising Engineer should monitor the atmosphere and, in the case of excessive vapours being detected at the site boundary, should instruct the contractor to cover the excavation face releasing the vapours with soil or sand (some suitable material should be required to be kept of site as a contingency) and any stockpiles should be located away from residential properties.

5.1.3 Noise

The requirements of BS 5228:1997 "Noise and Vibration Control on Construction Sites" shall be adhered to at all times. All machinery shall be fitted with effective silencers and shall be serviced at regular intervals. No plant shall be operated with engine covers raised.

5.1.4 Run-off into Drains

All potential drainage on site and any discharge points should be identified, including land drains, foul sewers, surface water drains and any combined drains. These should be marked, as appropriate, for easy identification. Works should be minimised during periods of heavy rainfall to reduce the likelihood of contaminated run-off. Temporary containment and cover measures or tamping down of stockpiles to reduce run-off shall be used where necessary.

5.2 CONTRACTORS RESPONSIBILITIES

The following regulations, guidance and legislation relating to the works shall be complied with at all times:

- The Health and Safety Executive "Protection of Workers and the General Public During Redevelopment of Contaminated Land," HS(G)66, HMSO 1991;
- The Construction (Design and Management) Regulations 1994;
- The Control of Substances Hazardous to Health Regulations 1994.
- The Control of Asbestos Regulations 2012.
- The Contractor shall detail in his method statement how any hazardous materials and / or situations are to be handled / managed.
- The Contractor shall also be responsible for the following:
 - The provision of health and welfare facilities;
 - Obtaining the relevant consents / approvals;
 - Mitigation measures;
 - Stability of works.

5.2.1 Health and Safety

Contaminated materials are present on site. During the reclamation and construction phases of site development, it will be necessary to protect the health and safety of the personnel. General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

Redevelopment of Contaminated Land” (HS(G)66). In summary, the following measures are suggested as a minimum level of protection:

- All ground workers should be issued with protective clothing, hard hats, footwear, and gloves. Personnel should be instructed as to how they are to be used;
- All personnel shall wear hard hats, high visibility clothing and protective footwear at all times;
- Hand washing and boot cleaning facilities shall be provided;
- No smoking except in designated areas;
- Good practices relating to personal hygiene shall be adopted.

Before site operations are commenced, the necessary COSHH Assessments, Method Statements and Health and Safety Plans should be completed and issued by the Principal Contractor in Accordance with the CDM regulations.

All visitors to site must enter and register at the main site office, subject to the relevant terms and conditions of entry. All site personnel shall undergo a site specific health and safety induction prior to commencement of works on site.

Suitable precautions will be implemented to prevent dust and odour emissions during all reclamation work activities. The contractor shall provide details of emergency procedures.

5.3 ASBESTOS RISK TO CONSTRUCTION WORKERS

5.3.1 Complying with Control of Asbestos Regulations (CAR): Risk Assessments, Licensing and Training

Asbestos has been encountered within Made Ground beneath the site. This section outlines CAR risk assessments and where they should be applied in relation to assessing and remediating brownfield sites. The information below details the different classifications of work with asbestos under CAR, summarises the legal requirements for asbestos awareness training for all involved in the investigation and management of asbestos containing soil (ACS), and details the potential requirements for suitable proficiency training relating specifically to ACS.

5.3.2 CAR Risk Assessments

A CAR Risk Assessment is required for any work which may expose employees to asbestos. It is recommended that a precautionary approach is adopted if there is any doubt about risks associated with asbestos.

CAR risk assessments are needed at remediation stage but may be incorporated into the overarching health and safety risk assessments for the site. The CAR risk assessment must:

- Identify the type of asbestos to which employees are liable to be exposed, where possible, or assume it is present in different forms;
- Determine the type and extent of exposures to asbestos that may occur during the work.
- Identify the steps to be taken to prevent exposure or reduce it to the lowest level reasonably practicable; and,
- Consider the effects of control measures that have been or will be taken.

The CAR risk assessment should include any information used to inform the risk assessment such as asbestos reports or desk study information. In the event that this information is not available, the assessor should be assumed that all forms of asbestos may be present on Site. For all investigation and remediation of ACSs, a detailed written work plan should be produced and followed as detailed on the HSE website and in the CAR. The CAR risk assessments for specific investigations or remediation projects, will determine whether or not work is 'licensable work' (LW), notifiable non-licensable work' (NNLW) or 'non-licensed work' (NLW). In addition, training requirements are also defined by the CAR risk assessment.

Some examples of control measures that apply during site reconnaissance, site investigation works, and site remediation are given below and should be applied depending on the asbestos risks identified for the Site at each stage of investigation:

- Avoiding stirring up dust;
- Cleaning footwear after site works;
- Removing and bagging any overalls for disposal/laundering;
- Respirators and hygiene facilities for high risk sites;



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

- Segregated welfare units;
- Wetting ground
- Minimising soil disturbances;
- Implementation or retention of capping/break layers;
- Implementation of awareness training;
- Air monitoring;
- Managing stockpiles;
- Area segregation;
- Wheel washing
- Road washing/cleaning

It is important to note that during Site reconnaissance visits, Site investigation works and Site remediation that asbestos should not be considered in isolation and control measures are likely to form part of a wider health and safety precautions.

5.3.3 Respiratory Protective Equipment (RPE)

RPE is the last line of defence and its requirement would be defined by the CAR risk assessment. HSE (2013b) advises that RPE should have an assigned protection factor of 20 or more for all work with asbestos. In certain instances, full face-piece, positive pressure respirators with a protection factor of 40 are necessary (to EN 12942:1998, TM3).

Suitable types of RPE for most **short** duration non-licensed asbestos work:

- Disposable respirator to standards EN149 (type FFP3) or EN1827 (type FMP3)
- Half mask respirator (to standard EN140) with P3 filter
- Semi-disposable respirator (to EN405) with P3 filter

These filters are not suitable for people with beards/stubble or for long or continuous use.

5.3.4 Licensing

CAR defined certain types of activities involving asbestos as 'licensable work' (LW) or as 'notifiable non-licensable work' (NNLW). All other work would be 'non-licensable work' (NLW).

LW is defined as:

- work where exposure is not 'sporadic and low intensity'
- work where the risk assessment cannot demonstrate that the control limits (four hour and 10 minute limits) will not be exceeded
- work on asbestos coating
- work on AIB or insulation where risk assessment is either of first two points above or not of short duration (where short duration is defined for any work liable to disturb asbestos as taking less than two hours per week (including ancillary work) and no one person carries out that work for more than one hour').

NNLW includes work with:

- AIB or asbestos insulation of short duration that is not licensable
- fire-damaged asbestos cement or asbestos cement damaged so as to create significant dust and debris.
- asbestos ropes, yarns, woven cloths in poor condition or handling cutting or breaking up the materials.
- asbestos papers, felts and cardboard in poor condition, unencapsulated or not bound into another material.
- Work with weathered asbestos cement, air monitoring and collecting samples of ACM in buildings would not normally be notifiable.



