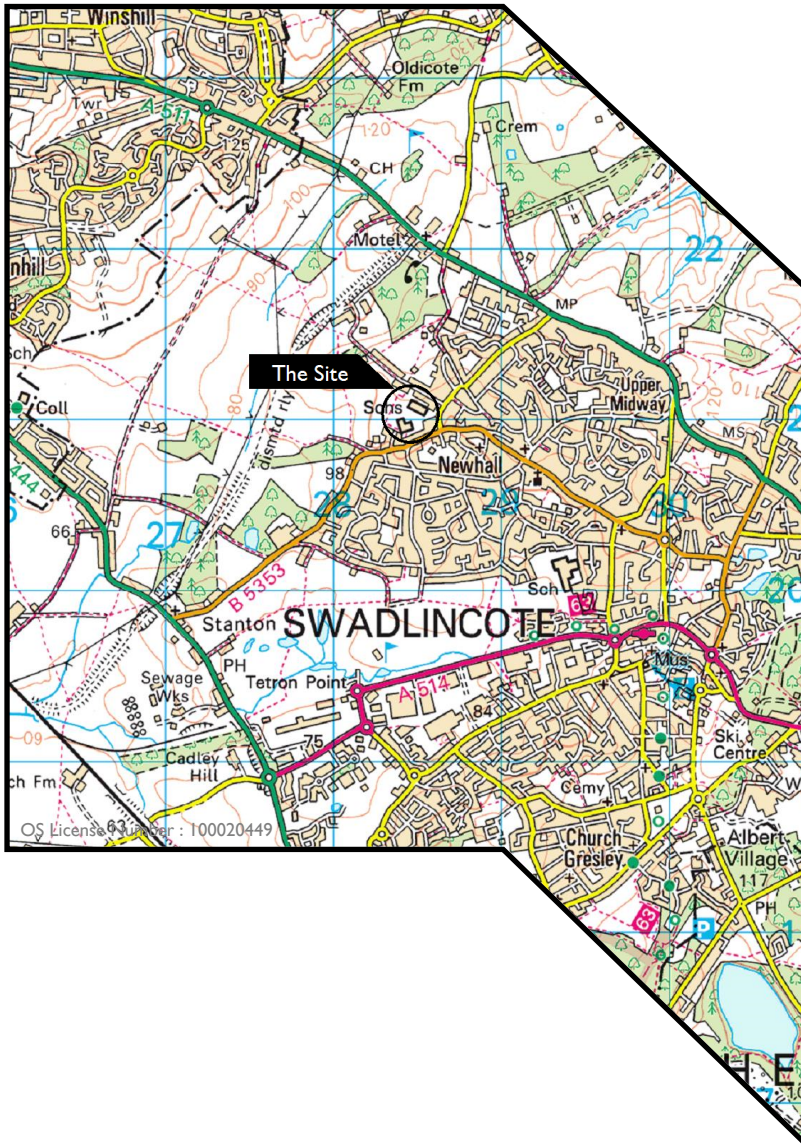


Desk Study



www.geotechnics.co.uk



Newhall and William Allitt
Schools, Derbyshire

for
Department for Education

Engineer : Mott MacDonald Limited

Project Number PC238588

April 2023

Issuing Office Head Office
The Geotechnical Centre
203 Torrington Avenue
Tile Hill
Coventry
CV4 9UT
Tel: 02476 694664
mail@geotechnics.co.uk

North West Office
The Geotechnical Centre
Unit 1, Borders Industrial Park
River Lane, Saltney
Chester
CH4 8RJ
Tel: 01244 671117
mail@chester.geotechnics.co.uk

South West Office
The Geotechnical Centre
Unit 5, Orchard Court
Heron Road, Sowton
Exeter
EX2 7NR
Tel: 01392 463110
mail@exeter.geotechnics.co.uk

North East Office
The Geotechnical Centre
Unit 1, Bypass Park Estate
Sherburn-in-Elmet
Leeds
LS25 6EP
Tel: 01977 525030
mail@yorkshire.geotechnics.co.uk

Ground Investigation
at

Desk Study

**Newhall and William Allitt Schools,
Derbyshire**

for
Department for Education

Engineer :
Mott MacDonald Limited

Project No:
PC238588
April 2023

DOCUMENT CONTROL

Issuing Office	The Geotechnical Centre, 203 Torrington Avenue, Tile Hill, Coventry, CV4 9UT
Project Number	PC238588
Project Title	Newhall and William Allitt Schools, Derbyshire
Document Title	PC238588 Geotechnical and Geoenvironmental Desk Study Report at Newhall and William Allitt Schools, Derbyshire
Client	Department for Education
Engineer	Mott MacDonald Ltd
Document Status	DRAFT

Revision History

Rev No.	Issue No.	Issue Date	Author	Authoriser
Draft	1	05.04.23	T Hardie	J S Jones
Final	2	01.06.23	T Hardie	J S Jones

Distribution

Rev No.	Issue No.	Reason for Issue	Organisation	Format
Draft	1	Issue for review	Mott MacDonald Ltd	PDF
Final	2	Issue as final	Mott MacDonald Ltd	PDF

Signatures

	Name	Position	Signature
Author	Trevor Hardie BSc MSc CEng MICE	Chief Geotechnical Engineer	
Authoriser	Jeremy S. Jones BSc (Hons), EurGeol, CGeol, FGS	Principal Engineering Geologist	

Please do not print this report unless necessary. If you do have to print this report, please reuse and recycle the paper.



CONFIDENTIALITY AND LIMITATIONS

This report was prepared by Geotechnics (Geotechnics Limited) for the use of the Client, named on the previous page, within the Document Control section. The report has been prepared specifically on the basis of the end use as defined by the Client. Any change of end use would necessitate review of this report and its findings. Use of or reliance on this report by any third party is not permitted without our express written agreement, and where this is given, will be subject to our terms and conditions.

