



Wates Construction Ltd

Harlington School

Remediation Strategy

Project no. 314963 R01 (01)

FEBRUARY 2021

RSK



RSK GENERAL NOTES

Project No.: 314963 R01 (01)





Title: Remediation Strategy: Harlington School

Client: Wates Construction Ltd

Date: 22 February 2021

Office: RSK Environment Limited, The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB. Tel: 44 0117 947 1006

Status: Final

Author	<u>Craig Lewis</u>	Technical reviewer	<u>Jeremy Leach</u>
Signature		Signature	
Date:	<u>22 February 2021</u>	Date:	<u>22 February 2021</u>
Project manager	<u>Craig Lewis</u>	Quality reviewer	<u>Stacey Brown</u>
Signature		Signature	
Date:	<u>22 February 2021</u>	Date:	<u>22 February 2021</u>

RSK Environment Limited (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd.

CONTENTS

1	INTRODUCTION.....	3
1.1	Instruction.....	3
1.2	Limitations.....	3
1.3	Contaminated land investigation and remediation process.....	4
1.3.1	Risk assessment:.....	4
1.3.2	Options appraisal:.....	4
1.3.3	Implementation of the remediation strategy:.....	4
1.4	Definitions.....	4
2	THE SITE.....	5
2.1	Site location and description.....	5
2.2	Proposed development.....	5
2.3	Planning permission.....	5
2.4	Previous Site Investigation and assessment.....	6
3	REMEDICATION STRATEGY.....	9
3.1	Potential pollutant linkages.....	9
3.2	Remedial objectives.....	9
3.3	Enabling and demolition phase.....	10
3.3.1	Demolition and site clearance.....	10
3.3.2	Removal of existing building floor slabs.....	10
3.3.3	Stockpiling and offsite disposal.....	10
3.3.4	Imported material.....	11
3.3.5	Inspection and testing.....	11
4	WORKING PRACTICE AND VALIDATION.....	12
4.1	Securing the site against unauthorised access.....	12
4.2	Prevention of pollution.....	12
4.2.1	General.....	12
4.2.2	Airborne pollution (dust, etc.).....	12
4.2.3	Vehicles.....	12
4.2.4	Re-contamination.....	12
4.3	Health and safety of site personnel.....	13
4.4	Waste disposal.....	13
4.5	Validation and Documentation.....	13

FIGURES

Figure 1	Site Location Plan
Figure 2	Existing Site Layout
Figure 3	Proposed Development Plan



APPENDICES

- Appendix A Service constraints
- Appendix B Soil contamination objectives
- Appendix C Generic Assessment Criteria Human Health

1 INTRODUCTION

1.1 Instruction

On the instruction of Wates Construction Ltd, RSK Environment Ltd (RSK), has prepared a Remediation Strategy for an area of land at Harlington School, Pinkwell Ln, Hayes UB3 1PB.

This report is subject to the RSK service constraints given in **Appendix A**.

This Remediation Strategy contains the detailed remediation strategy for the development which, with correct implementation and validation, will render the site safe for the redevelopment of the school and satisfy the relevant planning conditions (see section 2.3) relating to contamination.

1.2 Limitations

This report should be considered in the light of any changes in legislation, statutory requirement or industry practices that may have occurred subsequent to the date of issue.

The Remediation Strategy is based upon previous investigations designed generally to meet the objectives of a main investigation, as defined by BS10175:2011+A2:2017 Code of Practice for the Investigation of Potentially Contaminated Sites. The remediation strategy is therefore based on the ground conditions encountered during the investigation, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent a proportion of the materials present on-site, and therefore other conditions may be encountered during the remediation and ground works, which have not been revealed by these investigations.

The Remediation Strategy contains details of the procedures to be adopted for inspection and validation of the works (Verification Plan). However, it should be noted that responsibility for the correct implementation of the strategy lies with the Principal Contractor. RSK cannot be held responsible for any remedial works that are carried out without the agreed procedures involving either direct supervision by RSK, or inspection and verification of the works by a representative from RSK, or if suspect materials are not notified to RSK.

1.3 Contaminated land investigation and remediation process

The assessment and development of “brownfield” sites follows a phased approach to managing the risks associated with land contamination. The following stages are defined in the Land Contamination Risk Management (LCRM) guidance dated 8th October 2020.

1.3.1 Risk assessment:

Risk assessment comprises three tiers: a preliminary risk assessment (desk study and desk-based research); generic quantitative risk assessment (based on staged investigations) and detailed quantitative risk assessment. The risk assessment tiers identify potential sources of contamination, potential pathways for migration and potential receptors of concern, and then estimates or quantifies the risks associated with the identified by pollutant linkages to determine if there are unacceptable risks requiring further action.

1.3.2 Options appraisal:

The options appraisal also involves a staged approach, which commences with the identification of feasible remediation options for each relevant pollutant linkage. A detailed evaluation is then made of feasible remediation options to identify the most appropriate option for any particular linkage. Finally, a remediation strategy is developed that addresses all relevant pollutant linkages, where appropriate by combining remediation options.

1.3.3 Implementation of the remediation strategy:

There are three main stages in the implementation process: the preparation of the implementation plan; the design, implementation and verification of remediation; and (if required) long-term monitoring and maintenance.

1.4 Definitions

The following parties have a direct interest or involvement in the works described herein.

Landowner	- Wates Construction Ltd
Local Authority	- Hillingdon Borough Council
Pollution Control and Waste Regulatory Authority	- The Environment Agency
Environmental Consultant	- RSK Environment Ltd
Architect	- LSI Architects

2 THE SITE

2.1 Site location and description

The site is located on the southern outskirts of Hayes on the south side of Pinkwell Lane, Hayes, UB3 1PB at National Grid reference 508700,178700 as shown on **Figure 1**.

The site is approximately 4.3 Ha in size. It is RSK's understanding that the site consists of the existing school infrastructure, with the single storey school buildings at its western end with a hardstanding playground to the south of the existing school buildings. There is a large car park in the north-east, a MUGA in the centre and a large grass playing field to the east of the site.

The site is bounded by Pinkwell Lane to the north, residential properties on Dudley Place and Oakington Avenue to the east and playing fields and a recreation ground to the south and west.

The site is level and set at an elevation of approximately 26-27 m above Ordnance Datum (AOD).

The current layout of the site is shown on **Figure 2**.

2.2 Proposed development

It is understood that the proposed development comprises the construction of a new 8FE school in the current playing fields to the east of existing buildings followed by the demolition of existing buildings. The new school will comprise a public library, sixth form classrooms, new NP/ASD/SRP department, adult education classrooms, outdoor and indoor sport and recreation facilities, and associated landscaping and refuse stores/collection points.

A proposed development plan is presented as **Figure 3**.

2.3 Planning permission

The report has been commissioned to satisfy conditional planning permission contained within reference number 18948/APP/2020/2551, issued by Hillingdon Borough Council. The planning permission includes the following conditions that relate to ground conditions:

Contaminated Land

(i) The development shall not commence until a scheme to deal with contamination has been submitted to and approved by the Local Planning Authority (LPA). All works which form part of a remediation scheme shall be completed before any part of the development is occupied or brought into use unless the Local Planning Authority dispenses with any

such requirement specifically and in writing. The scheme shall include all of the following measures unless the LPA dispenses with any such requirement specifically and in writing:

a) A site investigation, including where relevant sampling of ground gas, soils, surface and groundwater, together with the results of analysis and risk assessment shall be carried out by a suitably qualified and accredited consultant/contractor. The report should also clearly identify all risks, limitations and recommendations for remedial measures to make the site suitable for the proposed use; and

(b) A written method statement providing details of the remediation scheme and how the completion of the remedial works for each phase will be verified shall be agreed in writing with the LPA prior to commencement of each phase, along with the details of a watching brief to address undiscovered contamination. No deviation shall be made from this scheme without the express agreement of the LPA prior to its implementation.

(ii) If during remedial or development works contamination not addressed in the submitted remediation scheme is identified an addendum to the remediation scheme shall be agreed with the LPA prior to implementation; and

(iii) Upon completion of the approved remedial works, this condition will not be discharged until a comprehensive verification report has been submitted to and approved by the LPA. The report shall include the details of the final remediation works and their verification to show that the works for each phase have been carried out in full and in accordance with the approved methodology.

(iv) No contaminated soils or other materials shall be imported to the site. All imported soils for landscaping purposes shall be clean and free of contamination. Before any part of the development is occupied, all imported soils shall be independently tested for chemical contamination, and the results of this testing shall be submitted and approved in writing by the Local Planning Authority. All soils used for gardens and/or landscaping purposes shall be clean and free of contamination.

REASON

To ensure that risks from land contamination to the future users of the land and neighbouring land are minimised, together with those to controlled waters, property and ecological systems and the development can be carried out safely without unacceptable risks to workers, neighbours and other offsite receptors in accordance with Policies DMEI 11 and DMEI 12 of the Hillingdon Local Plan: Part 2 - Development Management Policies (January 2020).

2.4 Previous Site Investigation and assessment

Structural Soils Ltd (part of the RSK Group) carried out a ground investigation between 10th and 14th August 2020 under report reference 735292-02. The investigation comprised the excavation of 8No. Hand dug inspection pits (maximum depth of 0.60 m), 5No. Dynamic sampling boreholes (maximum depth of 3.95 m), 4No. machine-excavated trial pits (to a maximum of 2.40m bgl) and 1No. Cable percussive borehole (to 25.45 m/bgl).