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

It is impossible to specify definitively what activities will and will not be licensable. This decision should be made as part of the CAR risk assessment. CAR is not primarily aimed at work with ACSs and there is little published information on airborne asbestos concentrations during work with ACSs. Nevertheless, CAR will require some remediation projects, and occasionally site investigations, to be LW. Investigations on other sites may involve NNLW. The decision as to whether work is LW or NNLW should be made during the CAR risk assessment by those in charge of the brownfield site investigations and remediation projects.

5.3.5 Training Requirements

Asbestos health and safety courses are offered by a number of providers in the UK. Training courses that include the problem of identifying ACMs in soil should be undertaken at regular intervals by those involved in the investigation, assessment and management of sites where ACs are known or suspected. It is the role of the employer to identify the level of training required for an employee based on their role, experience and duties. Reference to Regulation 10 of CAR should be referred to for more information on training requirements.

Recognising asbestos within soils is challenging due to the heterogeneity of such soils and the discolouration of asbestos by smeared soil. Specific training for ground workers should include understanding fibre release potential, potential control measures in the field, how to take representative ACSs safely, sample labelling and what analytical tests are available and when they should be implemented.

Health and safety training required under CAR includes asbestos awareness, non-licensable work (including notifiable non-licensable work) and licensable work with asbestos.

In addition to health and safety training, some staff involved in the technical identification on site of ACMs, sampling and analysis may require technical proficiency training (competency training).

5.3.6 Training vs. Competence

HSE (2005) identifies that 'training alone does not make people competent. Training must be consolidated by practical experience so that the person becomes confident, skilful and knowledgeable in practice on the job'. It is critical that ACS surveyors demonstrate competency with details of relevant field experience alongside training and examples of previous works/references.



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

6 CONTINGENCY FOR ANY UNKNOWNNS

Whilst relatively uniform ground conditions have been encountered across the site during the investigations, a small risk exists of the presence of localised unidentified contamination of Made Ground soils. Should any suspicious material be encountered during the redevelopment works, works shall be ceased within this part of the site and the area should then be investigated further by a suitably qualified geo-environmental engineer and sampled as necessary. The Environmental Health or Contaminated Land Officer at the local authority should also be notified immediately. Samples will be forwarded to a UKAS/MCERTS accredited laboratory for a suite of analytical testing deemed appropriate based upon an appraisal of the material identified. Once the results of the analysis are known and have been interpreted, the required remedial action (if any) will be determined and approved with the relevant regulatory authorities.



7 CLEAN COVER SYSTEM

7.1.1 Requirements

In order to remove the remaining pollutant linkages associated with the presence of asbestos fibres, a 600mm deep clean cover system has been proposed in all areas which have Made Ground present at surface and are within landscaped areas.

7.1.2 Installation

In order to remove the remaining pollutant linkages associated with the presence of asbestos fibres, a 600mm deep clean cover system (a layer of high visibility geotextile and 600mm topsoil layers) should be installed within the remaining areas of soft landscaping. A 600mm thick clean cover system is considered appropriate for the proposed "low vulnerability" commercial land use.

7.1.3 Independence and Competence

In respect to the level of competence required in general ground remediation, The Environment Agency recommends that conflicts of interest in verification should be avoided. A contractor or supplier certifying their own work or product is considered to be a conflict of interest and is therefore not good practice. If verification is carried out by the same company (or related company) that carried out the installation then the process, the results and report should be audited by an independent consultant. The verification will be undertaken by SoilSafe Ltd.

7.1.4 Verification

It will be necessary to ensure that the development of the site does not cause an increased risk to receptors. All topsoil materials imported to the site will be tested to determine its suitability for use on the site in landscaping areas. The imported material shall be tested and proven chemically suitable following YALPAG specification. Referring to Appendix 1a – Sampling & Testing Matrix the Topsoil to this site falls under the Brownfield/Screened soils.

The purpose of the testing is to verify the quality of any materials imported to the site and to determine the contaminant concentrations of materials. The results of chemical testing will be screened against the Human Health Assessment Criteria for residential with home grown produce land use (the most the stringent GAC). In addition to the chemical testing, the depth of clean cover will also be verified. Hand dug pits will be excavated within landscaped areas to ensure that a combined thickness of 600mm topsoil has been achieved over the high visibility geotextile layer. The verification process will comply with the following:

Environmental Engineer is to verify thickness of capping layer via augered, or hand dug exploratory holes within each soft landscaped area. The minimum number of verification locations is to be determined on an area basis; up to 20 m² = 1 hole, 20 to 50m² = 2 holes, over 50m² = 3 holes. Environmental Engineer to digitally photograph every soft landscaped area post capping.



8 GROUND GAS PROTECTION VERIFICATION PLAN

Mitigation of the risk from ground gases needs to be undertaken in accordance with BRE 414, CIRIA 665, BS 8485:2015 +A1:2019, CIRIA C735. In accordance with BS 8485:2015 +A1:2019, the design of gas protection measures needs to be undertaken in accordance with the Characteristic Situation and the building type:

- The site is classified as Characteristic Situation 2.
- The school is classified as a type C building, as such requires 2.5 points of protection.

Coupled with protection measures in line with Characteristic Situation 2, and with reference to BS8485 tables 3 and 4, a minimum gas protection score of 3.5 will be required. Based on the nature of the development (school) the following protection measures are deemed appropriate:

- A Cast *in situ* suspended floor slab (very good performance) (1 point)
- A ground gas membrane (2 points)

These measures must be agreed with the Local Authority. The Client shall engage a specialist to advise upon the detailed design and an independent suitably qualified person to undertake the verification of the gas protection measures.

It should be noted that this Remediation Strategy contains a Ground Gas Protection Verification Plan. At present, it is considered that the floor slab will be suspended cast *in situ* and a suitable membrane system will be supplied by a fully qualified specialist supplier and installer. At this early pre commencement stage of the development, detailed sections and drawings showing the design of the system have not been produced. This report will be updated with these detailed sections and drawings once these are made available. The updated report will be submitted to the local authority for review and comment.

8.1 MEMBRANE DESIGN

The details regarding the design of the ground gas protection measures have not yet been completed at this early stage; however, these will be agreed with the Local Authority prior to installation.

8.2 MEMBRANE SPECIFICATION

The supplier of the gas membrane has not been completed at this early stage; however, these will be agreed with the Local Authority prior to installation.

The criteria for a gas resistant membrane, as outlined within Table 7 of BS8485:2015+A1:2019, in order to achieve the 2 points are as follows:

- Sufficiently impervious, both in the sheet material and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and/or Carbon dioxide through the membrane;
- Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); and to withstand in-service stresses (e.g. settlement if placed below a floor slab); and
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas.

It should be noted that in order to fully qualify for the 2 points, the membrane should be verified by in accordance with CIRIA C735. Whilst the actual installation contractor has not yet been appointed at this stage, the gas membrane will be installed by a professional geomembrane installer, with all operatives having or working towards the NVQ Level 2 Qualifications in Gas Membrane Installation.