Any plans, diagrams, cross sections or images are for illustrative purposes only and should be checked for accuracy on-site. In the event of changes to the proposed end use of the Site, the report may require updating to reflect such changes. Although reference may be made to archaeological or ecological issues, invasive species, flood risk and the presence of asbestos containing materials (ACMs), this report does not constitute an archaeological assessment, ecological assessment, invasive species survey, flood risk assessment or asbestos survey.

We have prepared this report in our professional capacity using reasonable skill, care and diligence. The assessments, conclusions and recommendations within this report pertain to the study site defined herein, and the immediate area in continuity with the Site. They are based on the established historical uses, and information available at the time of writing and the proposed use of the Site. Where any information supplied by the client or other sources have been utilised, it has been assumed that the information is correct. No responsibility can be accepted by Geotechnics for inaccuracies in data supplied by any other party.

New information relating to environmental matters can come to light after the report has been prepared and changes in conditions and regulatory requirements may occur in future. Either of those factors may change the conclusions presented in our report. If development does not take place within the expected timescales, consideration should be given to reviewing this assessment to confirm that no changes to the site or relevant legislation have taken place. No part of this report is intended to provide legal advice or opinion of any nature.

Geotechnics Limited is a private limited company registered in England registration number: 1757790. Registered office; 203 Torrington Avenue, Tile Hill, Coventry, United Kingdom. CV4 9AP.

Copyright © 2023 Geotechnics. All rights reserved. [geotechnics.co.uk](https://www.geotechnics.co.uk)

LIST OF CONTENTS

	Page No
1.0 INTRODUCTION AND CLIENT'S BRIEF	1
2.0 THE SITE	2
3.0 SITE HISTORY	5
4.0 GEOLOGY	7
5.0 HYDROLOGY & HYDROGEOLOGY	10
6.0 ENVIRONMENTAL DATA	11
7.0 PREVIOUS REPORTS / INVESTIGATIONS	13
8.0 POTENTIAL CONTAMINANT LINKAGES & PRELIMINARY CONCEPTUAL SITE MODEL	14
9.0 GEOTECHNICAL HAZARDS ASSOCIATED WITH THE DEVELOPMENT	18
10.0 CONCLUSION & RECOMMENDATIONS	19
11.0 REFERENCES	22

APPENDICES

APPENDIX 1	Site Plans
APPENDIX 2	Site Walkover Photographs
APPENDIX 3	Envirocheck Report, Historic Maps, UXO Report and Coal Authority Report
APPENDIX 4	Contaminated Land Risk Assessment
APPENDIX 5	Geotechnical Risk Register

I.0 INTRODUCTION AND CLIENT'S BRIEF

This Phase I Desk Study was carried out to the instruction of the Engineer, Mott MacDonald Limited, on behalf of the Client, The Department for Education. The purpose of the Desk Study is to provide a geotechnical and geoenvironmental assessment of the site to facilitate the proposed redevelopment of a site in the village of Newhall, Derbyshire. The site boundary encompasses William Allitt Secondary School and Newhall Community Junior School and their associated school buildings, hardstanding for car-parking and play areas together with sports fields and facilities.

There are multiple options being considered by the Client and Engineer for the proposed redevelopment. These can be summarised as the following:

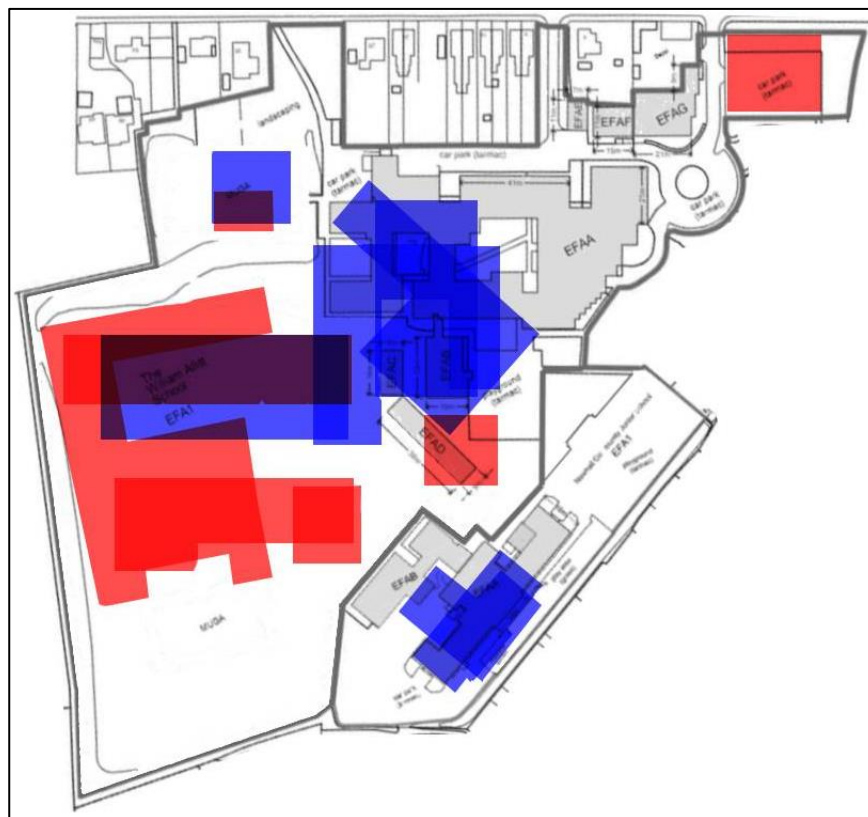
- The demolition of existing school buildings.
- The construction of new two and three storey buildings for primary and secondary students.
- Construction of a sports hall with soft landscaped areas for sports activities and hard surfaced MUGA (multi-use games area) pitches.

The locations for the various proposed building options are summarised in the drawing in Appendix I and in the figure below.

This report will primarily provide an assessment in relation to the options involving construction of new structures, as instructed by the Engineer.

Further details of the site's layout are presented in Appendix I.