The scope of works regarding the Structural Investigation was based upon the findings of the previous ground investigation at the site by Opus (reference Report No. JW0641.00, Dated April 2018).

The Opus report identified potentially complete pollutant linkages as follows:

- *Linkage 1 - Direct contact by future site users with soil that may be impacted by asbestos, heavy metals or hydrocarbons.*
- *Linkage 2 - Ingress of ground gases into buildings leading to Inhalation or generation of explosive or asphyxiating atmospheres.*

Gas monitoring had been installed as part of the Opus investigation and these were deemed to give sufficient coverage of the area of the school playing field, where the proposed new school buildings would be constructed. No further installations are recommended. At least 4 further rounds of gas monitoring should be carried out with at least one during period of low and/or falling atmospheric pressure.

No information on soil types or potential contamination is available within the built part of the school as the Opus works were undertaken around the playing field. It is recommended that should there be any proposed works within this area, either in the form or changes to soft landscaping, routing of services, construction of new roads or buildings etc, it may be prudent to undertake additional investigation and contamination analysis to confirm the assessment of linkage 1, and to provide information for the costing of waste disposal.

The exploratory holes undertaken determined the site to be underlain by made ground of between 0.40 m and 1.00 m thickness underlain by the Langley Silt Member between 1.70 m and 2.30 m. This strata is underlain by deposits associated with the Taplow Gravel Member between 0.30 m and 3.70 m in thickness. The London Clay Formation was encountered within BH101 only at a depth 7.00 m. The full extent of this strata was not encountered during the investigation (>18.45 m)

The made ground comprised varying compositions, WS103 and WS104/CBR101A were undertaken in asphalt overlying clayey sandy gravel, the rest of the exploratory positions were undertaken in soft landscaping or the playing fields and comprised friable slightly gravelly sandy clay. The made ground across the site varied in thickness from 0.40 m to 1.00 m. Anthropogenic (man-made) components of the made ground included brick fragments, concrete fragments, glass, metal and plastic. A fragment of amosite asbestos board was encountered at 0.15 m depth in WS102, whilst low concentrations (<0.001% w/w) of chrysotile asbestos fibres were found in WS103 at 0.40-0.60 m depth. All other asbestos testing was shown to be negative and no further potential fragments of ACM were observed.

Within WS103 water seepage was encountered between 0.40m - 0.60m depth with a slight sheen and the stratum had a mild hydrocarbon odour.

The Langley Silt Member was encountered in all exploratory locations. It was encountered from 0.45 m to 1.00 m bgl and ranges in thickness from 1.70 m to 2.30 m, comprising firm to stiff slightly sandy slightly gravelly silty clay.

The Langley Silt Member was underlain by the Taplow Gravel Member and was encountered within the borehole and window sample exploratory holes at a depth of 2.20 - 3.30 m bgl and ranging in thickness from >0.30 m to 3.70 m. The stratum comprises very dense to medium dense slightly clayey slightly sandy gravel of fine to coarse flint.

The Taplow Gravel Member was underlain by the London Clay Formation in BH101 and encountered at 7.00 m depth and proven to be >18.45 m thick. The London Clay Formation comprised very stiff clay with rare thinly bedded extremely weak to weak mudstone layers.

Groundwater was only encountered in BH101 at a strike depth of 4.50 m rising to 3.70 m depth. Subsequent standing groundwater levels were recorded on the previous BH1 and BH2 standpipes ranging from 2.89-3.16 m depth. These depths lie within the Taplow Gravel Member.

The concentrations of PAH and TPH in the soils associated with the hydrocarbon odour noted in WS103 did not exceed the GAC for a secondary school end-use, and therefore has been deemed below levels of concern.

There is evidence of sporadic asbestos impact within the near surface soils around the existing built part of the school around WS102 and WS103.

The presence of visible fragments of ACM or measurable concentrations of asbestos fibres will not be acceptable within near surface soils which may be disturbed by general site usage in the future, as such disturbance brings with it the possibility of the release of asbestos fibres from the soil which may be respirable. Impacted soils present beneath hard surfaces such as roadways, buildings or MUGA pitches do not pose such a high risk as disturbance of the soils is unlikely.

In summary, the previous report concluded that Linkage 1 has the potential to be complete due to the presence of asbestos within WS102 at 0.15m (a fragment of amosite asbestos insulation board) and WS103 in the sample between 0.40-0.60 m (chrysotile fibres <0.001% w/w). Linkage 2 was shown not to be complete and has been discounted from further assessment.

3 REMEDIATION STRATEGY

3.1 Potential pollutant linkages

This Remedial Strategy has been designed to break or remove the potential pollutant linkages identified on site from preceding investigation works. These comprise inhibiting:

- future end-users and surrounding users from the presence of asbestos fibres and ACM within made ground in areas of the site.

The made ground across the site varied in thickness from 0.40 m to 1.00 m. Anthropogenic (man-made) components of the made ground included brick fragments, concrete fragments, glass, metal and plastic. A fragment of amosite asbestos board was encountered at 0.15 m depth in WS102, whilst low concentrations, <0.001% w/w, of chrysotile asbestos fibres were found in WS103 at 0.40-0.60 m depth.

3.2 Remedial objectives

This Remediation Strategy is intended to satisfy the related conditions for the existing Planning Permission, by providing a remediation strategy for the safe redevelopment of the site for its proposed end use.

The remediation strategy has been designed to minimise risks to human health from the identified active linkages as follows:

- Delineate the impacted areas around WS102 and WS103 through hand excavated inspection pits and asbestos testing. Alternatively, a 5x5m area should be assumed as impacted around each.
- Removal of made ground in the areas of WS102 and WS03 and replacement with an appropriate alternative. Based on the proposed landscaping layout presented within **Figure 3**, WS102 and WS103 are shown to be beneath an access road and parking which would sever the active linkage. However, given that the made ground in these areas is only 0.55 and 0.60m thick respectively it is likely to be removed to facilitate construction of the hard landscaping. It would therefore be prudent to undertake these works in advance of the general groundworks to minimise the risk of cross contamination with non-impacted soils.
- Import of a chemically and physically suitable material as required by for the access and parking construction.

Responsibility for the correct implementation of the remediation strategy lies with the appointed Contractor. However, the remedial works shall be regularly inspected and validated by a suitably qualified and experienced Environmental Consultant (see below).

The impacted soils within WS102 and WS103 are outside of the initial constriction zone and within the existing school which it is understood is to remain operational during the construction in the adjacent playing field. Therefore, if agreeable to the Local Authority, it

is considered that it would be prudent to leave the impacted material in-situ until such a time that the existing school has been vacated. The removal works can then be undertaken ahead of the wider demolition and groundworks which will reduce the risks associated with excavating and removing asbestos impacted soils within a live school environment.

3.3 Enabling and demolition phase

3.3.1 Demolition and site clearance

Before commencing demolition works of the remaining buildings, an asbestos survey suitable for demolition purposes should be undertaken to confirm the presence or absence of ACM within all structures. Where ACM are encountered removal works should be undertaken by an appropriately licensed contractor before commencing demolition works.

Copies of the relevant survey and clearance documents, including disposal records, should be made available for inclusion within the site verification report.

3.3.2 Removal of existing building floor slabs

In the event that the asbestos demolition survey identifies the presence of asbestos at the site, all identified ACMs should be determined within the asbestos report, accompanied by any appropriate air monitoring (reassurances, 4-stage clearances etc). Following the demolition, the associated ground slabs should be removed under the supervision of a suitably accredited asbestos consultant given the increased likelihood of ACM lagging materials to be present along service ducts beneath the slab.

As a part of this process, licensed asbestos removal contractors may need to be in attendance to remove lagging materials identified within service ducts beneath the slab. The removal of any licensed materials will need to be conducted following the submission of an ASB5 notification to the HSE, with an appropriate method statement having been prepared and approved in advance of the works commencing. Please note works on licensable ACM cannot commence until the 14 day notification period is complete. The contractor's method statement will need to outline all appropriate control measures to be implemented including the requirement for air testing, damping down of all exposed soils and the provision for decontamination measures to demonstrate compliance with the Control of Asbestos Regulations 2012.

Copies of the relevant survey and clearance documents, including records of air monitoring and disposal records should be made available for inclusion within the site verification report (in the event that asbestos is identified in the demolition survey)

3.3.3 Stockpiling and offsite disposal

All excavated impacted material should be collected and removed off-site to a suitably licensed waste management facility. Soils to be disposed of may require additional

chemical analysis depending on the landfill operator requirements. All documentation including waste transfer notes should be supplied to the Environmental Consultant for inclusion in the validation report.

Where possible, impacted soils should be excavated directly into road going vehicles and removed from site as opposed to being stockpiled. Where this is not possible, material should be placed on an impermeable membrane and stockpiles covered to prevent dust.

3.3.4 Imported material

It is considered that should a virgin quarried material be used for the access and parking make up, laboratory testing will not be required over and above that supplied by the provider. Should a recycled material (either imported or site won) be used, it shall conform with the criteria set out in Appendix B.

The Contractor shall provide details of the provenance of imported material and evidence of compliance (i.e. chemical testing certificates representative of the type and volume of material) to the Environmental Consultant whose written approval will be needed **before** importation and use of the material on the site.

Upon arrival on site, any material used should be visually inspected for unacceptable inclusions; should any such inclusion be noted that may otherwise call the material's provenance into question, it should be rejected and an alternative sought.

3.3.5 Inspection and testing

The Environmental Consultant shall undertake inspections of the works as they progress. The inspections shall comprise regular visits matched to key dates and times in the contractor's programme. In addition to the routine, pre-arranged inspections, the Environmental Consultant shall also undertake ad hoc inspections of the groundworks.