8.3 VERIFICATION PLAN

An informed and risk-based approach has been taken as part of the verification plan, which has been produced to determine the following:

1. Decide which stakeholders are deemed suitable to undertake the necessary verification procedures;
2. How many site inspections should be undertaken;



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

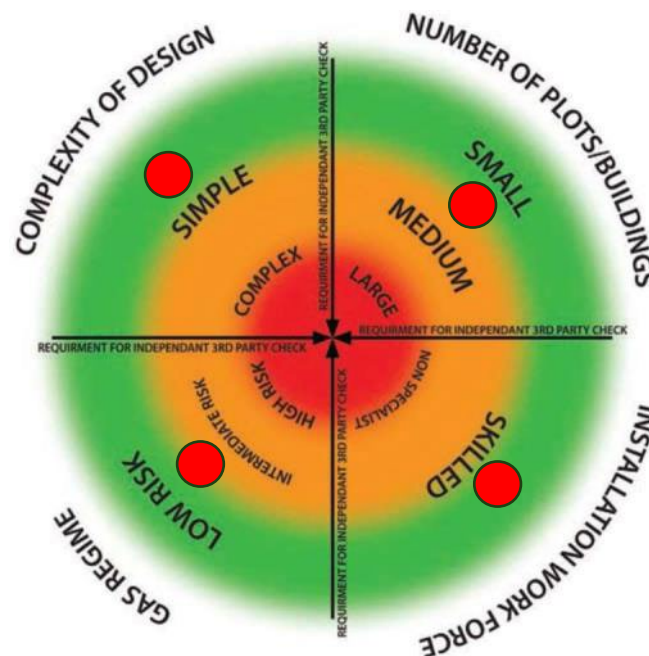
3. The need for, and scope of, any integrity testing.

This risk-based system has taken into account the various factors that have influenced the scope of verification activities (including the possibility of integrity testing), which have included:

- Site specific gas regime;
- Number of buildings to be inspected and the period over which this will take place;
- Complexity of the design and installation;
- Qualifications and experience of the workforce.

Table 5.1 has been modified from CIRIA C735, with the red dots showing the relative placement of the site.

Table 5.1 Analysis of the variables which have influenced the scope of the verification plan for this site



8.4 INDEPENDENCE AND COMPETENCE

In respect to the level of competence required in general ground remediation, The Environment Agency recommends that conflicts of interest in verification should be avoided. A contractor or gas membrane supplier certifying their own work or product is considered to be a conflict of interest and is therefore not good practice.

If verification is carried out by the same company (or related company) that carried out the installation then the process, the results and report should be audited by an independent consultant.

A specialist contractor will be chosen to install the membrane, with all operatives qualified to the appropriate NVQ Level 2 for ground gas membrane installation, have been appointed to undertake the installation of the gas protection measures across the site.

8.5 THE INSPECTION REGIME

The gas membrane installation should be subject to verification inspections to establish the adequacy of the ground preparation and, subsequently, possible damage to the installed gas membrane. The inspection visits should fall generally in line with the following:



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

1. The client should determine whether an area to be covered in a ground gas membrane is ready for inspection by initiating contact with verifier;
2. The verifier would then inspect all areas of interest with the site manager or groundworks supervisor;
3. The inspection will cover:
 - a. The ground prepared for the gas membrane which should be clean and free from stones etc;
 - b. The installation of the membrane to an acceptable standard,
 - c. The membrane itself, over the whole floor area, paying particular attention to laps, welds, edges and the sealing of service entries and penetrations such as columns and lift shaft. This may include air lance testing;
4. The visual inspection should be recorded;
5. Any discrepancies with the installation method recommended by the gas membrane supplier should be highlighted. These may include small or large holes and rips, tears and punctures, absence of tape (double sided or single sided tape) on the lapped areas, loose or unstuck tape, inadequate corner details, and unbounded seams such as loose edges and 'fish mouths' in the gas membrane;
6. Tapes used to join gas membranes should be inspected to make sure they are compatible with the gas membrane being joined and are as specified by the gas membrane supplier or specifier; non proprietary gas resistant tape should never be used to seal a gas membrane. Where welded joints are used, the verifier should ensure they are correctly tested;
7. Repairs should be instructed and observed on the same day as the site visit or inspected at a later date. This will be documented on the Gas Protection Verification Pro Forma for that visit. The frequency and intensity of inspections should increase to reflect any lower level of competence of the workers installing the gas protection system;
8. As this membrane will be covered in screed/insulation following installation, inspections should take place before the installation of insulation and/or screeding. The screed should then be poured as soon as possible after the gas membrane has been signed off, in order to ensure that follow-on trades do not damage a gas membrane that has been signed off; and
9. All follow-on trades should be made aware of the presence and purpose of the gas membrane and pressure relief pathway, and who they should contact if they believe their actions have had the potential to compromise it.

The final verification report will include photographs as supporting evidence. A pro forma should be completed for each inspection visit. All pro formas should be retained for inclusion within the final verification report in order to demonstrate the involvement of the verifier throughout the process and provide evidence of the appropriate installation of the gas protection measures. An example pro forma which highlights all aspects to inspect is provided in the appendices.

8.6 INSPECTION TIMING AND FREQUENCY

There is currently no absolute guidance relating to the number and frequency of visits; however, for the purposes of this verification plan, reference has been made to table A2 within Annex 1 of CIRIA C735. Whilst at this stage it is not possible to give specific dates for inspection visits, the following should be adhered to when attending site to make the required visual inspection. A verified consultant or third party qualified and experienced installer is to conduct thorough verification (visual) inspection prior to pours but after placement of the membrane. All joints, pipe penetrations etc to be inspected. Contractor is to supply sign off sheets (verification evidence) including photographs for all other pours. Integrity testing should only be undertaken if unacceptable results are obtained and no concerns are raised by visual inspections.



9 FINAL VERIFICATION REPORT

The site engineer should ensure that the requirements of the strategy are complied with. On satisfactory completion of all remedial works, a verification report should be produced. This report will comprise all relevant site records and act as certification that the remedial preparation works have been carried out in accordance with this Remediation Strategy.

9.1.1 Verification Report

The reporting of verification activities will be in general accordance with the Model Procedures (Environment Agency, 2004) and other relevant guidance (Environment Agency, 2010a and b). The reporting requirements will reflect the type and level of verification activity (if deemed to be required by the verifier) carried out at this site.

The final report will inform all the relevant stakeholders (regulators, site owners, funders, the local community etc) of the verification activities/integrity testing undertaken and will provide a logical framework to demonstrate confidence in the remediation measures.

The SE will maintain records of the works to include the following:

- Site details and reasons for carrying out remediation;
- Details of the various parties involved in the project, i.e. client, consultant, contractor;
- A summary of the original site conditions and contaminated land risk assessment carried out;
- The CSM for remediation identifying each pollutant linkage to be addressed by remedial activities, and the lines of evidence to test whether the linkages are broken;
- A description of the remediation measures put in place, with reference to detailed design drawings;
- A clear description of this remediation strategy, including the methods used for data collection and interpretation;
- A description of the inspection regime (who carried out the inspections, their competence to do so, over what period, at what frequency and supported by a written record, e.g. completed pro formas and captioned photographs presented in the appendices);
- Presentation of the manufacturer's material(s) specifications(s) for all elements of the remediation system, including warranty information;
- A summary of progress data, such as completed pro formas and monitoring results;
- Details of all communications held with regulatory bodies during implementation;
- A clear statement, based on the presentation of 'lines of evidence' and review of the CSM, of the extent to which the remedial objectives and criteria have been achieved and the presence, extent and nature of any residual hazards;



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

10 REGULATORY APPROVALS

The conclusions and recommendations presented above are considered reasonable based on the findings of the site investigation. However, these cannot be guaranteed to gain regulatory approval and, therefore, the report should be passed to the appropriate regulatory authorities and/or other organisations for their comment and approval prior to undertaking any works on site.