Site Proposals



The above image is taken from the plan titled 'GI Options – temps and new build' contained within Appendix I. The plan is a composite plan showing areas for proposed temporary structures in red and areas for proposed permanent structures in blue.

This report comprises a geoenvironmental and geotechnical Site Survey undertaken in accordance with Stage I of RIBA Plan of Work 2020 Overview. It is intended to be used by the developer to aid in the later Stages of the design and construction of the proposed development. In addition, this report has been devised to generally comply with the relevant principles and requirements of a range of guidance including:

- Part IIA of the Environment Protection Act, 1990;
- Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, April 2012);
- National Planning Policy Framework (HCA, July 2021);
- BS EN 1997-1:2004+A1:2013: "Eurocode 7. Geotechnical Design"
- BS5930:2015+A1:2020: "Code of Practice for Ground Investigations";
- BS10175: 2011 +A2:2017 "Investigation of Potentially Contaminated Sites - Code of Practice";
- The Building Regulations 2010. Part C (HM Government 2013);
- Environment Agency (2020) "Land Contamination Risk Management";
- Environment Agency (2011) Report GPLCI "Guiding Principles for Land Contamination";
- Environment Agency (2017) "The Environment Agency's Approach to Groundwater Protection" November 2017 Version 1.1; and
- Sustainable Remediation Forum UK (SuRF) Framework

2.0 THE SITE

Site Location

A Site Location Plan and Site Boundary plan can be found in Appendix I and the site location is summarised in the table below.

Location	William Allitt Secondary School and Newhall Community Junior School, Newhall, Swadlincote
Grid Reference	SK 28430 21040
Post Code	DE11 0TL and DE11 0TR
Site Area	Approximately 4.8 ha
Site Shape	The site is irregular in shape with maximum plan dimensions of 375m north east to south west by 220m north west to south east.
Topography	The site level falls to the south, from a high point in the north of the site surveyed at 116.3mOD falling to the lowest point on site, in the southwest, surveyed at 102.6mOD. On a local scale, the northwest part of the site falls to the south by about 5m and the east of the site falls to the south by about 2m to 3m. Over the rest of the William Allitt school site and the sports fields the level falls more gently to the south and south west to northern edge of the Junior School site, where the levels drops more steeply again to the south and south east with a change in level of about 3m to 4m. On a wider scale, the site is located on sloping ground. The land around the site generally falls from the north to the south and south east across the site. However, to the north west of the site, the ground appears to fall more steeply from the north east to the south west.

Site Description

A site visit was undertaken on 7th February 2023. A summary of observations made is presented in the table below which makes reference to the site layout plan presented in Appendix I and photographs from the site walkover, which are presented in Appendix 2 along with a photo location plan.

Current Use	The site boundary encompasses two schools named William Allitt Secondary School and Newhall Community Junior School. The boundary includes all the school buildings, areas of car parking and playing fields.
-------------	---

Access	There are multiple access points for the site. These are shown in the Site Layout Plan in Appendix 1. Access points 1A, 1B and 1C are all located along the northern boundary of site off the road named Sunnyside. Access point 1D is the only access point onto Newhall school and is off Chesterfield Avenue in the south.
Existing Buildings & Structures	<u>William Allitt Secondary School</u> The buildings on the William Allitt part of the site are within the eastern half. The buildings are labelled in the site layout plan in Appendix 1. The buildings are a mixture of one- and two- stories. Building 2A and 2B, around the centre of site, and connected with a link bridge. Buildings 2C and 2D, to the southwest of 2A, had been demolished prior to the walkover and the area was covered with soil and grass seed and sectioned off with Heras fencing (see photo “Location 12” in Appendix 2). Building 2E, to the northeast of building 2A, is a boiler house (discussed below) with a classroom above. Buildings 2F and 2G, to the east of building 2A, appear to be newer structures on the site which are used as drama and dance studios. A small garage for storage is located in the north of the site (location 5A) and a shed, also used for storage, is located around the west of building 2A, is at location 5B. There are two bike shelters located at 8A (to the west of building 2A) and 8B (in the east of the site). There is visible cracking of an external wall of building 2A at location 10, on the south eastern edge of the building (photo “Location 36”). <u>Newhall Community Junior School</u> The Newhall part of the site comprises one school building set over two levels with associated retaining walls. The lower section of the school is labelled 3A on the site layout plan and sits to the south of the higher section which is labelled 3B. To the western end of building 3A is a boiler room set in a basement (at location 4D) and this is discussed below. There is a variety of wooden play equipment / play structures along the southern and eastern parts of Newhall school (location 13). <u>Other buildings or structures across the whole site</u> A canopy is present at location 9A within the centre of building 2A, covering an area of benches. Further canopies are present over the entrances some of the buildings on site and are labelled from 9B to 9E. All the canopies appear to be of satisfactory condition. Retaining walls are present across the site. At location 6A in the north of the site is a concrete retaining wall between the pavement of Sunnyside and the site. The wall is an average of 0.5m in height. Cracking is present within the wall structure and shown in photo Location 1 in Appendix 2. At location 6B, also in the northern part of the site, is a brick built retaining wall between the slope outside the MUGA area and the road around the site. The wall is an average of 0.6m in height. At location 6C, to the north of the Newhall school building, is a set of brick built retaining walls between the slopes of the playing field for William Allitt and the walkways of Newhall school. The maximum height of the retaining walls in this area is approximately 1.2m. The overall change in levels from the set of retaining walls is 2.3m and can be seen in the photo “Location 33” in Appendix 2. At location 6D, amongst the Newhall school buildings, are brick built retaining walls either side of a set of stairs as the site levels change in this area. The levels change by about 1.1m (photo “Location 23” in Appendix 2). At 6E adjacent to the entrance of Newhall school is a brick built retaining wall. The wall is around 0.5m in height. There are four boiler rooms located across the site. At location 4A in the north of the site is a large boiler room set in a basement more than 2m below ground level (photo “Location 6”) with a chimney (photo “Location 7 – facing NW”). At location 4B in the northeast of the site is a boiler room set around 1.5m below ground level (photo “Location 46”). At location 4C in the east of the site is a small and relatively new boiler room set around 1m below ground level (photo “Location 45”). Adjacent to the boiler room is a chimney (photo “Location 44”), however, the facilities manager indicated that the chimney isn’t related to the boiler room. [Given the site history and how the other boiler rooms on site were previously