It is possible that the groundworks may encounter different conditions from those revealed by site investigation that may require special treatment or other alleviation measures. Where the Contractor encounters unexpected ground conditions or potentially suspect materials, he shall immediately inform the Environmental Consultant who shall then carry out an inspection as soon as is reasonably practical.

During or immediately following the inspection, the Environmental Consultant shall advise the Client and Contractor of any requirements for additional investigations or possible modifications to the remediation works.

4 WORKING PRACTICE AND VALIDATION

4.1 Securing the site against unauthorised access

Suitable temporary fencing shall be erected around the site to prevent members of the public and any other unauthorised personnel from entering the site.

4.2 Prevention of pollution

4.2.1 General

The targets perceived to be potentially most at risk from pollution during the remediation of the site are workers on-site, neighbouring properties and residents.

All contractors on site should adopt environmental good practice as set out in CIRIA publication C650 (2005), Environment Agency Pollution Prevention Guidelines and National Planning Policy Framework (NPPF).

4.2.2 Airborne pollution (dust, etc.)

Care shall be taken by the contractor to minimise the amount of dust generated on-site during excavation, backfilling and trafficking. In the event that dry weather leads to excessive dust generation, exposed soils shall be damped down, but not flooded, with clean water.

4.2.3 Vehicles

Wheel cleaning facilities shall be provided on-site if operations are likely to result in vehicles leaving site with potentially contaminated soil/mud clinging to them. Contaminated water on-site, including water and other liquid collected from vehicle washing facilities shall be disposed of off-site in an approved manner with full regard to current legislation and good practice.

All vehicles leaving the site shall be clear of contaminated materials other than that contained within the load container, which shall be sheeted to prevent the loss of dust and other materials.

4.2.4 Re-contamination

The programme of works and any subsequent modifications shall be designed to avoid the potential re-contamination of areas already worked, i.e. site traffic shall be routed to avoid passing from contaminated to clean areas and contaminated soils shall not be stockpiled on clean areas.

4.3 Health and safety of site personnel

It is the responsibility of the main contractor and any appointed sub-contractors to enforce an appropriate health and safety regime for all site personnel. Full details regarding the proposed working practices in connection with the remediation works shall be agreed in advance of the commencement of the works with the Planning Supervisor and if appropriate with the Environmental Health Officer.

Measures will be necessary to protect the health and safety of site workers during the site works. The contractors will be under a statutory obligation to take reasonable care to protect the health and safety of their employees. The following measures are suggested to provide a minimum level of protection.

- All ground workers on-site should be issued with protective clothing, dust masks, footwear and gloves as applicable. These should not be removed from site, and advice should be given on when and how they are to be used;
- Care should be taken to minimise the amount of dust and mud generated on-site; and;
- Good practices relating to personal hygiene should be adhered to on-site, i.e. food and drink should only be consumed within designated areas on the site and smoking should be prohibited in all working areas.

Reference should also be made to the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Development of Contaminated Land".

All works to remove the impacted material should be undertaken in line with CAR:SOIL with appropriately competent, trained and experienced personnel used. Additional mitigating measures over and above standard working practices and PPE may be required in line with the Contractor's site specific Risk Assessment for the works.

4.4 Waste disposal

Any materials to be removed off-site may require further classification into inert and non-hazardous waste following an initial hazardous waste risk assessment and prior to any disposal. The contractor shall agree the waste classification in advance with the landfill operator(s), as appropriate.

4.5 Validation and Documentation

It is recommended that a suitable Environmental Consultant be in attendance for the removal of the impacted soils to undertake a visual inspection and sample the sides and base of the excavations for laboratory testing to demonstrate the successful removal of the asbestos.

All contaminated materials removed off-site shall be transported to an approved licensed waste facility for final disposal. The Contractor shall provide a full documentary record of

this operation in accordance with the Duty of Care. Copies of the waste consignment documentation shall be provided to the Environmental Consultant for inclusion in the verification report.

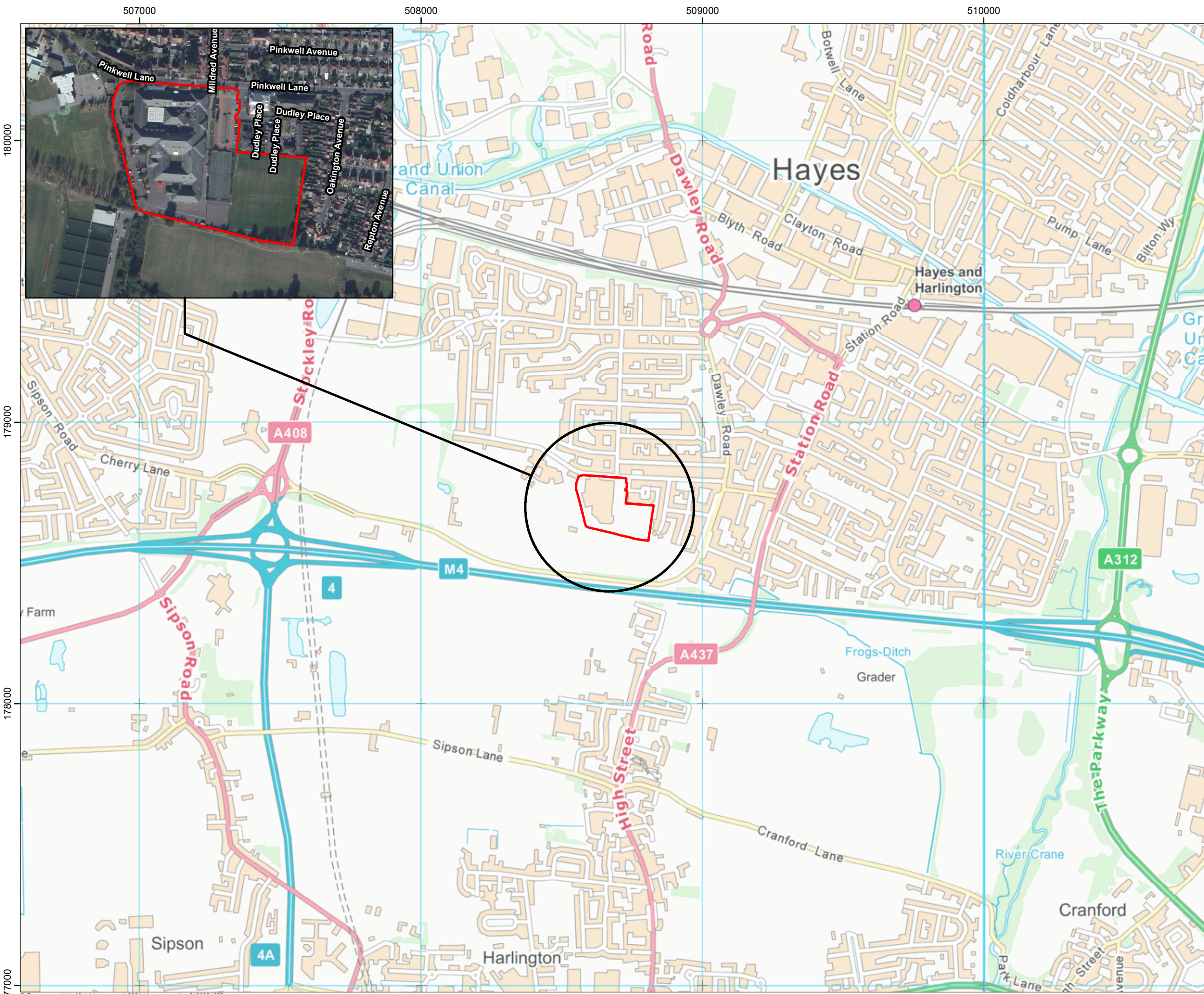
At the completion of the remediation works the Environmental Consultant shall produce a verification report for the site, including:

- The extent of works that have actually been carried out;
- The results of all soil chemical testing carried out during the works;
- Approvals for imported backfill materials, including supporting chemical test results as applicable;
- Collation of all other relevant documents, including records of waste movements; and
- A photographic record of the works and inspection pits within private garden areas.

Where the Contractor encounters unexpected ground conditions or potentially suspect materials, s/he shall immediately inform the Environmental Consultant who shall then carry out an inspection as soon as is reasonably practical. If previously unidentified contamination is found this should be reported to the Local Planning Authority in writing.

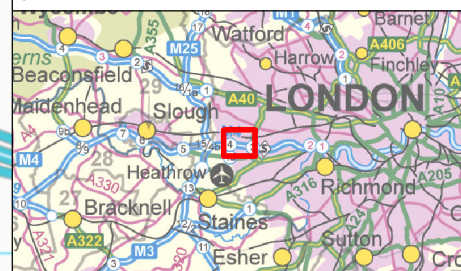
A copy of the report shall be forwarded to the Local Authority for approval of the remediation works.