This report has outlined a detailed remediation scheme/strategy and method statement for the remediation works so that the site can be made suitable for its intended use by removing any unacceptable risks to human health and the natural environment such as controlled waters. This report includes details on the anticipated works and provides method statements for these works in order to achieve the proposed remedial objectives/criteria presented through the report. Details of site management procedures including environmental monitoring and mitigation and the contractor responsibilities are given, as well as details of what should be included as part of the required verification report to verify the remedial works outlined in this document. As such, this report is satisfactory to discharge Condition 5 and Condition 6.



11 REFERENCES

- Bieniawski, Z. T. (1993). In J. A. Hudson (Ed.), *Classification of rock masses for engineering: The RMR system and future trends, comprehensive rock engineering* (Vol. 3, pp. 553–574). New York, Pergamon Press.
- BRE (1999). *Radon: Guidance on Protective Measures for New Dwellings*. IHS BRE Press, Bracknell.
- BRE (2005). *Concrete in Aggressive Ground. Special Digest 1* (revised edition). IHS BRE Press, Bracknell.
- BS 10175:2011 *Investigation of Potentially Contaminated Sites - Code of Practice*. British Standards Institution, London.
- BS EN 1997-1:2004 *Eurocode 7. Geotechnical Design. General Rules*. British Standards Institution, London.
- BS EN 1997-2:2007 *Eurocode 7. Geotechnical Design. Ground Investigation and Testing*. British Standards Institution, London.
- BS EN ISO 14688-1:2002 *Geotechnical Investigation and Testing. Identification and Classification of Soil. Identification and Description*. British Standards Institution, London.
- BS EN ISO 14688-2:2004 *Geotechnical Investigation and Testing. Identification and Classification of Soil. Principles for a Classification*. British Standards Institution, London.
- BS EN ISO 14689-1:2003 *Geotechnical Investigation and Testing. Identification and Classification of Rock. Identification and Description*. British Standards Institution, London.
- CIRIA (1983) *Trenching Practice*. Report 097, 2nd edition, CIRIA, London.
- CIRIA (1995a) *Protecting Development from Methane*. Report 149, CIRIA, London.
- CIRIA (1995b) *Methane Investigation Strategies*. Report 150, CIRIA, London.
- CIRIA (1995c) *Interpreting Measurement of Gas in the Ground* Report 151, CIRIA, London.
- CIRIA (1995d) *Risk Assessment for Methane and Other Gases from the Ground*. Report 152, CIRIA, London.
- CIRIA (1996) *A Guide for Safe Working on Contaminated Sites*. Report 132, CIRIA, London.
- DEFRA and Environment Agency (2002e) *Model Procedures for the Management of Land Contamination*. Report CLR11, Environment Agency, Bristol.
- Environment Agency (2000) *Technical Aspects of Site Investigation*. Report P5-065/TR, Environment Agency, Bristol.
- Environment Agency (2002) *Guidance on Monitoring Landfill Leachate, Groundwater and Surface Water*. Report LFTGN02, Environment Agency, Bristol.
- Environment Agency (2007) *Evaluation of Models for Predicting Plant Uptake of Chemicals from Soil*. Report SC050021/SR, Environment Agency, Bristol.
- Environment Agency (2008) *Science Report SC050021/SR7 Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values*.
- [Environment agency, 2007. Inter-laboratory comparison of in vitro bioaccessibility measurements for arsenic lead and nickel in soil, Science Report SC040060/SR2.](#)
- Environment Agency, 2009 *Human health toxicological assessment of contaminants in soil (Science Report Final SC050021/SR2)*
- Gibbons, R. (1994) *Statistical Methods for Groundwater Monitoring*. Wiley, New York.
- Highways Agency (2006) *Design of Pavement Foundations*. Document HD 25/IAN 73/06.



A REMEDIATION STRATEGY REPORT FOR THE PROPOSED SEND SCHOOL, ROCHDALE

P-1010R
28/03/2024

HSE (1991) Protection of Workers and the General Public During the Development of Contaminated Land. HMSO, London.

HSE (2005) Occupational Exposure Limits. HSE report EH40/2005, HMSO, London.

ICRCL (1986) Notes on the Fire Hazards of Contaminated Land. Guidance Note 61/84, 2nd Edition, Interdepartmental Committee on the Redevelopment of Contaminated Land, London.

Jeffries, HYPERLINK "http://www.environment-agency.gov.uk/static/documents/Research/CLEA_Technical_Review.pdf"J.(2009 HYPERLINK "http://www.environment-agency.gov.uk/static/documents/Research/CLEA_Technical_Review.pdf"). A review of body weight and height data used within the Contaminated Land Exposure Assessment model (CLEA). Project SC050021/ Technical Review 1. Bristol: Environment Agency

LQM/CIEH Ltd (2015) S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.

NRA (1994) Protocol for a Leaching Test to Assess the Leaching Potential for Soils from Contaminated Sites. R&D Note 181.

WHO (2000) Air Quality Guidelines for Europe. 2nd edition, WHO Regional Office for Europe, Copenhagen.

APPENDIX A – GLOSSARY OF TERMS

ACEC	Aggressive Chemical Environment for Concrete (classification)
aOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
Designated location	Site (and the ecosystem on that site) protected under national or international legislation. A potential ecological receptor to be considered as part of the assessment of land contamination. Example designated locations include SSSIs (q.v.), SACs (q.v.), national nature reserves, Ramsar sites and bird special protection areas.
DQA	Data Quality Assessment
DQO	Data Quality Objective
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
K _{ow}	Octanol-water partition coefficient
LEL	Lower Explosive Limit
LL	Liquid Limit
LoD	Limit of Detection (analytical)
LoQ	Limit of Quantification (analytical)
Mean Value Test	Statistical test (described in the CIEH Guidance) to estimate the mean value of a normally distributed population of data at a given level of confidence. Normally for contaminated land assessment, the 95th percentile (referred to as the 95%UCL or US95) is applied as a reasonable but conservative estimate of the mean concentration for comparison with the relevant assessment criteria.
Maximum Value Test	Statistical test (described in the CIEH Guidance) to identify whether an elevated concentration within a normally distributed data set forms part of the underlying population from which it has been sampled or whether it is an outlier (such as a localised area of contamination) that merits further consideration.
MC	Moisture Content
NGR	National Grid Reference
OS	Ordnance Survey
PI	Plasticity Index
PID	Photoionisation Detector
PL	Plastic Limit
ppm	Parts per million
ppmv	Parts per million by volume
QA	Quality Assurance
QC	Quality Control
SOM	Soil Organic Matter
SPT	Standard Penetration Test
SPZ	Source Protection Zone
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest
SVOC	Semi-Volatile Organic Compound
TPH	Total Petroleum Hydrocarbons
US95	95 th percentile estimate of the true mean value of a data population (also known as 95%UCL).
VOC	Volatile Organic Compound

APPENDIX B – QUALITATIVE AND QUANTITATIVE RISK ASSESSMENTS

For the qualitative and quantitative assessment of risks posed by potential pollutant linkages have been undertaken using the risk matrix adapted from CIRIA C552 and outlined in the table below.