	coal fuelled, it is possible that a historic coal fuelled boiler was present at this location explaining the presence of the chimney.] At 4D in the south of the site (at Newhall school) is a large boiler room set around 2m below ground level with a chimney (photo “Location 24”). The facilities manager stated that the boilers at locations 4A, 4B and 4D were historically coal powered, although all are now gas powered, and that the boiler at 4C has always been gas powered. The facilities manager had no information on when the energy source was changed. The site boundaries comprise a mixture of metal fencing, chain link mesh fencing and wooden fencing.
Site Surface	Hardstanding surfaces around the site predominantly comprise asphalt. The car parks across the site (locations 12A to 12F) are all surfaced with asphalt. The surfacing where buildings 2C and 2D were located is now seeded topsoil. A large grass covered playing field is present in the western half of the site (location 14). The multi-use games area (MUGA) at location 15A (in the north) is surfaced with asphalt and at 15B (in the west) is surfaced with Astro turf.
Evidence of surface staining	No surface staining was observed during the walkover.
Ecology / Vegetation	Mature trees were observed lining the western boundary of site (photo “Location 14”). The remaining boundaries are more sparsely lined with trees. The tree species are variable and include sycamore, maple and birch. NB – This should not be considered as an ecological survey. A full ecological survey should be undertaken by a suitably qualified and experienced ecologist.
Storage Tanks	The boiler rooms on site all contain the associated water tanks for the heating system. There was no obvious staining associated with any of the boiler rooms. No other tanks were observed on site.
Services	Evidence for underground services was seen in the form of surface drains, access chamber covers and overhead cables. A service search has been supplied by the engineer and is discussed in Section 6 below.
Asbestos	No potential Asbestos Containing Materials (ACMs) were noted on the ground surface. Geotechnics Ltd has not assessed the inside of buildings for the possibility of ACMs.
Waste Disposal/ Materials Storage	No evidence for surface burning was observed during the walkover. There are multiple waste disposal areas on the site at locations 7A to 7E on the site layout plan. Location 7A in the north of the site consists of two skips with some litter on the surrounding land. All other locations contain large waste bins. Litter had also collected in the stairwell down to the boiler room at location 4A in the north of the site (photo “Location 5”).
Surrounding Area	The surrounding land to the north, east and south is mainly residential with another school being present to the immediate east (Newhall Infant and Nursery School). To the west of the site are fields and Bretby Household Waste Recycling Centre. Around the western edge of the site is a passageway (Public Footpath) with access from Sunnyside and Chesterfield Avenue.
Local Water Features	No water features were observed on site.
Potential Off-Site Receptors	Residential properties and school surrounding the site.

Potential Off-Site Sources	Bretby Household Waste Recycling Centre however located down slope from the site. No other off-site sources identified during the walkover.
Local / Background Knowledge	The facilities manager explained that three of the four boilers rooms on site previously used coal as the fuel source. Given the site history and how the other boiler rooms on site were previously coal fuelled, it is possible that all boilers have been coal fuelled at some point but not shown on records.

3.0 SITE HISTORY

A search of available historic maps was undertaken to establish the previous land uses of the site. The maps discussed below are presented in Appendix 3 of this report.

Summary of Site History

On Site

The following table summarises the significant changes in historical use on site:

On Site		
Feature & description	Date Appears on OS mapping	Date No longer shown on OS Mapping
The site is formed from a series fields, the boundaries of some being lined with trees.	1883	1960
A small pond-like feature is shown approximately in the central part of the site.	1883	1960
A footpath is shown crossing the western part of the site, to the west of the pond, on an approximate north to south alignment.	1883	1960
Two buildings are shown in the eastern corner of the site, which together with two smaller buildings just outside the site boundary, are marked as schools. In 1960 the eastern-most of these buildings is marked as Infants School and the eastern as Newhall County Secondary School. From 1968, the western building is marked as Newhall County Infant School and Newhall Infant School from 1988.	1901	1968 (Newhall County Secondary School)
An approximately rectangular shaped building shown just inside the south eastern site boundary marked as a school.	1938	1960
The school building on the south eastern edge of the site now (south east of the William Allitt school site) is shown as the Newhall County Junior School. The south western two thirds of the rectangular area school site comprises a building with a square area (play ground) in the north eastern part. In 1968, the school building has been extended to the north into the slope between the two school sites.	1960	
The William Allitt County Secondary School is shown occupying nearly all site apart from a Junior school area on the south eastern edge. The William Allitt main buildings take up much of the eastern half of the site, just to the south west of the Infants School. The western part of the William Allitt school site is marked as playing fields. In 1978, the main buildings were extended to the north west towards the tennis courts.	1960	

The boundary between the two school sites is marked by a slope and the Junior school site appearing to be at a lower level than the William Allitt site to the north west. The slope is more defined in 1968 and has changed shape to accommodate the extension to the Junior School buildings.	1960	
Just to the north west of the marked slope between the two school sites, a string of small mounds are shown that continue beyond the north eastern end of the slope northwards into the area of the William Allitt buildings.	1960	1968
Tennis courts are shown in the northern corner of the site with a slope being marked along the southern edge of the courts down to the playing field. A slope is also shown along the north western site boundary and western corner suggesting the placement of fill to create a level platform for the playing fields.	1968	
The former Newhall County Secondary School building appears to be an open rectangular area with a slope down along the to the north east and south east around the edges.	1968	

The 1:10,000 historic maps suggest the site has remained largely unchanged since the 1968 maps.