FIGURES



Legend:
 Site Boundary

Coordinate System: British National Grid
 Projection: Transverse Mercator
 Datum: OSGB 1936
 Units: Meter

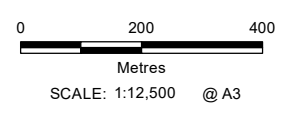


Rev	Date	Description	Drm	Chk	App
00	19/02/2021	First Draft	DR	CL	CL

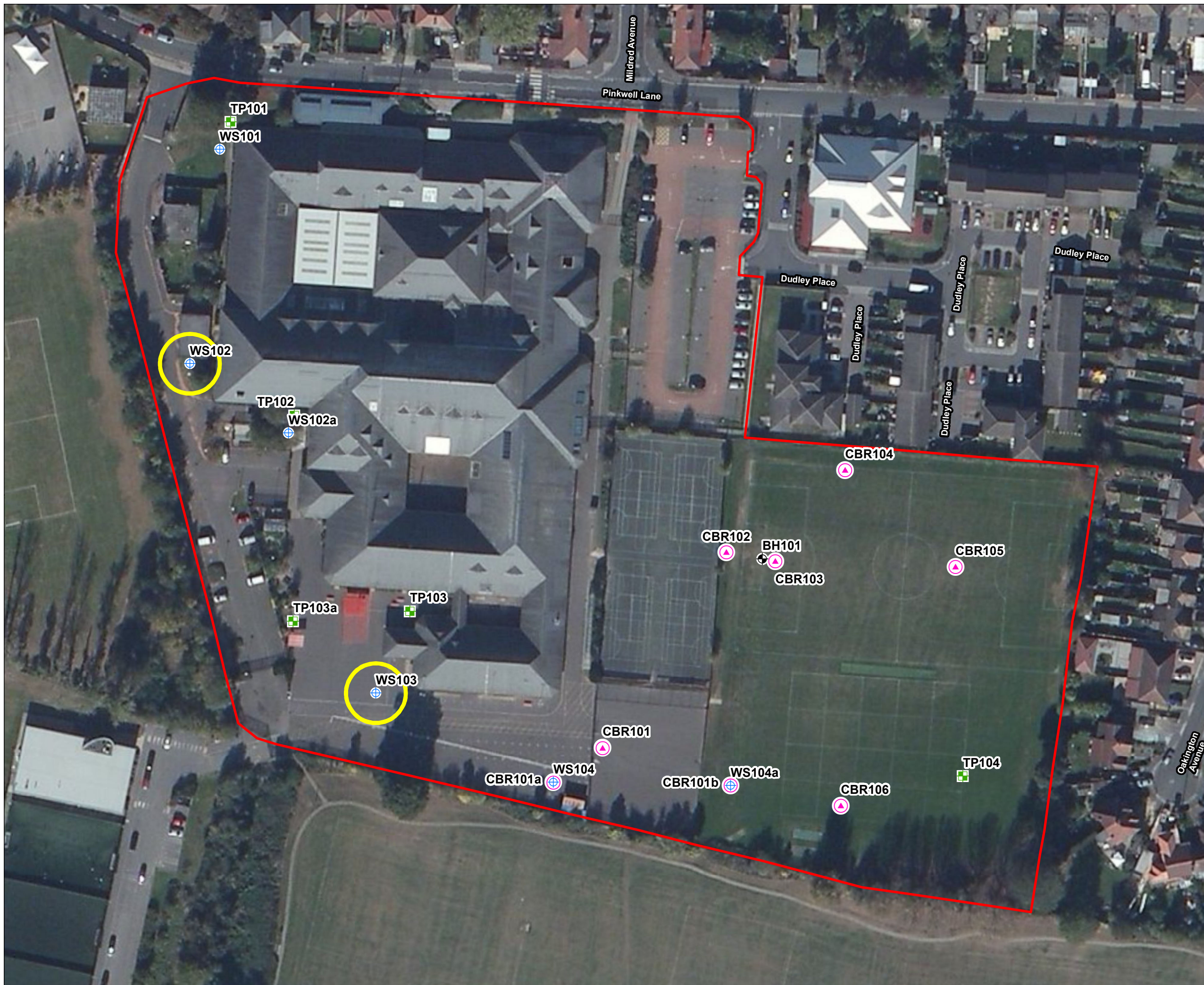
Wates Construction Limited
Harlington School



TITLE: Figure 1:
 Site Location Plan

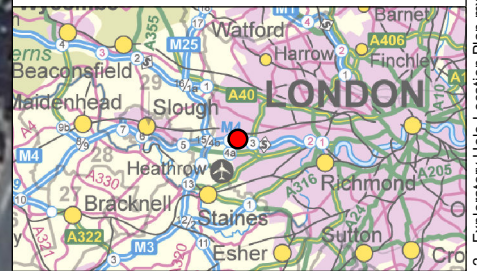


REV 00



- Legend:**
- Site Boundary
 - Previous Soils Investigation - (Aug 2020)
 - ⊕ Borehole Location
 - ⊕ California Bearing Ratio Location
 - Identified ACM Areas
 - ⊕ Trial Pit Location
 - ⊕ Window Sample Location

Coordinate System: British National Grid
 Projection: Transverse Mercator
 Datum: OSGB 1936
 Units: Meter

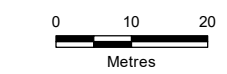


Rev	Date	Description	Drn	Chk	App
00	19/02/2021	First Draft	DR	CL	CL

**Wates Construction Limited
Harlington School**



TITLE: Figure 2:
Exploratory Hole Location Plan



SCALE: 1:1,000 @ A3



REV 00





APPENDIX A

SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Wates Construction Ltd (the "client") in accordance with the terms of a contract between RSK and the "client", dated 18 December 2020. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B

SOIL CONTAMINATION OBJECTIVES

Determinands	Topsoil / Subsoil within soft landscaped areas
	(mg/kg)
Metals	
Arsenic	37
Cadmium	22
Chromium (III)	910
Chromium (VI)	21
Copper	2500
Lead	200
Mercury (inorganic)	39
Nickel	130
Selenium	258
Zinc	3900
Polycyclic Aromatic Hydrocarbons (PAH)	
Acenaphthene	230
Acenaphthylene	180
Anthracene	2400
Benzo(a)anthracene	7
Benzo(a)pyrene	5
Benzo(b)fluoranthene	2.6
Benzo(g,h,i)perylene	310
Benzo(k)fluoranthene	77
Chrysene	15
Dibenzo(a,h)anthracene	0.24
Fluoranthene	290
Fluorene	170
Indeno(1,2,3-c,d)pyrene	27
Naphthalene	13
Phenanthrene	100
Pyrene	620
Total Petroleum Hydrocarbons Aromatic/Aliphatic Split	
Aliphatic EC5-EC6	42
Aliphatic >EC6-EC8	100
Aliphatic >EC8-EC10	27
Aliphatic >EC10-EC12	130
Aliphatic >EC12-EC16	1100
Aliphatic >EC16-EC44	65,000
Aromatic >EC8-EC10	30
Aromatic >EC10-EC12	80
Aromatic >EC12-EC16	140
Aromatic >EC16-EC21	260
Aromatic >EC21-EC44	1100
Other	
Asbestos	Not detected



APPENDIX C GENERIC ASSESSMENT CRITERIA HUMAN HEALTH

Generic assessment criteria for human health: secondary school

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009⁽¹⁾. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009⁽²⁾. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC: 2015

In 2014, the publication of Category 4 Screening Levels (C4SL)^(3,4), as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)⁽⁵⁾ used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010⁽³⁾). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report⁽³⁾ and associated appendices⁽⁶⁾, and adopts them as GAC for these six substances for the published land uses. The current RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015⁽⁷⁾, where a C4SL has not been published.

GAC for a secondary school land use have not been published previously, and RSK has used available reference documents, experience and professional judgement to provide suitable exposure assumptions to characterise this land use. RSK has used the toxicology published within the SP1010 final project report⁽³⁾ and associated appendices⁽⁶⁾, where available, or the toxicology published by LQM/CIEH in 2015⁽⁷⁾.

This GAC appendix therefore presents RSK GAC that may be used in the GQRA stage for a secondary school. **It should be noted that all schools (irrespective of age of pupils) fall within Use Class D1 Non-residential institutions under The Town and Country Planning (Use Classes) Order 1987 (as amended). Use Class D1 includes, amongst others, crèches, day nurseries, day centres and schools. Therefore consideration should be given to the most sensitive potential school land use within Use Class D1, when undertaking a GQRA for a proposed secondary school development. The most sensitive school land use out of a primary and secondary school is considered to be a primary school, for which RSK has published GAC.**

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.06 and supporting EA guidance^(5,8,9). As the SAC are calculated using generic assumptions with respect to a particular scenario, they will be referred to as generic assessment criteria (GAC).

Conceptual model

This scenario considers the risk to a female child from the age of 11 to 16 years, which is the typical age range within a UK secondary school without a sixth form. Whilst the number of attendance days is prescribed by the Department of Education⁽¹⁰⁾, the length of the school day is determined by the school governing body⁽¹¹⁾. The consumption of home-grown produce has not been included in this scenario, as the amount of produce grown by a school (if grown) is typically very small and often in raised planters. The consumption of any produce is usually overseen by a teacher or parent and therefore likely to have been thoroughly washed. The pathways considered for the production of SAC in the secondary school are

- direct soil and dust ingestion
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium⁽¹⁾, the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure (to AC18). Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

The CLEA model only considers the risk of volatile compounds from the soils and not groundwater. Groundwater assessment criteria (GrAC) have not been produced by RSK for this land use scenario, so site-specific assessment criteria should be derived if required.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase⁽⁹⁾. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached⁽⁹⁾. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required⁽⁹⁾.

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible, as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, vapour exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based

on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook⁽⁹⁾, this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook⁽⁹⁾, which explains how to calculate an effective assessment criterion manually.