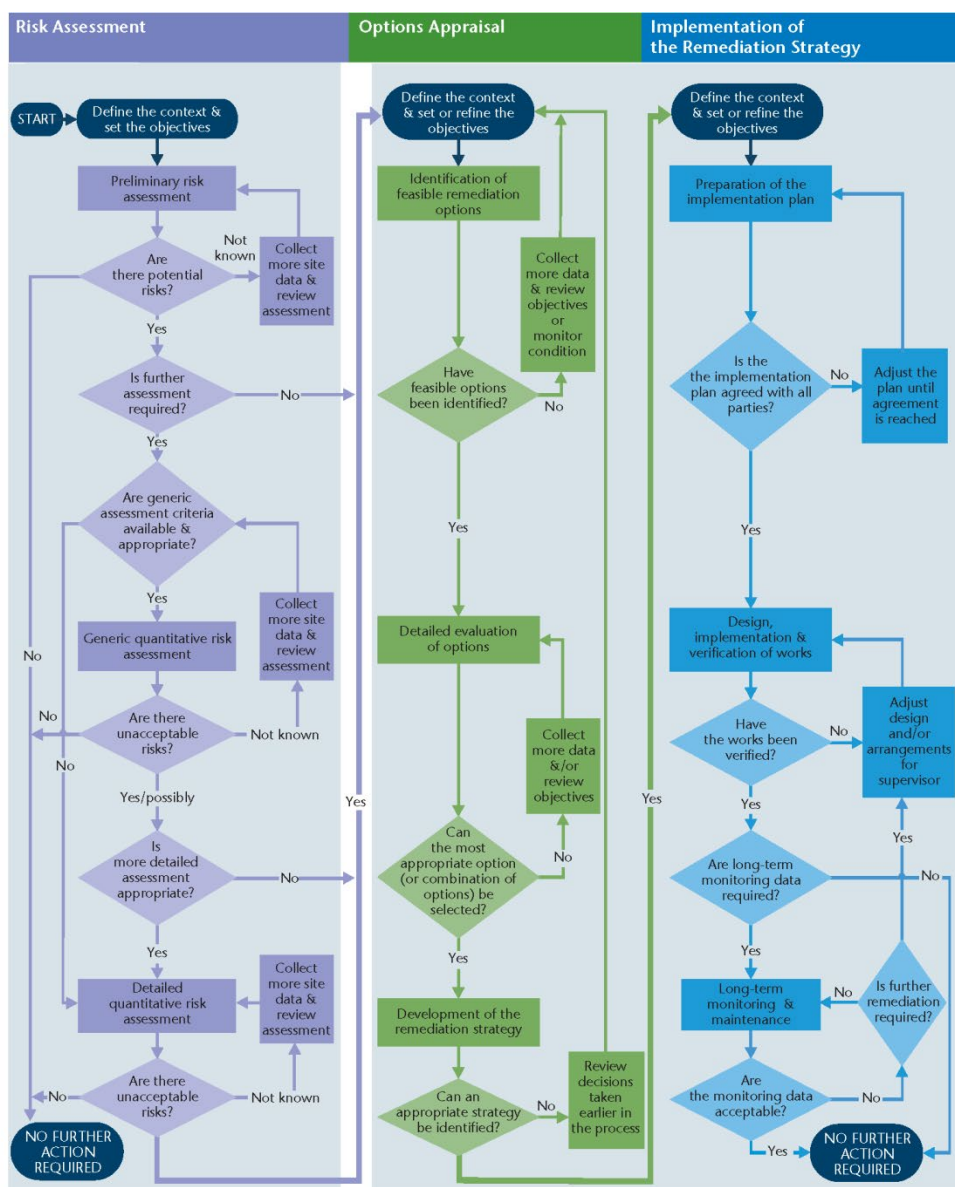
	Category	Definition
Potential severity	Severe	Acute (short term) risk to human health, Major pollution of sensitive controlled waters, ecosystems or habitat. Catastrophic damage to buildings or property or crops.
	Medium	Chronic (Medium / long term) risk to human health Pollution of sensitive controlled waters, ecosystems or species, Significant damage to crops, buildings or structures
	Mild	Easily preventable permanent health effects on humans. Pollution of non-sensitive controlled waters. Minor damage to buildings or structures.
	Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soil. Easily repairable damage to buildings or structures.
Probability of risk	High Likelihood	Pollutant linkage may be present and the risk is almost certain to occur, or there is evidence of harm already occurring.
	Likely	Pollutant linkage may be present and it is probable that the risk will occur over the long term.
	Low Likelihood	Pollutant linkages may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
	Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

		Potential Severity			
		Severe	Medium	Mild	Minor
Probability of risk	High Likelihood	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

APPENDIX C – HUMAN HEALTH RISK ASSESSMENTS

Contaminated Land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995 and associated guidance (“Part IIA”). These specify that a “suitable for use” approach is to be applied in the assessment of potentially contaminated land, implemented through a phased programme of site investigation and risk assessment appropriate to the site under consideration.

The assessment of potential risks posed by contaminated land is based upon the assessment of plausible contaminant source - pathway - receptor linkages (“pollutant linkages”) for the current and/or proposed future use of the site. The process for the assessment of contaminated land adopted in this report is in line with guidance issued by DEFRA and Environment Agency (EA) 2004: “Model Procedures for the Management of Contaminated Land (CLR11)”. The overall process for the management of land contamination is shown Figure 1 of CLR11 and reproduced below:



Note: The process may apply to one or more pollutant linkages each of which may follow a different route. For some linkages, it may be possible to stop at an early stage – others will progress all the way through the process. The level of complexity of each stage may also vary and in some cases may be very simple.

The risk assessment and subsequent investigation, remediation and verification must address all potential sources of pollutants that may be present on the site (the “hazards”), all receptors that may be harmed by these (e.g. human health, controlled waters, ecological receptors) and the pathways by which the contamination may be transported from the contaminant source(s) to the receptor(s). This is defined within the conceptual model for the site, which represents the characteristics of the site in a form that shows the possible pollutant linkages. As further information becomes available (for example, through site investigation), so the conceptual model will be refined.

Remedial action can be specified at any phase within this assessment process to break the identified pollutant linkage. In determining whether or not to undertake further assessment or to undertake remediation, the potential

cost-savings arising from a more thorough assessment of the pollutant linkages and more tightly defined remedial strategy must be considered against the direct costs involved in the work and the time that this will take to execute and gain regulatory approval.

A different approach to the statistical appraisal of data is required depending on whether the assessment is being undertaken to assess land as Contaminated Land in accordance with the regulations or whether the assessment is to assess whether the site is suitable for new development in accordance with the Planning regime. The statistical approach to assessment is discussed further in CL:AIRE:2009 “Guidance on Comparing Data with a Critical Concentration”.