The levels on site appear to have changed over the period of the historical maps. Contours are shown on the 1:10,000 maps dated 1955, 1972, 1982 and 1991, although they lack detailed topographic information for the site itself. Slopes are first shown in the eastern part of the site near to Newhall County Secondary School and in the southern part of the site surrounding Newhall Country Junior School on the 1960 map. Further slopes are shown along the western boundary, in the north of the site adjacent to the tennis courts and in the south of the site around the extension to Newhall County Junior School in 1968.

Surrounding Area

The following table summarises the significant changes in historical use on land surrounding the site:

Off Site					
Feature & description		Distance from site (m)	Direction from site	Date Appears on OS mapping	Date No longer shown on OS Mapping
Midland Railway (aligned NW to SE). Disused from 1972 maps		550	NW	1883	-
Bretby Colliery and shaft		950	N	1884	1902
Bretby Colliery (Stadhope Pit)		500	NW	1884	1902
Stanton Colliery		1000	S	1884	1955
Matsyard Colliery – disused and shaft. With indication of excavation just the shafts from 1955		150	E	1884	1982
Matsyard Colliery – indication of excavation, possibly opencast pit		100	E	1884	1982
Brickyard and excavation / quarry		0	NE	1884	1923
Schools (later Sunday Schools)		45	S	1884	1988
Chapel		45	S	1884	1988
Bretby Brick and Stoneware Works (on former colliery site), later pottery works and works.		500	N	1902	
Clay Pits	Pits (disused from 1972)	400 – 450	NW	1902	1972
	Pit	350	NW	1982	2022
	Pit	200	W	2000	2022
	Excavation (disused)	500	NW	1938	
	Pit	1000	S	1924	1982

Burton and Ashby Light Railway		5	NE	1923	1960
Stanton Lane Brickworks		950	SW	1924	1972
Old Clay Pit (Disused 1972)		950	SW	1924	1972
Saw Mills		900	N	1924	1972
Wells	3 No.	0	S	1901	1923
		350	SW	1902	1924
		650	SW	1902	1924
		750	SE	1902	1924
		800	SE	1902	1924
		500	W	1925	1955
Sluice		750	W	1925	1955
Allotment Gardens		300	NE	1925	1972
		250	SW	1925	1982
		450	SW	1925	1991
		400	SE	1925	1982
Old Shaft		900	E	1925	1972
Sink / Drain		850	SW	1955	1982
Garage		60	SE	1960	1999
Pond		700	SW	1972	-
Works Building		800	SW	1972	1991
NCB Central Engineering Establishment Building and Electrical Substation, Bretby Business Park from 2000.		600	NE	1972	-
Wood Yard		50	N	1973	1985
Builders Yard and Garden Centre		750	SW	1991	-
Disused Pit with Water		250	W	1991	2000
Substation		0	SE	1981	-
Surface Water Features connected by drains		200 & 550	SW	2000	-
Ponds / Issues		950	SW	2000	-
Area shown as refuse / slag		650-1000	SW	2000	2006
Works		950	SW	2000	-

4.0 GEOLOGY

The following section details information published by the British Geological Survey (BGS) on geological maps of the area. Where readily available and relevant, Geological memoirs and other literature have been consulted along with the BGS website (www.bgs.ac.uk).

Published Geology

The documented geology of the site is summarised below:

	Map Reference	Geology
Superficial Geology	BGS GeoIndex. Envirocheck report 303736358_I_1. BGS 1:50,000 Sheet 141 Loughborough, 2001.	No superficial deposits are shown on the BGS Geology of Britain Viewer on the site. Glacial deposits comprising the Oadby Member (formerly known as Boulder Clay) are shown overlying the bedrock about 300m to the north east of the site. Alluvium is shown around 750m to the south east of the site, consisting clay, silt, sand and gravel.

		No Made Ground is shown on the maps to be present on the site. However, the development of the site and the earthworks used to create the level plateaus for the school buildings and the play / sports areas is likely to have led to varying thicknesses of Made Ground being present. Extensive areas of Made Ground are mapped in the vicinity of the site, to the south west (about 200m), to the west (about 450m), the north west (about 400m) and the north east (about 400m) associated with historic quarrying activities. Infilled ground, from historic quarrying activities is mapped about 200m to the west of the site.
Bedrock Geology	BGS GeoIndex. Envirocheck report 303736358_I_I. BGS 1:50,000 Sheet 141 Loughborough, 2001. Geology of the country between Loughborough, Burton and Derby: sheet description of the 1:50000 series sheet 141 Loughborough (England & Wales), 2001	The bedrock geology is shown to be the Pennine Middle Coal Measures Formation of Carboniferous age. The formation typically comprises interbedded grey mudstone, siltstone, pale grey sandstone and coal seams. A layer of sandstone within the formation is shown to outcrop approximately north east to south west across the centre of the site. The underlying Pennine Lower Coal Measures Formation, comprising similar strata, is shown about 100m to 200m to the west, north and north east of the site. Figure 1 and Figure 16 of the Sheet Description memoir indicates that the bedrock beneath the site is located west of the axis of the Newhall Syncline. It is anticipated that the bedrock may dip at a shallow angle down to the east. No coal seams are shown to outcrop on the site. The Main Seam is shown on the maps about 200m to 300m from the site boundaries, wrapping around the site from the east to the north and north west of the site, with the underlying Little Woodfield seam about 10m to 40m further away. Approximately 100m to the south east the Little Coal Seam is shown to outcrop. From the marked coal seams the strata local to the site dip down to the south east and hence, it is likely that the Main and Little Woodfield coal seams underlie the site.
Structural	BGS GeoIndex. Envirocheck report 303736358_I_I. BGS 1:50,000 Sheet 141 Loughborough, 2001.	There is a single fault indicated crossing the south eastern part of the site with a north east to south west trend, just to the north of the Newhall Community Junior School. The downthrow of the fault is shown to be to the north west. There are a number of similar trending faults at distances greater than 400m to the south east that connect with a north west to south east trending fault that lies about 700m to the north east of the site.