SR3⁽⁵⁾ states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical correction factor of 10 into the CLEA chemical database for all petroleum hydrocarbons (including BTEX, trimethylbenzenes and total petroleum hydrocarbons (TPH) fraction) and the polycyclic aromatic hydrocarbons (PAH), naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7⁽¹²⁾, the EA TOX⁽¹⁾ reports, the C4SL SP1010 project report and associated appendices^(3,6) or the 2015 LQM/CIEH report⁽⁷⁾.

Following the methodology in the C4SL SP1010 project report and associated appendices^(3,6), receptor-specific (AC12 to 16) inhalation LLTCs were calculated for arsenic, benzene, chromium VI and benzo(a)pyrene. This reflects the average bodyweight and inhalation rate for these age classes.

Toxicological and specific chemical parameters for aromatic hydrocarbon C₈–C₉ (styrene), 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report⁽¹³⁾.

For TPH, aromatic hydrocarbons C₅–C₈ were not modelled, as this range comprises benzene and toluene, which are modelled separately. The aromatic C₈–C₉ hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for aromatic C₈–C₉ have been taken from styrene.

Physical parameters

The building type has been based on best practice guidance for the construction of new secondary schools as set out in 'Building Bulletin 98: Briefing Framework for Secondary School Projects'⁽¹⁴⁾, published by the Department for Education and Skills. The site area has been calculated using the methodology in Building Bulletin 98⁽¹⁴⁾, for a single-storey building with 915 pupils based on the 2013 Department for Education statistical release for schools, pupils and their characteristics in England⁽¹⁴⁾. This equates to a total net site area of 63,985m² and a building footprint of 7981m². A total area of 46,228m² has been classed as soft landscaping (pitches, habitat areas and soft landscaped areas), with 50% of this assumed to be disturbed ground. Fifty percent is considered highly conservative as most of this area is likely to be covered by grass, which is classed as not available for dust generation in the CLEA model. The building parameters are given in Table 1.



The parameters for a sandy loam soil type were used in line with SR3⁽⁵⁾. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced SAC for an SOM of 1%, 2.5% and 6%.

The SAC were produced using the input parameters in Tables 1 to 5. The final selected GAC are presented by pathway in Table 6 and the combined GAC in Table 7.

Figure 1: Conceptual model for secondary school scenario

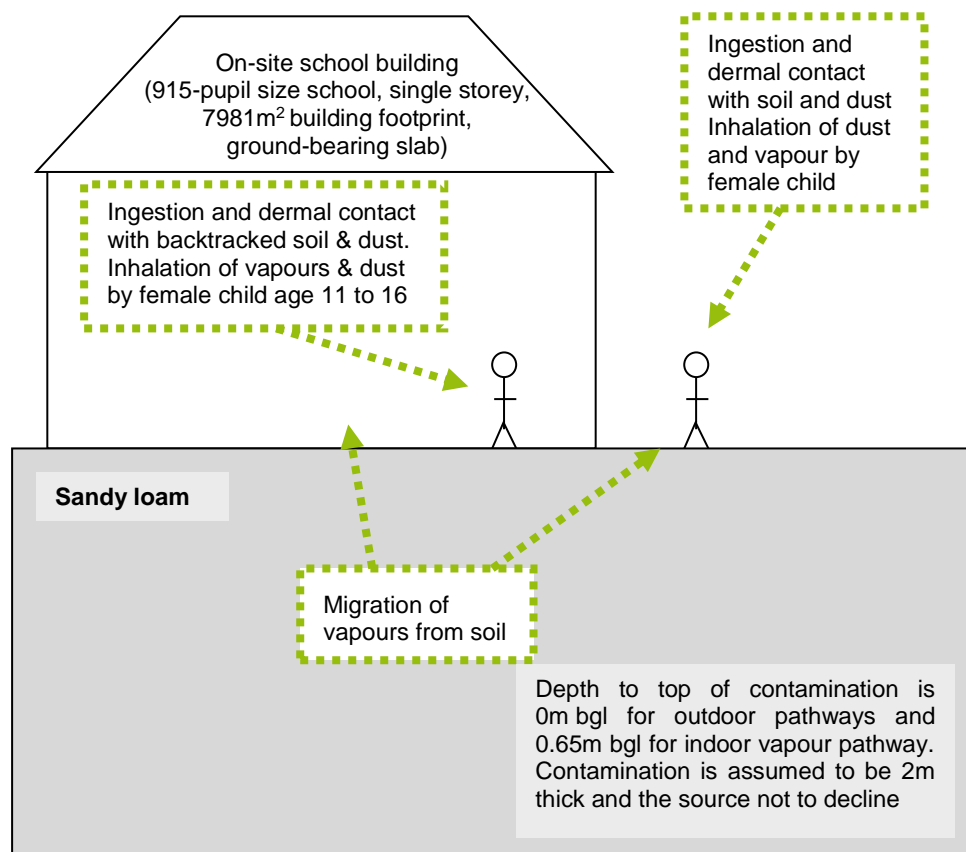


Table 1: Exposure assessment parameters for primary school scenario – inputs for CLEA model

Parameter	Value	Justification
Land use	Secondary school – RSK-derived land use	Chosen land use. It has been assumed that the amount of produce grown and consumed by the pupils is negligible. The assumed secondary school characteristics are presented in Table 2.
Receptor	Female child age 11 to 16	Typical age range of secondary schools without a sixth form attached.
Building	Secondary school	Building type varies significantly depending on age of school and location. Therefore, typical building type scenario was created for a 915-pupil size school, using guidance set out in 'Building Bulletin 98: Briefing Framework for Secondary School Projects' ⁽¹³⁾ . It has been assumed that the building is single storey with a ground-bearing floor slab.
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, report SC050021/SR3) ⁽⁵⁾
Start AC (age class)	12	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 11 to 16. AC12 is the age range 11-12; AC16 is 15–16. For lifetime exposure (cadmium) AC12 to AC18 is considered.
End AC (age class)	16	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents' ⁽¹⁶⁾
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Secondary school characteristics

Parameter	Unit	Value	Justification
Number of pupils	No	915	Considered reasonable assumption based on Dept. of Education statistics for the average number of pupils aged 11 to 16 at a state secondary school in England ⁽¹⁵⁾
Number of storeys	No	1	Assumed school is one storey
Building area			
Likely gross building (usable) area	m ²	7981	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Site area			
Pitches (assumed to be soft cover)	m ²	42025	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Soft play (informal and social)	m ²	3088	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Games courts (hard surfaced)	m ²	2430	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Hard play (informal and social)	m ²	1773	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Habitat (soft landscaped areas)	m ²	1115	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Float (any of the above assumed to be soft)	m ²	5575	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Total net ^(A) site area	m ²	56005	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Area of soft cover	m ²	46228	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
Total site area ^(B)	m ²	63986	Calculated using the formula in BB98 ⁽¹⁴⁾ , in Appendix 3
<p>Note: BB98⁽¹⁴⁾ stipulates best practice for new build secondary schools.</p> <p>^A Net site area is the total of five categories of space (sports pitches, games courts (hard surfaces), soft play (informal and social), hard play, habitat areas), as defined in figure D.1 of BB98⁽¹⁴⁾</p> <p>^B Total site area is the sum of the net area plus buildings and access, as calculated using the formula in Appendix 3 of BB98⁽¹⁴⁾</p>			

Table 3: Secondary school – land use data for CLEA model

Parameter	Unit	Age class						
		12	13	14	15	16	17	18
EF (soil and dust ingestion)	day yr ⁻¹	190	190	190	190	190	190	190
EF (consumption of home-grown produce)	day yr ⁻¹	0	0	0	0	0	0	0
EF (skin contact, indoor)	day yr ⁻¹	190	190	190	190	190	190	190
EF (skin contact, outdoor)	day yr ⁻¹	190	190	190	190	190	190	190
EF (inhalation of dust and vapour, indoor)	day yr ⁻¹	190	190	190	190	190	190	190
EF (inhalation of dust and vapour, outdoor)	day yr ⁻¹	190	190	190	190	190	190	190
Justification	Based on 190 days for secondary school education ⁽¹⁰⁾							
Occupancy period (indoor)	hr day ⁻¹	6	6	6	6	6	6	6
Occupancy period (outdoor)	hr day ⁻¹	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Justification	Based on a typical school day of 7h (08:30 to 15:30) including a 1h lunch break and an average of 12 mins of extracurricular activity per day (1 hour per week), totaling a 7.2h school day. The school day assumes 2hr of exercise per week (voluntary target set by Department for Education ⁽¹⁷⁾), 1hr of which is indoors to account for inclement weather and forms part of the 7h school day; and 1hr of extracurricular (additional to the school day) outdoor activity a week outside of school hours. It is assumed that all of the 1h lunch break is outside, equating to 1.2h of outdoor occupancy per week. The occupancy period does not include for daily use of after-school clubs or activities, as this is not a statutory requirement and not all schools provide these.							
Soil to skin adherence factor (indoor)	mg cm ⁻² day ⁻¹	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Soil to skin adherence factor (outdoor)	mg cm ⁻² day ⁻¹	0.1	0.3	0.3	0.3	0.3	0.3	0.3
Justification	Indoor: Table 8.1, SR3 ⁽⁵⁾ ; Outdoor: Table 3.5, SP1010 ⁽³⁾ . Outdoor adherence factors are based on a limited number of studies and are summarised in the USEPA Exposure Factor Handbook ⁽¹⁸⁾ Table 7-4. Of the activities relevant to behaviours at a secondary school the highest adherence was for hands, and for outdoor sports, with a mean adherence factor of 0.11 mg cm ⁻² . Therefore applying the value of 0.1 in Table 3.5, SP1010 ⁽³⁾ used for AC1-12. Default values for AC13 to AC16 (older children) and, AC17 and 18 (lifetime exposure) from Table 4.1, SR4 ⁽⁹⁾ have been used.							