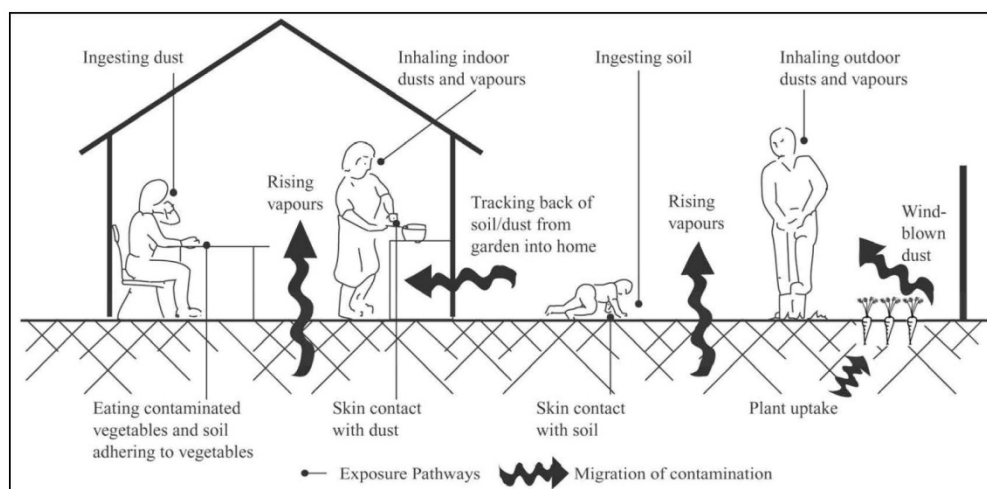
Some form of Detailed Quantitative Risk Assessment (DQRA) will be essential for those cases where appropriate GAC values cannot be established for the contaminant linkages under consideration.

Generic Assessment Criteria for Human Health Risk Assessment

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports and guidance. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. The initial documents (CLR7 – 10) were withdrawn and replaced with revised guidance issued by the Environment Agency including:

- “Using Soil Guideline Values”; SC050021/SGV Introductions, EA, 2009;
- “Human Health toxicology assessment of contaminants in soil”; SC050021/SR2, EA, 2009;
- “Update technical background to the CLEA model;” SC050021/SR3, EA, 2009;
- CLEA Software (Version) Handbook; SC050021/SR4; EA, 2008;
- Compilation of Data for priority Organic Contaminants for Derivation of Soil Guideline Values; Science Report SC050021/SR7, 2008; and,
- Guidance on Comparing Data with a Critical Concentration; CL:AIRE, 2009.

The CLEA model and associated guidance was developed to calculate an estimated tolerable daily intake (TDI) of contaminants for site users given a set of ‘typical’ human health exposure pathways which are detailed in “SR3: Updated technical background to the CLEA model” (Science Report SC050021/SR3, EA, 2009) and reproduced below.



- **Ingestion**
 - Outdoor soil;
 - Indoor dust;
 - Home grown produce;
 - Soil attached to home grown produce.
- **Dermal Contact**
 - Outdoor soil;
 - Indoor dust.
- **Inhalation**
 - Outdoor dust;
 - Indoor dust;
 - Outdoor vapour;
 - Indoor vapour.

It should be noted that the CLEA model does not include an exhaustive list of potential exposure pathways, e.g. certain compounds can pass through plastic water pipes into drinking water supply.

The potential significance of each of the exposure pathways is dependant upon the type of land use and the nature of the contaminant being considered. The CLEA model considers principal 'default' land use scenarios and makes a series of assumptions with regards to building type (where applicable), identification of the critical human receptor group, exposure frequency and duration. The definitions of the principal land use types given in SR3 (EA, 2009) are:

- **Residential land use;**

A typical residential property consisting of a two story terraced house built on a ground-bearing slab of 0.15m thickness with a private garden consisting of lawn, flowerbeds, and a small fruit and vegetable patch. The occupants are assumed to be parents with young children, who make regular use of the garden. The critical receptor is a 0 – 6 year old female.

Active exposure pathway are: ingestion of outdoor soil, ingestion of indoor dust, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and indoor dust and vapour.

- **Allotments**

A plot of open space commonly made available by the Local Authority to tenants to grow fruit and vegetables for their own consumption. There are usually several plots to a site and the overall site area may cover more than one hectare. The tenants are assumed to be the parents or grandparents and that young children make occasional accompanied visits to the plots. The critical receptor is a 0 – 6 year old female and there is no building present on Site.

Active exposure pathways are ingestion of outdoor soil, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil; inhalation of outdoor vapour.

- **Commercial and industrial land use.**

A typical commercial or light industrial property consisting of a three-story office building (pre-1970) with a ground bearing floor slab at which employees spend most time indoors and are involved in office based or related light physical work. The critical receptor is a working female adult aged 16 – 65 years.

Active exposure pathway are ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and inhalation of indoor dust and vapour.

Soil Guideline Values

Based on the assumption of each land use type, the EA and DEFRA developed and published Soil Guideline Value (SGV) using the CLEA model for a number of principal contaminants and 'default' end-use scenarios of residential, allotments and commercial/industrial use. The primary purpose of the SGVs are as trigger value for the tolerable daily intake (TDI), below which it can be assumed that the soil does not pose an unacceptable risk to the identified receptor. Where soils contamination is present above this level further assessment may be required. SGVs were developed for the following contaminants:

- Heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury, nickel and selenium;
- Benzene, ethylbenzene, toluene and xylenes;
- Phenol;
- Dioxins and dioxin-like polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs) – 11 substances

LQM/CIEH Generic Assessment Criteria of Human Health Risk Assessment

In addition, in 2009 CIEH through LQM and EIC published generic assessment criteria (GACs) for 82 substances including metals, petroleum hydrocarbons, PAHs and explosive substances for a variety of soil types and the three 'default' land uses – (residential, allotments and commercial end-uses) as described in SR3 (EA, 2009). These have been superseded as described below.

Category 4 Screening Values

In 2013 "SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination" (CL:AIRE 2013) was issued which detailed findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. This was supplemented in 2014 by "SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination –

Policy Companion Document” (DEFRA, 2014). SP1010 proposed several updated toxicology information relating to contaminant behaviour updated assumptions relating to the modelling of human exposure to soil contaminants, derivation of separate C4SLs for residential with the consumption of home grown produce, residential without the consumption of home grown produce, and two new land uses: public open spaces near residential housing (POS resi) and public parks (POS park).

- **Public Open Space: Residential**

For public open space in close proximity to residential housing and the central green area around which houses are located, as on many housing estates from the 1930s to 1970s. It is also applicable for smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting. It is considered to be a generally grassed area up to 0.5ha with up to 50% bare soil. The land use is an important resource for children and the area is near the homes. The critical receptor is a female child age >3 - <9 years old (CLEA age class 4 – 9) as younger children are unlikely to play outdoors unsupervised.

Active exposure pathways are: ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor soil derived dust; inhalation of outdoor and indoor dust and inhalation of outdoor vapour.

- **Public Open Space: Park**

A public park is defined as an area of open space provided for recreational use and usually owned and maintained by the Local Authority. It is anticipated the park could be used for a wide range of activities, including the following:

- Family visits and picnics;
- Children’s play area;
- Sporting activities such as football on an informal basis (i.e no a dedicated sports pitch); and
- Dog walking.

The park is modelled as an area >0.5 ha of predominantly grasses open space with no more than 25% of exposed soil.

The critical receptor is a female child with CLEA age classes 1 – 6.