Although no superficial deposits are mapped on site, they are present a short distance away and it is possible that they could extend below the site. Also, the upper section of the bedrock may have weathered and behave in a similar way to superficial materials.

There are no records of boreholes held by the BGS on the site. There are a few boreholes for which records were available on the BGS website within 250m of the site. Two boreholes are located at nearby collieries, one of which (SK22SE18 located 170m east of the site) was drilled from the bottom of a coal shaft with the other (SK22SE39 – 180m northeast of the site) from ground level. Both showed a general sequence of coal seams, mudstone and sandstone. Other boreholes within 250m of the site (SK22SE177, 187 and 189) showed 0.35 to 1.90m of topsoil or Made Ground over soft varying to firm silty clay, with gravel in some boreholes, which in turn overlies at depths of

2.50 to 3.80m; in Borehole 177 mudstone and in Boreholes 187 and 189, a variable sequence of clayey and shaley mudstone, sandstone and shaley clay with coal fragments. In Boreholes 187 and 189 groundwater was recorded at depths of 8.60m bgl and 5.80m bgl (standing level) respectively within the bedrock. In Borehole 177, groundwater was struck at 3.20m bgl (rising to 3.00m bgl after 20 minutes) within the upper clay stratum.

Details of the site geology from Envirocheck report 285028132_I_I are presented in Appendix 3.

Geological Features

The presence of recorded geological features such as BGS Mineral Sites, Man Made Mining Cavities or natural cavities within 250m of site are summarised below. If entries are present in a wider radius than 250m, further details are presented in Appendix 3.

Data type	Entries (On site)	Entries (0-250m)
BGS Recorded Mineral Sites	None	2 – Relating to Westend Terrace Brick Yard about 60m to the north east and Matsyard Colliery about 165m to the east. Operations at both sites have ceased.
Man Made Mining Cavities	None	None
Natural Cavities	None	None
Artificial Ground / Made Ground	None	An area of Made Ground is shown about 200m to the south west and infilled ground, from historic quarrying activities, shown about 200m to the west of the site.
Mining instability	None, but the site is within an area affected by coal mining activity, see below.	None, but the site is within an area affected by coal mining activity, see below.
Coal Authority Interactive Map – Mine entries	None	Four – approximately 200m to the east, former Matsyard Colliery.

Radon

The site is split over two Radon Areas. The north of the site is designated as an Intermediate Probability Radon Area where 1 to 3% of homes are estimated to be at or above the Action Level. The southern half of the site is within a Lower Probability Radon Area (less than 1% of homes are estimated to be at or above the Action Level).

It is recommended that either basic radon protection should be installed, or a BR Radon Report is obtained to give definitive guidance on the requirement for protection measures.

Coal

The site lies within an area affected by coal mining and as such a Coal Mining Report was obtained, Reference 51003326132001. The report indicates that 33 seams have been worked in the vicinity of the site at depths of between 93m and 240m below ground level (bgl). Of these, 23 seams are indicated to have been worked beneath the site with the uppermost seam being, the Woodfield Seam located at 93m bgl with a thickness of 1.50m that was last mined in 1956. Three further seams, also indicated to be the Woodfield Seam were worked at a depth of 94m bgl to 104m bgl below the site. From the BGS maps the Woodfield Seam outcrops about 750m to the north east of the site beyond the Main and Little Woodfield Seams.

The Coal Authority report also indicates the following:-

- There are probable unrecorded shallow workings. Evidence of coal and coal working were found in old boreholes put down at the site (see Section 7.0 below).
- There are no mine entries within 100m of the site boundaries.
- There are two opencast mines shown to be present; 2C/I Bretby South about 150m to the west and OP/95/0108/S Nadins about 150m to the south west. There is an unlicensed opencast site just to the north

of the Bretby South site, approximately 200m to the north west. A further three unlicensed opencast sites that overlap each other and are shown 300m to the north - north west.

- There are no Coal Authority managed tips within 500m of the site.
- There are two site investigations within the site boundaries (in the northern corner of the site). The borehole records or reports for these investigations were not available to examine at the time of preparing this report.
- There are no remediated sites within 50m of the site boundaries.
- No mine gas or mine water treatment schemes are recorded within 500m of the site.
- No future underground mining is recorded and no coal mining licenses are recorded within 200m of the site.
- The site is not within an area where a notice to withdraw support has been given and is not in an area where a notice cancelling the entitlement to withdraw support has been given under Section 41 of the Coal Industry Act 1994.
- In relation to subsidence, no damage notices or claims for the site or any properties within 50m have been received by the Coal Authority have been received since the 31st October 1994. There is no stop notice delaying the start of remedial works or repairs to the site.

Brine

The site does not lie within an area affected by Brine subsidence and as such, a Brine report was not obtained.

5.0 HYDROLOGY & HYDROGEOLOGY

Hydrology

The presence of any hydrological licences and incidents within 250m of the proposed site is summarised below. If entries are present in a wider radius than 250m, further details are presented in Appendix 3

Data type	Entries (On site)	Entries (0-250m)
Discharge Consents	None	None
Pollution Incidents to Controlled Waters	None	None
Water Abstractions	None	None
Nearest Surface Water Feature	None	An inland river is indicated on the Envirocheck OS Water Network Map running approximately west - south westwards from a point about 200m south west of the site. The 1:10,000 2022 map indicates the starting point to be a small pond / reservoir.
Flooding	No potential for flooding from rivers or sea on site. Two small areas in the central part of the site and within a courtyard to the main William Allitt school buildings are indicated to have a low risk of flooding from surface water.	No potential for flooding from rivers or sea on site. There is a longitudinal area about 200m to the east of the site (aligned approximately north to south) shown as having a medium to high potential for flooding from surface water, with small areas with a low potential between this zone and the site. Thin tracts of low potential are also indicated running from the site to the west and south west towards the surface water feature indicated above which has a medium to high flooding potential.