Parameter	Unit	Age class						
		12	13	14	15	16	17	18
Soil and dust ingestion rate	g day ⁻¹	0.1	0.05	0.05	0.05	0.05	0.05	0.05
Justification	Table 6.2, SR3 ⁽⁵⁾ and Table 4.1 (lifetime), SR4 ⁽⁹⁾ .							
<p>Note: For cadmium, the exposure assessment for the secondary school land use is based on estimates representative of <u>lifetime</u> exposure to AC18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer time period. See the Environment Agency Science Report SC050021/TOX 3⁽¹⁾ and Science Report SC050021/Cadmium SGV⁽¹⁾.</p>								

Table 4: Secondary school – receptor data for CLEA model

Parameter	Unit	Age class						
		12	13	14	15	16	17	18
Body weight	kg	41.3	47.2	51.2	56.7	59.0	70.0	70.9
Body height	m	1.4	1.5	1.6	1.6	1.6	1.6	1.6
Justification	Table 4.6, SR3 ⁽³⁾ . See Table 4.8 SR3 ⁽³⁾ for AC12 to 18							
Inhalation rate	m ³ day ⁻¹	25.20	25.20	25.20	25.20	25.20	24.54	23.58
Justification	USEPA Exposure Factor Handbook ⁽¹⁸⁾ Table 6.2, short-term mean exposure values (males and female combined). Mean inhalation rates calculated for the occupancy period and factored up to assume an hourly rate for a 24hr period in accordance with SR3 ⁽⁵⁾ . Assumed: 0.9h (54 mins) high-intensity activity (i.e. football, running during 24 mins of sport/PE per day and 30 mins of the lunch break); 6.3 h light intensity (i.e. time in classroom, eating, light activity during half of the lunch break over 6h 18 mins).							
Max exposed skin fraction (indoor)	m ² m ⁻²	0.22	0.22	0.22	0.21	0.21	0.33	0.33
Max exposed skin fraction (outdoor)	m ² m ⁻²	0.14	0.14	0.14	0.14	0.14	0.27	0.27
Justification	Data in Table 4.8, SR3 ⁽⁵⁾ . See Table 4.8 of SR(3) ⁽⁵⁾ for AC12 to 18.							

Table 5: Secondary school – default soil and building inputs for CLEA model

Parameter	Unit	Value	Justification
Soil properties for sandy loam			
Porosity, total	cm ³ cm ⁻³	0.53	Default soil type is sandy loam, Section 4.3.1, SR3 ⁽⁵⁾ Parameters for sandy loam from Table 4.4, SR3 ⁽⁵⁾
Porosity, air filled	cm ³ cm ⁻³	0.20	
Porosity, water filled	cm ³ cm ⁻³	0.33	
Residual soil water content	cm ³ cm ⁻³	0.12	
Saturated hydraulic conductivity	cm s ⁻¹	3.56E-03	
van Genuchten shape parameter (m)	-	3.20E-01	
Bulk density	g cm ⁻³	1.21	
Threshold value of wind speed at 10m	m s ⁻¹	7.20	Default value taken from Section 9.2.2, SR3 ⁽⁵⁾
Empirical function (F _x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3 ⁽⁵⁾
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils. Section 4.3.1, SR3 ⁽⁵⁾
Air dispersion model			
Mean annual wind speed (10m)	m s ⁻¹	5.00	Default value taken from Section 9.2.2, SR3 ⁽⁵⁾
Air dispersion factor at height of 0.8m	g m ⁻² s ⁻¹ per kg m ⁻³	68	Values for a 2ha site, appropriate to land use in Newcastle (considered the most representative city for the UK as its data is close to the 10 th percentile value for mean values of all 13 cites modelled in SR3; Table 9.1, SR3 ⁽⁵⁾)
Air dispersion factor at height of 1.6m	g m ⁻² s ⁻¹ per kg m ⁻³	120	
Fraction of site with hard or vegetative cover	m ² m ⁻²	0.587	Total site area calculated from BB98 ⁽¹⁴⁾ less the building footprint ⁽⁵⁾ . It has been assumed that 50% of the soft cover is vegetative cover such as grass. The remaining 50% of soft cover is assumed to be disturbed in some way, either by gardening or sports/ playtime activities.
Building properties for secondary school with ground-bearing floor slab			
Building footprint	m ²	7981	Calculated from BB 98 ⁽¹⁴⁾ . See Table 2.
Living space air exchange rate	hr ⁻¹	2	The Building Regulations 2000, Approved Document F ⁽¹⁹⁾ states that ventilation should be designed in accordance with 'Building Bulletin 101: Ventilation for School Buildings' ⁽²⁰⁾ . The School Premises Regulations 1999 ⁽²¹⁾ apply to existing buildings and state that all occupied areas in a school building shall have controllable ventilation at a minimum rate of three litres of fresh air per second for each of the maximum number of persons the area will accommodate. BB101 ⁽¹⁸⁾ states that in a special school, the minimum air exchange rate should be 2.5 air changes per hour. CIBSE Guide B2:2001 ⁽²²⁾ , states that for schoolrooms, there should be a

Parameter	Unit	Value	Justification
			minimum of 4–6 air changes per hour. A conservative rate of 2 has been used.
Living space (i.e. classroom) height (above ground)	m	2.4	Minimum height requirement for a school sports hall is 7.6m and an activity studio is 3.5m (BB98 ⁽¹⁴⁾). It is assumed that the school is single storey. A minimum classroom height of 2.4m has been assumed in order to be conservative.
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	5.1	From Table 4.21, SR3 ⁽⁵⁾ . Based on the negative pressure of an office of similar dimensions and construction, most conservative value assumed.
Foundation thickness	m	0.15	Assumed reasonable
Floor crack area	cm ²	25687	From Table 4.21, SR3 ⁽⁵⁾ . Based on an office of similar construction, scaled up to the size of the generic school building (office post 1970 x 13).
Dust loading factor (indoors)	µg m ⁻³	100	Default value for a commercial property taken from Section 9.3, SR3 ⁽⁵⁾ . Oatway & Mobbs 2003 (cited in SR3 ⁽⁵⁾) suggest a value of 500 µg m ⁻³ for residential and school use, during surface disturbances. Surface disturbances are considered unlikely and Oomen & Lijzen 2004 (cited in SR3 ⁽⁵⁾) recommend mean fine particulate (PM ₁₀) concentrations 100 µg m ⁻³ for very crowded places such as classrooms.
Vapour model			
Default soil gas ingress rate	cm ³ s ⁻¹	150	Generic flow rate for commercial property, Section 10.3, SR3 ⁽⁵⁾ , based on a worst-case building type and therefore considered suitable for a secondary school building. The value also lies at the top end of soil ingress rate observed by Hers et al ⁽²³⁾ .
Depth to top of source (beneath building)	cm	65	Section 3.2.6, SR3 ⁽⁵⁾ states source is 50cm below building or 65cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3 ⁽⁵⁾ assumes impact from 0m to 1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4 ⁽⁹⁾
Time average period for surface emissions	years	5	Time period of AC 12-16 year old, Box 3.5, SR3 ⁽⁵⁾ ; time period of AC 12–18 (64 years) for lifetime exposure.
User-defined effective air permeability	cm ²	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3 ⁽⁵⁾

References

1. Environment Agency (2009), 'Science Reports SC050021 - SGV and TOX reports for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'; 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'. Available at: <https://www.gov.uk/government/publications/contaminants-in-soil-updated-collation-of-toxicological-data-and-intake-values-for-humans> and <https://www.gov.uk/government/publications/land-contamination-soil-guideline-values-sgvs> (accessed 4 February 2015)
2. Nathaniel, C. P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A. G., Ogden, R. C. and Scott, D. (2009), *LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment*, second edition (Nottingham: Land Quality Press).
3. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010.
4. Department for Environment, Food and Rural Affairs (Defra) (2014), 'SP1010: Development of Category 4 Screening Levels for assessment of land affected by contamination – Policy Companion Document', Revision 2.
5. Environment Agency (2009), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).
6. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Appendices C to H). DEFRA research project SP1010'.
7. Nathaniel, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathaniel, J. F. (2015), *The LQM/CIEH S4ULs for Human Health Risk Assessment* (Nottingham: Land Quality Press).
8. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2* (Bristol: Environment Agency).
9. Environment Agency (2009), *Science Report – SC050021/SR4 CLEA Software (version 1.05) Handbook* (Bristol: Environment Agency).
10. Department for Education (2014), 'School attendance. Departmental advice for maintained schools, academies, independent schools and local authorities'.
11. Department for Education (2015), 'Governors' handbook. For governors in maintained schools, academies and free schools'.
12. Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).
13. CL:AIRE (2010), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).
14. Department for Education and Skills (2014), 'Building Bulletin 98: Briefing Framework for Secondary School Projects. Revision to BB82: Area Guidelines for Schools (secondary school)'.