Active exposure pathway are: ingestion of outdoor soil; direct dermal contact with outdoor soil; inhalation of outdoor dust and inhalation of outdoor vapour.

Furthermore, the C4SLs are based on a different toxicological benchmark, the ‘low level of toxicological concern’ (LLTC). This difference in approach was adopted because the C4SLs were primarily intended for use under Part 2A of the EPA 1990 to quickly screen out Category 4 sites where there is “*no risk or that the level of risk posed is low*”. SGVs and LQM GACs are based on the more conservative ‘minimal or tolerable level of risk’ as defined in SR2 (EA, 2009) and were derived for assessment of contamination for the Planning process.

Lead

The SGV for lead was withdrawn in 2011 and is not used in this report. The C4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling than the withdrawn SGV and derived in line with current science of lead toxicology.

LQM/CIEH Suitable 4 Use Levels (S4ULs)

The publication of the C4SLs resulted in considerable and inconclusive debate about the applicability of the lower level of protection of the C4SL, which are underlain by the LLTC, outside of the Part 2A context for which they were derived. In 2014 LQM/CIEH presented a Suitable 4 Use Levels (S4ULs), which incorporate the updated assumption exposure derived for the production of the C4SLs but within the context of deriving screening criteria above which further assessment of the risks or remedial action may be needed. The S4ULs replace the 82 substances, species and fractions and congeners contained in the previous LQM/CIEH GACs issued in 2009. Additionally, following changes and new land uses proposed in the C4SL research project, S4ULs have also been derived for the majority of substances for which the EA derived SGVs in 2009.

The GAC values adopted in this report are summarised in Table 1, below.

Parameter	Residential with homegrown produce			Residential without homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
Metals/metalloids																			
Arsenic	37			40			43			640			79			170			LQM (2014)
Beryllium	1.7			1.7			35			12			2.2			63			LQM (2014)
Boron	290			11000			45			240000			21000			46000			LQM (2014)
Cadmium	11			85			1.9			190			120			532			LQM (2014)
Chromium III	910			910			18000			8600			1500			33000			LQM (2014)
Chromium VI	6			6			1.8			33			7.7			220			LQM (2014)
Copper	2400			7100			520			68000			12000			44000			LQM (2014)
Lead	200			310			80			2330			630			1300			C4SL
Mercury (elemental)	1.2			1.2			21			58 (25.8)			16			30 (25.8)			LQM (2014)
Mercury (Inorganic)	40			56			19			1100			120			240			LQM (2014)
Methylmercury	11			15			6			320			40			68			LQM (2014)
Nickel	180			180			230			980			230			3400			LQM (2014)
Selenium	250			430			88			12000			1100			1800			LQM (2014)
Vanadium	410			1200			91			9000			2000			5000			LQM (2014)
Zinc	3700			40000			620			730000			81000			170000			LQM (2014)
Other																			
Total Sulphate	2,400			2,400			2,400			2,400			2,400			2,400			BRE (2005)
Water Soluble Sulphate (g/l)	0.5			0.5			0.5			0.5			0.5			0.5			BRE (2005)
PAHs																			
Acenaphthene	210	510	1100	3000 (57)	4700(141)	6000 (336)	34	85	200	84000 (57)	97000 (141)	100000	15000	15000	15000	29000	30000	300 00	LQM (2014)
Acenaphthylene	170	420	920	2900 (86.1)	4600 (212)	6000 (506)	28	69	160	8300 (86.1)	97000 (212)	100000	15000	15000	15000	29000	30000	300 00	LQM (2014)
Anthracene	2400	5400	11000	31000 (1.17)	35000	37000	380	950	2200	520000	540000	540000	74000	74000	74000	150000	150000	150 000	LQM (2014)

Benzo(a)anthracene	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	LQM (2014)
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	LQM (2014)
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	0.99	2.1	3.9	44	44	45	7.1	7.1	7.1	13	15	16	LQM (2014)
Benzo(g,h,i)perylene	320	340	350	360	360	360	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600	LQM (2014)
Benzo(k)fluoranthene	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	LQM (2014)
Chrysene	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	LQM (2014)
Dibenz(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.61	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	LQM (2014)
Fluoranthene	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	63	6300	6400	LQM (2014)
Fluorene	170	400	860	2800 (30.9)	3800 (76.5)	4500 (183)	27	67	160	63000 (30.9)	68000	71000	9900	9900	9900	20000	20000	20000	LQM (2014)
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	LQM (2014)
Naphthalene	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190 (76.4)	460 (183)	1100 (432)	4900	4900	4900	1200 (76.4)	1900 (183)	3000	LQM (2014)
Phenanthrene	95	220	440	1300 (36)	1500	1500	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300	LQM (2014)
Pyrene	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	LQM (2014)
Coal Tar (BaP as surrogate marker)	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	LQM (2014)
BTEX and TPH																			
Benzene	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110	LQM (2014)
Toluene	130	290	660	880 vap (869)	1900	3900	22	51	120	56000 vap (869)	110000 vap (1920)	180000 vap (4360)	56000	56000	56000	87000 vap (869)	95000 vap (1920)	100000 vap (4360)	LQM (2014)

Ethylbenzene	47	110	260	83	190	440	16	39	91	5700 vap (518)	13000 vap (1220)	27000 vap (2840)	24000	24000	25000	17000 vap (518)	22000 vap (1220)	270 00 vap (284 0)	LQM (2014)
Xylene - o	60	140	330	88	210	480	28	67	160	6600 (478)	15000 (1120)	33000 (2620)	41000	42000	43000	17000 (478)	24000 (1120)	330 00 (262 0)	LQM (2014)
Xylene - m	59	140	320	82	190	450	31	74	170	6200 (625)	14000 (1470)	31000 (3460)	41000	42000	43000	17000 (625)	24000 (1470)	320 00 (346 0)	LQM (2014)
Xylene - p	56	130	310	79	180	430	29	69	160	5900 (576)	14000 (1350)	30000 (3170)	41000	42000	43000	17000 (576)	23000 (1350)	310 00 (317 0)	LQM (2014)
Aliphatic EC 5-6	42	78	160	42	78	160	730	1700	3900	3200 (304)	5900 (558)	12000 (1150)	570000 (304)	590000	600000	95000 (304)	130000 (558)	180 000 (115 0)	LQM (2014)
Aliphatic EC >6-8	100	230	530	100	230	530	2300	5600	13000	7800 (144)	17000 (322)	40000 (736)	600000	610000	620000	150000 (144)	220000 (322)	320 000 (736)	LQM (2014)
Aliphatic EC >8-10	27	65	150	27	65	150	320	770	1700	2000 (78)	4800 (190)	11000 (451)	13000	13000	13000	14000 (78)	18000 (190)	210 00 (451)	LQM (2014)
Aliphatic EC >10-12	130 (48)	330 (118)	760 (283)	130 (48)	330 (118)	760 (283)	2200	4400	7300	9700 (48)	23000 (118)	47000 (283)	13000	13000	13000	21000 (48)	23000 (118)	240 00(2 83)	LQM (2014)
Aliphatic EC >12-16	1100 (24)	2400 (59)	4300 (142)	1100 (24)	2400 (59)	4300 (142)	11000	13000	13000	59000 (24)	82000 (59)	90000 (142)	13000	13000	13000	25000 (24)	25000 (59)	260 00 (142)	LQM (2014)
Aliphatic EC >16-35	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	160000 0	1700000	1800000	250000	250000	250000	450000	480000	490 000	LQM (2014)
Aliphatic EC >35-44	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	160000 0	1700000	1800000	250000	250000	250000	450000	480000	490 000	LQM (2014)
Aromatic EC 5-7	70	140	300	370	690	1400	13	27	57	26000 (1220)	46000 (2260)	86000 (4710)	56000	56000	56000	76000 (1220)	84000 (2260)	920 00 (471 0)	LQM (2014)
Aromatic EC >7-8	130	290	660	860	1800	3900	22	51	120	56000 (869)	110000 (1920)	180000 (4360)	56000	56000	56000	87000 (869)	95000 (1920)	100 000 (436 0)	LQM (2014)
Aromatic EC >8-10	34	83	190	47	110	270	8.6	21	51	3500 (613)	8100 (1500)	17000 (3580)	5000	5000	5000	7200 (613)	8500 (1500)	930 0 (358 0)	LQM (2014)
Aromatic EC >10-12	74	180	380	250	590	1200	13	31	74	16000 (364)	28000 (899)	34000 (2150)	5000	5000	5000	9200 (364)	9700 (899)	100 00	LQM (2014)