	A zone running east to west across the middle of the site is classified as having the limited potential for groundwater flooding. This area coincides with the layer of sandstone shown outcropping on the geological map for the site.	Much of the surrounding area to the west of the site between about 150m and 250m is classified as having limited potential for groundwater flooding to occur. The area to the south west around the surface water feature is marked as having the potential for groundwater flooding to occur affecting the ground surface and properties below ground.
--	---	---

Hydrogeology

The Groundwater Vulnerability map is summarised in the table below:

Geology	Formation	Aquifer Type	Permeability
Solid	Pennine Middle Coal Measures Formation	Secondary A	Unknown

No Source Protection Zones or catchments areas have been identified at the site or within 500m of the site boundary.

6.0 ENVIRONMENTAL DATA

The following section details environmental data available for the site and the surrounding area. Full details can be found in the Envirocheck Report presented in Appendix 3. The tables below summarise the presence/absence of any waste, hazardous substance sites and/or industrial land uses within 250m of the site with details provided. For entries present in a radius wider than 250m, further details are provided in Appendix 3.

	Data Source	Data Summary
Environmental Database Information	Industrial Processes	There are no registered Integrated Pollution Control (IPC) Sites, Registered Radioactive Substances sites, Control of Major Accident sites (COMAH), Explosives Sites or Notification of Installations Handling Hazardous Substances (NIHHS) within 250m of the site.
Landfill & Waste Sites Search	Landfills: Ordnance Survey Historical Mapping	There are 2 records for historical Landfill Sites recorded within 250m of the site. The nearest being recorded at 170m west of the site named 'Bretby 2 landfill site'; the licence for this site has expired. The second record is 237m west of the site and named 'Bretby 1 Landfill site'; this site is recorded as having or had a landfill gas engine on site. Both sites are operated by Derbyshire Waste Limited. Two areas of unknown filled ground, that could be former pits or quarries, are indicated 11m to the north east (Brickyard on the 1883 map) and 74m to the east (Matsyard Colliery). There is a single area of potentially infilled land (water) on the site which is probably the pond marked on the historical maps up to 1960 (see Section 3 above).
	Other Waste Sites	There is one record for a Registered Waste Transfer Site, 241m west of the site boundary, at the Bretby Coal Authority site. The licence date is 01/12/1994 for household waste and garden/garage waste. The current licence status is 'Operational as far as known'.

	Data Source	Data Summary
Trade Directories	Trade Directory Entries recorded in 250m radius	There are 7 recorded entries within 250m of the site of which 1 is active for garage services. The inactive entries include, manufacturers, chemical manufactures, commercial cleaners and catering equipment.
Fuel Stations	Fuel Stations recorded in 250m radius	There are no fuel stations recorded.
Radon Potential	Building Research Establishment, 2015, 'Radon: Guidance on protective measures for new buildings'	The site is split over two Radon Areas. The north of the site is designated as an Intermediate Probability Radon Area and the southern half of the site is within a Lower Probability Radon Area. It is recommended that either basic radon protection should be installed, or a BRE Radon Report is obtained to give definitive guidance on the requirement for protection measures.
Other Radiation		No reasonable grounds for believing land to be radioactively contaminated (in accordance with 2005 extension of Part IIA of The Environment Protection Act 1990).
Unexploded Ordnance	6 Alpha Associates Detailed Unexploded Ordnance (UXO) Threat- 14 th November 2022 (Presented in Appendix 3)	Risk of encountering UXO assessed as being 'unlikely'. World War II high explosive bomb density assessed as <15 high explosive bomb / 100 hectares. Report concludes that no further action is required.
Ecology	Sites of Ecological Importance MAGIC website 21/03/2023	There are no Sites of Special Scientific Interest (SSSI), areas of Adopted Green Belt, National Nature Reserves, National Parks, Local Nature Reserves, Areas of Outstanding Natural Beauty or RAMSAR (wetlands) within 250m of the site.
Asbestos	Walkover	No potential Asbestos Containing Materials (ACMs) were noted on the ground surface. Geotechnics Ltd has not assessed the inside of buildings for the possibility of ACMs.
Buried and overhead Services	Site Walkover Groundwise Desktop Utility Search. Report reference is 7879.2RB-GWS dated 25 th November 2022	Access covers, drains and overhead cables were observed on site during the site walkover. The search results show multiple services to be present within the roads and pavements surrounding the site including gas, power, water and telecoms. The services indicated on the plans to cross onto the site are: - Power – LV cables enter the south western corner of the site off Chesterfield Avenue into the Junior School site and around the northern side of the buildings before heading north eastwards to the William Allitt school buildings. LV cables also enter the south eastern edge of the main William Allitt building from a substation just to the east of the Junior School. - Gas – LP mains enter the site from exit road to William Allitt site off Sunnyside and enters the main building along the north eastern edge, comprising 125mm reducing to 90mm and 63mm diameter PE pipes with a cover of 0.5m to 1.10m. A LP pipe also runs up Chesterfield Avenue to the Junior School but appears to stop just inside the site boundary.

	Data Source	Data Summary
		- Severn Trent Water – a main enters the site off Sunnyside along the exit road and runs north westwards along the edge of the site before entering the north eastern corner of the main William Allitt building. A main also enters the south western corner of the site and the Junior School off Chesterfield Avenue. - Severn Trent Water - a 225mm diameter foul sewer crosses the western part of the site from the north western corner of the site off Sunnyside. It passes under the tennis courts and the sports field and exits the site to the west of the Junior School near Chesterfield Avenue. There are four manholes within the site boundaries, two in the sports fields. One of these contain a junction with a branch that runs from the main William Allitt buildings. - BT – an underground cable enters the William Allitt site off Sunnyside down the access road and around the roundabout and into the main school building close to the south eastern corner. Overhead cables run along the exit road on to Sunnyside from the northern edge of the William Allitt main building. Overhead cables also enter the site off Chesterfield Avenue in the south western corner leading to the Junior School building. Underground cables also enter the site at this point connecting to the school buildings.
Archaeological & Building Heritage	MAGIC website 21/03/2023 Historic England website 21/03/2023 https://www.historicengland.org.uk	There are no scheduled ancient monuments, buildings in historic parks, gardens on site or buildings within the curtilage of scheduled ancient monuments. There are no sites of archaeological interest on site.