15. Department for Education (2013), 'Schools, pupils and their characteristics'. SFR 21/2013.
16. Environment Agency (2009), 'Changes made to the CLEA framework documents after the three-month evaluation period in 2008', released January 2009.
17. Department for Education and Skills (2003), 'Learning through PE and Sport: A guide to the Physical Education, School Sport and Club Links Strategy'.
18. USEPA (2011), *Exposure factors handbook*, EPA/600/R-090/052F (Washington, DC: Office of Research and Development).
19. HM Government (2010), *The Building Regulations 2000. Approved Document F: Ventilation* (London: NBS/RIBA).
20. Department for Children, Schools and Families (2006), 'Building Bulletin 101: Ventilation of School Buildings. Regulations Standards Design Guidance, Version 1.4'.
21. The Education (School Premises) Regulations 1999. SI 1999 No.2.
22. Chartered Institution of Building Services Engineers (2001), *CIBSE Guide B2, Ventilation and Air Conditioning* (London: CIBSE).
23. Hers, I., Zapf-Gilje, R., Johnson, P. C. and Li, L. (2003), 'Evaluation of the Johnson and Ettinger Model for Prediction of Indoor Air Quality', *Groundwater Monitoring & Remediation*, 23/1: 62–76.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - SECONDARY SCHOOL



Table 6
Human Health Generic Assessment Criteria by Pathway for Secondary School

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	4.23E+02	1.25E+03	NR	NR	4.23E+02	1.25E+03	NR	NR	4.23E+02	1.25E+03	NR	NR
Barium	(b)	1.54E+04	NR	NR	NR	1.54E+04	NR	NR	NR	1.54E+04	NR	NR	NR
Beryllium		2.72E+03	6.07E+00	NR	NR	2.72E+03	6.07E+00	NR	NR	2.72E+03	6.07E+00	NR	NR
Boron		1.54E+05	1.65E+07	NR	NR	1.54E+05	1.65E+07	NR	NR	1.54E+05	1.65E+07	NR	NR
Cadmium	(a)	8.75E+02	7.06E+02	4.06E+02	NR	8.75E+02	7.06E+02	4.06E+02	NR	8.75E+02	7.06E+02	4.06E+02	NR
Chromium (III) - trivalent	(c)	2.31E+05	4.88E+03	NR	NR	2.31E+05	4.88E+03	NR	NR	2.31E+05	4.88E+03	NR	NR
Chromium (VI) - hexavalent	(a,d)	6.61E+02	4.94E+01	NR	NR	6.61E+02	4.94E+01	NR	NR	6.61E+02	4.94E+01	NR	NR
Copper		1.24E+05	5.21E+04	4.16E+04	NR	1.24E+05	5.21E+04	4.16E+04	NR	1.24E+05	5.21E+04	4.16E+04	NR
Lead	(a)	3.59E+03	NR	NR	NR	3.59E+03	NR	NR	NR	3.59E+03	NR	NR	NR
Elemental Mercury (Hg ⁰)	(d)	NR	2.89E+01	NR	4.31E+00	NR	4.70E+01	NR	1.07E+01	NR	6.33E+01	NR	2.58E+01
Inorganic Mercury (Hg ²⁺)		8.19E+02	1.15E+04	7.65E+02	NR	8.19E+02	1.15E+04	7.65E+02	NR	8.19E+02	1.15E+04	7.65E+02	NR
Methyl Mercury (Hg ⁴⁺)		2.04E+02	8.71E+02	1.65E+02	7.33E+01	2.04E+02	1.23E+03	1.75E+02	1.42E+02	2.04E+02	1.80E+03	1.83E+02	3.04E+02
Nickel	(d)	2.12E+03	5.76E+02	NR	NR	2.12E+03	5.76E+02	NR	NR	2.12E+03	5.76E+02	NR	NR
Selenium	(b)	8.44E+03	NR	NR	NR	8.44E+03	NR	NR	NR	8.44E+03	NR	NR	NR
Vanadium		1.49E+04	5.26E+03	NR	NR	1.49E+04	5.26E+03	NR	NR	1.49E+04	5.26E+03	NR	NR
Zinc	(b)	4.66E+05	1.15E+08	NR	NR	4.66E+05	1.15E+08	NR	NR	4.66E+05	1.15E+08	NR	NR
Cyanide (free)		4.50E+02	4.40E+04	4.48E+02	NR	4.50E+02	4.40E+04	4.48E+02	NR	4.50E+02	4.40E+04	4.48E+02	NR
Volatile Organic Compounds													
Benzene	(a)	6.62E+02	1.40E+02	1.15E+02	1.22E+03	6.62E+02	2.45E+02	1.79E+02	2.26E+03	6.62E+02	4.64E+02	2.73E+02	4.71E+03
Toluene		2.58E+05	1.62E+05	9.97E+04	8.69E+02	2.58E+05	3.23E+05	1.44E+05	1.92E+03	2.58E+05	6.37E+05	1.84E+05	4.36E+03
Ethylbenzene		1.16E+05	1.34E+04	1.20E+04	5.18E+02	1.16E+05	2.75E+04	2.22E+04	1.22E+03	1.16E+05	5.42E+04	3.70E+04	2.84E+03
Xylene - m		2.09E+05	1.36E+04	1.28E+04	6.25E+02	2.09E+05	2.77E+04	2.45E+04	1.47E+03	2.09E+05	5.39E+04	4.29E+04	3.46E+03
Xylene - o		2.09E+05	1.44E+04	1.35E+04	4.78E+02	2.09E+05	2.92E+04	2.56E+04	1.12E+03	2.09E+05	5.65E+04	4.45E+04	2.62E+03
Xylene - p		2.09E+05	1.32E+04	1.24E+04	5.76E+02	2.09E+05	2.68E+04	2.37E+04	1.35E+03	2.09E+05	5.21E+04	4.17E+04	3.17E+03
Total xylene		2.09E+05	1.32E+04	1.24E+04	6.25E+02	2.09E+05	2.68E+04	2.37E+04	1.47E+03	2.09E+05	5.21E+04	4.17E+04	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		3.48E+05	2.36E+04	2.21E+04	2.04E+04	3.48E+05	3.79E+04	3.42E+04	3.31E+04	3.48E+05	7.05E+04	5.86E+04	6.27E+04
Trichloroethene		5.81E+02	3.91E+00	3.88E+00	1.54E+03	5.81E+02	8.11E+00	8.00E+00	3.22E+03	5.81E+02	1.78E+01	1.72E+01	7.14E+03
Tetrachloroethene		6.81E+03	5.23E+01	5.19E+01	4.24E+02	6.81E+03	1.16E+02	1.14E+02	9.51E+02	6.81E+03	2.63E+02	2.53E+02	2.19E+03
1,1,1-Trichloroethane		6.97E+05	2.08E+03	2.08E+03	1.43E+03	6.97E+05	4.23E+03	4.21E+03	2.92E+03	6.97E+05	9.20E+03	9.08E+03	6.39E+03
1,1,1,2-Tetrachloroethane		6.70E+03	3.13E+02	2.99E+02	2.60E+03	6.70E+03	7.08E+02	6.40E+02	6.02E+03	6.70E+03	1.58E+03	1.28E+03	1.40E+04
1,1,2,2-Tetrachloroethane		6.70E+03	7.97E+02	7.12E+02	2.67E+03	6.70E+03	1.58E+03	1.28E+03	5.46E+03	6.70E+03	3.28E+03	2.20E+03	1.20E+04
Carbon Tetrachloride		4.64E+03	8.55E+00	8.54E+00	1.52E+03	4.64E+03	1.86E+01	1.85E+01	3.32E+03	4.64E+03	4.18E+01	4.14E+01	7.54E+03
1,2-Dichloroethane		1.39E+02	2.21E+00	2.18E+00	3.41E+03	1.39E+02	3.17E+00	3.10E+00	4.91E+03	1.39E+02	5.37E+00	5.17E+00	8.43E+03
Vinyl Chloride		1.63E+01	2.24E-01	2.21E-01	1.36E+03	1.63E+01	2.90E-01	2.84E-01	1.76E+03	1.63E+01	4.42E-01	4.30E-01	2.96E+03
1,2,4-Trimethylbenzene		NR	4.26E+02	NR	4.74E+02	NR	6.19E+02	NR	1.16E+03	NR	7.86E+02	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		6.48E+04	9.25E+05	6.05E+04	5.70E+01	6.48E+04	1.43E+06	6.20E+04	1.41E+02	6.48E+04	2.10E+06	6.28E+04	3.36E+02
Acenaphthylene		6.48E+04	8.91E+05	6.04E+04	8.61E+01	6.48E+04	1.37E+06	6.19E+04	2.12E+02	6.48E+04	2.02E+06	6.28E+04	5.06E+02
Anthracene		3.24E+05	8.66E+06	3.12E+05	1.17E+00	3.24E+05	1.32E+07	3.16E+05	2.91E+00	3.24E+05	1.87E+07	3.18E+05	6.96E+00
Benzo(a)anthracene		1.67E+02	1.41E+02	7.65E+01	1.71E+00	1.67E+02	1.74E+02	8.53E+01	4.28E+00	1.67E+02	2.02E+02	9.16E+01	1.03E+01
Benzo(a)pyrene	(a)	4.49E+01	5.37E+01	NR	9.11E-01	4.50E+01	6.39E+01	NR	2.28E+00	4.50E+01	7.22E+01	NR	5.46E+02
Benzo(b)fluoranthene		4.21E+01	3.96E+01	2.04E+01	1.22E+00	4.21E+01	4.76E+01	2.24E+01	3.04E+00	4.21E+01	5.43E+01	2.37E+01	7.29E+00
Benzo(g,h,i)perylene		3.72E+03	4.47E+03	2.03E+03	1.54E-02	3.72E+03	5.01E+03	2.13E+03	3.85E-02	3.72E+03	5.41E+03	2.20E+03	9.23E-02
Benzo(k)fluoranthene		1.11E+03	1.12E+03	5.59E+02	6.87E-01	1.11E+03	1.33E+03	6.05E+02	1.72E+00	1.11E+03	1.49E+03	6.37E+02	4.12E+00
Chrysene		3.35E+02	2.63E+02	1.47E+02	4.40E-01	3.35E+02	3.29E+02	1.66E+02	1.10E+00	3.35E+02	3.88E+02	1.80E+02	2.64E+00
Dibenzo(a,h)anthracene		3.35E+00	3.57E+00	1.73E+00	3.93E-03	3.35E+00	4.15E+00	1.85E+00	9.84E-03	3.35E+00	4.61E+00	1.94E+00	2.36E-02
Fluoranthene		1.35E+04	7.08E+05	1.32E+04	1.89E+01	1.35E+04	9.64E+05	1.33E+04	4.73E+01	1.35E+04	1.23E+06	1.33E+04	1.13E+02
Fluorene		4.32E+04	5.87E+05	4.02E+04	3.09E+01	4.32E+04	9.96E+05	4.14E+04	7.65E+01	4.32E+04	1.55E+06	4.20E+04	1.83E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - SECONDARY SCHOOL