Aromatic EC >12-16	140	330	660	1800	2300 (419)	2500	23	27	130	36000 (169)	37000	38000	5100	5100	5000	10000	10000	10000	LQM (2014)
Aromatic EC >16-21	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800	LQM (2014)
Aromatic EC >21-35	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >35-44	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >44-75	1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
VOCs																			
1,2-dichloroethane (1,2-DCA)	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	LQM (2014)
1,1,1-trichloroethane	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000 (1425)	76000 (2915)	100000 (6392)	LQM (2014)
1,1,2,2-tetrachloroethane	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	LQM (2014)
tetrachloroethene	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	45	95	1400	1400	1400	810 (424)	1100 (951)	1500	LQM (2014)
tetrachloromethane (Carbon tetrachloride)	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	LQM (2014)
Trichloroethene	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	LQM (2014)
Trichloromethane (chloroform)	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	LQM (2014)
Chloroethene (Vinyl chloride)	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	LQM (2014)
2,4,6 Trinitrotoluene (TNT)	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	LQM (2014)

RDX	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000 (18.7)	51000	530 00	LQM (2014)
HMX	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000 (0.35)	23000 (0.39)	240 00 (0.4 8)	LQM (2014)
Aldrin	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	LQM (2014)
Dieldrin	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	LQM (2014)
Atrazine	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	240 0	LQM (2014)
Dichlovos	0.032	0.066	0.014	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	LQM (2014)
Alpha-Endosulfan	7.4	18	41	160 (0.003)	280 (0.007)	410 (0.016)	1.2	2.9	6.8	5600 (0.003)	7400 (0.007)	8400 (0.016)	1200	1200	1200	2400	2400	250 0	LQM (2014)
alpha-Hexachlorocyclohexane	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	LQM (2014)
beta-hexachlorocyclohexanes	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	LQM (2014)
gamma-hexachlorocyclohexanes	0.06	0.14	0.33	2.9	3.3	3.5	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15	LQM (2014)
Chlorobenzene	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	1300 (675)	2000 (1520)	290 0	LQM (2014)
1,2-Dichlorobenzene	23	55	130	24	57	130	94	230	540	2000 (571)	4800 (1370)	11000 (3240)	90000	95000	98000	24000 (571)	36000 (1370)	510 00 (324 0)	LQM (2014)
1,3-Dichlorobenzene	0.4	1	2.3	0.44	1.1	2.5	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470	LQM (2014)
1,4-Dichlorobenzene	61	150	350	61	150	350	15	37	88	4400 (224)	10000 (540)	25000 (1280)	17000	17000	17000	36000 (224)	36000 (540)	360 00 (128 0)	LQM (2014)
VOCs Continued																			
1,2,3-Trichlorobenzene	1.5	3.6	8.6	1.5	3.7	8.8	4.7	12	28	102	250	590	1800	1800	1800	770 (134)	1100 (330)	160 0 (789)	LQM (2014)

1,2,4-Trichlorobenzene	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	1700 (318)	2600 (786)	4000 (1880)	LQM (2014)
1,3,5-Trichlorobenzene	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	380 (36.7)	580 (90.8)	860 (217)	LQM (2014)
1,2,3,4-Tetrachlorobenzene	15	36	78	24	56	120	4.4	11	26	1700 (122)	3080 (304)	4400 (728)	830	830	830	1500 (122)	1600	1600	LQM (2014)
1,2,3,5-Tetrachlorobenzene	0.66	1.6	3.7	0.75	1.9	4.3	0.38	0.9	2.2	49 (39.4)	120 (98.1)	240 (235)	78	79	79	110 (39)	120	130	LQM (2014)
1,2,4,5-Tetrachlorobenzene	0.33	0.77	1.6	0.73	1.7	3.5	0.06	0.16	0.37	42 (19.7)	72 (49.1)	96	13	13	13	25	26	26	LQM (2014)
Pentachlorobenzene	5.8	12	22	19	30	38	1.2	3.1	7	640 (43)	770 (107)	830	100	100	100	190	190	190	LQM (2014)
Hexachlorobenzene	1.8 (0.2)	3.3 (0.5)	4.9	4.1 (0.2)	5.7 (0.5)	6.7 (1.2)	0.47	1.1	2.5	110 (0.2)	120	120	16	16	16	30	30	30	LQM (2014)
Phenol	280	550	1100	750	1300	2300	66	140	280	760 dir (31000)	1500 dir (35000)	3200 dir (37000)	760 dir (31000)	1500 dir (35000)	3200 dir (37000)	760 dir (31000)	1500 dir (35000)	3200 dir (37000)	LQM (2014)
Chlorophenols (excluding pentachlorophenol)	0.87 (g)	2	4.5	94	150	210	0.13 (g)	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100	LQM (2014)
Pentachlorophenol	0.22	0.52	1.2	27 (16.4)	29	31	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	LQM (2014)
Carbon Disulphide	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700	LQM (2014)
Hexachlorobutadiene	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	LQM (2014)

(g) derived based on 2,3,4,6-tetrachlorophenol; dir - based on a threshold protective of direct skin contact with phenol (guideline in brackets based on health effects following long term exposure provided for illustration only); (vap) calculated for vapour phase only. SOM – Soil Organic Matter; (4.5) solubility.

APPENDIX D – DRAWINGS

BB104 Site Areas		
For special schools without formal teams games		
Recommended min. external areas for all special schools	BB104 Area (m2)	Proposed Area (m²)
Soft Outdoor PE	n/a	91
Hard Outdoor PE	276	685 (MUGA)
Soft informal and social areas	752	1711
Hard informal and social areas	752	1264
Habitat areas	276	3179
Float	3184	-
Non-net area	6096	5700
Min. recommended Site area (BB104)	11336	
Max. recommended Site area (BB104)	14,692	
Proposed Site Area		12630
Cost Plan GIFA	2,224	
Proposed GIFA	2,224	
Min. Building GIFA (BB104)	2,152	
Max. Building GIFA (BB104)	2,504	