Table 6
Human Health Generic Assessment Criteria by Pathway for Secondary School

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Indeno(1,2,3-cd)pyrene		4.78E+02	4.33E+02	2.27E+02	6.13E-02	4.78E+02	5.25E+02	2.50E+02	1.53E-01	4.78E+02	6.03E+02	2.67E+02	3.68E-01
Naphthalene		2.15E+04	1.99E+03	1.82E+03	7.64E+01	2.15E+04	3.49E+03	3.00E+03	1.83E+02	2.15E+04	5.79E+03	4.56E+03	4.32E+02
Phenanthrene		1.35E+04	3.77E+05	1.30E+04	3.60E+01	1.35E+04	5.68E+05	1.32E+04	8.96E+01	1.35E+04	7.97E+05	1.32E+04	2.14E+02
Pyrene		3.24E+04	1.64E+06	3.18E+04	2.20E+00	3.24E+04	2.24E+06	3.19E+04	5.49E+00	3.24E+04	2.87E+06	3.20E+04	1.32E+01
Phenol		7.67E+05	1.04E+04	1.03E+04	2.42E+04	7.67E+05	1.10E+04	1.09E+04	3.81E+04	7.67E+05	1.18E+04	1.16E+04	7.03E+04
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC ₅ -EC ₆		2.90E+06	1.09E+04	1.09E+04	3.04E+02	2.90E+06	1.97E+04	1.97E+04	5.58E+02	2.90E+06	3.94E+04	3.93E+04	1.15E+03
Aliphatic hydrocarbons >EC ₆ -EC ₈		2.90E+06	2.59E+04	2.59E+04	1.44E+02	2.90E+06	5.56E+04	5.54E+04	3.22E+02	2.90E+06	1.20E+05	1.19E+05	7.36E+02
Aliphatic hydrocarbons >EC ₈ -EC ₁₀		5.81E+04	6.16E+03	5.99E+03	7.77E+01	5.81E+04	1.38E+04	1.29E+04	1.90E+02	5.81E+04	2.92E+04	2.47E+04	4.51E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂		5.81E+04	2.56E+04	2.22E+04	4.75E+01	5.81E+04	5.44E+04	3.74E+04	1.18E+02	5.81E+04	1.07E+05	4.82E+04	2.83E+02
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆		5.81E+04	1.37E+05	5.07E+04	2.37E+01	5.81E+04	2.59E+05	5.45E+04	5.91E+01	5.81E+04	4.53E+05	5.61E+04	1.42E+02
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	(b)	9.68E+05	NR	NR	8.48E+00	1.04E+06	NR	NR	2.12E+01	1.08E+06	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	9.68E+05	NR	NR	8.48E+00	1.04E+06	NR	NR	2.12E+01	1.08E+06	NR	NR	5.09E+01
Aromatic hydrocarbons >EC ₉ -EC ₁₀		2.32E+04	8.35E+03	7.47E+03	6.13E+02	2.32E+04	1.70E+04	1.30E+04	1.50E+03	2.32E+04	3.23E+04	1.78E+04	3.58E+03
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂		2.32E+04	3.09E+04	1.75E+04	3.64E+02	2.32E+04	5.74E+04	2.04E+04	8.99E+02	2.32E+04	9.98E+04	2.17E+04	2.15E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆		2.32E+04	1.45E+05	2.22E+04	1.69E+02	2.32E+04	2.41E+05	2.26E+04	4.19E+02	2.32E+04	3.81E+05	2.29E+04	1.00E+03
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	(b)	1.67E+04	NR	NR	5.37E+01	1.69E+04	NR	NR	1.34E+02	1.71E+04	NR	NR	3.21E+02
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	(b)	1.72E+04	NR	NR	4.83E+00	1.72E+04	NR	NR	1.21E+01	1.73E+04	NR	NR	2.90E+01
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	1.72E+04	NR	NR	4.83E+00	1.72E+04	NR	NR	1.21E+01	1.73E+04	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

	Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.
	Calculated SAC exceeds soil saturation limit but will not effect the SAC significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.
	Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cells have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs naphthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4S4 toxicology data.

(b) SAC for barium and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - SECONDARY SCHOOL



Table 7
Human Health Generic Assessment Criteria for Secondary School

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	423	423	423
Barium	15,400	15,400	15,400
Beryllium	6.1	6.1	6.1
Boron	154,000	154,000	154,000
Cadmium	406	406	406
Chromium (III) - trivalent	4,880	4,880	4,880
Chromium (VI) - hexavalent	49	49	49
Copper	41,600	41,600	41,600
Lead	3,590	3,590	3,590
Elemental Mercury (Hg ⁰)	28.9 (4.3)	47.0 (10.7)	63.3 (25.8)
Inorganic Mercury (Hg ²⁺)	760	760	760
Methyl Mercury (Hg ⁴⁺)	165 (73)	175 (142)	183
Nickel	580	580	580
Selenium	8,440	8,440	8,440
Vanadium	5,300	5,300	5,300
Zinc	465,700	465,700	465,700
Cyanide (free)	450	450	450
Volatile Organic Compounds			
Benzene	115	179	273
Toluene	100,000 (869)	144,000 (1,920)	184,000 (4,360)
Ethylbenzene	12,000 (518)	22,000 (1,220)	37,000 (2,840)
Xylene - m	12,800 (625)	24,500 (1,470)	42,900 (3,460)
Xylene - o	13,500 (478)	25,600 (1,120)	44,500 (2,620)
Xylene - p	12,400 (576)	23,700 (1,350)	41,700 (3,170)
Total xylene	12,400 (625)	23,700 (1,470)	41,700 (3,460)
Methyl tertiary-Butyl ether (MTBE)	22,100 (20,400)	34,200 (33,075)	58,600
Trichloroethene	3.88	8.00	17.23
Tetrachloroethene	52	114	253
1,1,1-Trichloroethane	2,080 (1,430)	4,210 (2,920)	9,080 (6,390)
1,1,1,2-Tetrachloroethane	300	640	1,280
1,1,2,2-Tetrachloroethane	710	1,280	2,200
Carbon Tetrachloride	8.54	18.54	41.43
1,2-Dichloroethane	2.18	3.10	5.17
Vinyl Chloride	0.221	0.284	0.430
1,2,4-Trimethylbenzene	426	619	786
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	60,500	62,000	62,800
Acenaphthylene	60,400	61,900	62,800
Anthracene	312,000	316,000	318,000
Benzo(a)anthracene	77	85	92
Benzo(a)pyrene	44.9	45.0	45.0
Benzo(b)fluoranthene	20	22	24
Benzo(g,h,i)perylene	2,030	2,130	2,200
Benzo(k)fluoranthene	560	610	640
Chrysene	147	166	180
Dibenzo(a,h)anthracene	1.73	1.85	1.94
Fluoranthene	13,200	13,300	13,300
Fluorene	40,000	41,000	42,000
Indeno(1,2,3-cd)pyrene	230	250	270
Naphthalene	1,820 (76)	3,000 (183)	4,560 (432)
Phenanthrene	13,000	13,200	13,200
Pyrene	32,000	32,000	32,000
Phenol	440*	690*	1,300*
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC ₅ -EC ₆	10,900 (304)	19,700 (558)	39,300 (1,151)
Aliphatic hydrocarbons >EC ₆ -EC ₉	26,000 (144)	55,000 (322)	119,000 (736)
Aliphatic hydrocarbons >EC ₉ -EC ₁₀	6,000 (78)	12,900 (190)	24,700 (451)
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	22,200 (48)	37,400 (118)	48,200 (283)
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	51,000 (24)	54,000 (59)	56,000 (142)
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	968,000	1,000,000**	1,000,000**
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	968,000	1,000,000**	1,000,000**
Aromatic hydrocarbons >EC ₆ -EC ₁₀	7,500 (613)	13,000 (1,500)	17,800 (3,580)
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	17,500 (364)	20,400 (899)	21,700 (2,150)
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	22,200	22,600	22,900
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	16,700	16,900	17,100
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	17,200	17,200	17,300
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	17,200	17,200	17,300

Minerals

Asbestos Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC)¹

Notes:

¹- Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. GRAC - groundwater assessment criteria. SAC - soil assessment criteria.

* The GAC for Phenol is based on a threshold which is protective of direct contact (SC050021/Phenol SGV report)

** Denoted SAC calculated exceeds 100% contaminant, hence 100% (1,000,000mg/kg) has been taken as SAC

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.

1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs naphthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS) The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.