7.0 PREVIOUS REPORTS / INVESTIGATIONS

No previous study or investigation reports were made available for this site. However, a Stage I Feasibility Report for the William Allitt Secondary School (Report 521115, dated 29/09/2021) prepared by Concertus, and made available by Mott MacDonald, makes reference to two investigations by GRM Development Solutions in August 2019 and by Analytic Geotechnics Limited in November 2015. The results of the investigations are very briefly summarised by Concertus but no plans or borehole records are included. The findings as discussed by Concertus are:-

- Analytics Geotechnics Limited (2015)**
 Comprised 3 dynamic sample boreholes to 4m depth, their location not being given. They found Made Ground over firm to stiff clay grading to weak mudstone at about 1.8m bgl. The clay was indicated to become stiffer with depth with fragments of mudstone. A medium volume change potential was indicated for the clay with a Plasticity Index of 24.5%. The report recommended shallow foundations but it is not certain what the purpose of the investigation was. A groundwater seepage was recorded at 2m bgl in one of the boreholes. A Design Sulphate Class of DC-I was also indicated with regard to buried concrete.
- GRM Development Solutions (2019)**
 An unspecified number of boreholes were carried out and their drilling method and location not given. The summary indicates that evidence of coal workings were found in BH1 at a depth of 13m to 15m bgl and intact coal in BH2 at 18.5m bgl. It states that coal was not found in BH3 or BH4 (although the final depth of these boreholes is not given) which were located near the school buildings, although it is not stated which school buildings are being referred to.

It is recommended that copies of these reports are obtained to provide more information on the ground conditions at the site and the presence of shallow coal workings or seams. The Coal Authority report, referred to in Section 4 above, indicates that two site investigations have taken place on the site. It is not certain whether these are the two investigations referred to above, but copies of these reports should be sought also. The Coal Authority report (summarised in Section 4 above) indicates there are 'probable unrecorded shallow workings' beneath the site which is confirmed by the GRM Development Solutions investigations discussed above.

The Concertus report also states that the old school buildings were built in 1895, which ties in with the historic maps discussed in Section 3 above, the first school buildings being shown on the 1901 maps. Concertus indicate that these buildings had a history of severe subsidence damage in the 1940s and 1950s and were replaced with the William Allitt buildings which were constructed in 1960. This also ties up with the maps, the William Allitt building first appearing on the 1960 map with the old Secondary school building in the north eastern corner of the site disappearing from the maps in 1968. This former building location was over the mapped location of the geological fault. It is possible that the historical subsidence at the site might be linked to the presence of unrecorded shallow workings and the coal found in the boreholes by the GRM Development Solutions.

8.0 POTENTIAL CONTAMINANT LINKAGES & PRELIMINARY CONCEPTUAL SITE MODEL

Hazards Identified with the Proposed Development

The hazard identification is based on the assumptions presented below:

- The site redevelopment will be Junior and Secondary school facilities;
- Drinking water will be from mains supply;
- Site levels have been altered during the history of the site including probable placement of fill materials.

Potential Sources of Contamination

For the purpose of this assessment the potential contaminants of concern have been considered according to whether they are likely to have originated from on-site or off-site sources.

Potential On-site Sources of Contamination

- Sources within Made Ground associated with historical buildings on site and their demolition (ash which may include asbestos, heavy metals, sulphate, pH, petroleum hydrocarbons and poly-aromatic hydrocarbons).
- Sources within fill material used for infilling the historical pond on site.
- Sources within fill material used for earthworks across the site.
- Sources from the historical mounds of materials at the site (1960 mapping).

Potential Off-site Sources of Contamination

- The associated fill material from Matsyard Colliery - entries at 100 and 150m east of the site (no longer shown by 1982)
- Associated fill from brickyard and quarry 0m northeast of the site (no longer shown by 1923)
- Associated fill from Clay pits 200m west of the site (no longer shown by 2022) at the location of the current Household Recycling Centre
- Associated wastes from the Landfill sites 170 and 237m west of the site
- Associated fill from disused pits infilled around 250m west of the site (no longer shown by 2000)
- Any associated wastes or filling from open cast mining around 150m west and 150m southwest of the site

Potential Receptors of Contamination

Based on the data previously discussed, the following potential receptors to contamination have been identified:

- Humans – Pre-development completion, i.e. working on site during demolition and construction.
- Humans – Pupils, staff and visitors attending the school following development.
- On-site existing site users.
- Off-site Human Health receptors including the neighbouring properties and school.
- Groundwater – Groundwater within the Secondary A aquifer.
- Building structure and services following development.

The possible contaminant linkages are discussed below. It should be noted not all may be formed between all sources and receptors.

Identification of Pathways

Pathways to Human Health

A potential contaminant may reach a receptor by various routes. For example, in areas where contaminated material is exposed, dermal contact with the material, inhalation or ingestion of dust may occur.

Inhalation or ingestion of dust and water could occur during the construction and development phase at the site. Pathways from dermal contact with soil and groundwater may also arise. It is considered that the risk of short term exposure for ground workers and other construction workers is low unless there are asbestos fibres in any Made Ground.

Post construction, the surface of the development area will predominantly comprise an of buildings and hard standing which may be capped depending on the results of the preliminary ground investigation. This would likely reduce the number of potential pathways that are possible such as long-term direct contact and dust inhalation/ingestion.

Ground Gas and Vapour related Pathways

Ground gas and vapour entry into buildings is considered to be a potential pathway for the proposed development due to the possibility of advection and diffusion into buildings, which may occur regardless of the presence of hard standing across part of the site.

Pathways to Controlled Waters

Groundwater levels are predicted to be around 8-10m bgl at the site within the bedrock based on local borehole data. There may also be some localised shallow pockets within the Made Ground or areas of weathered bedrock.

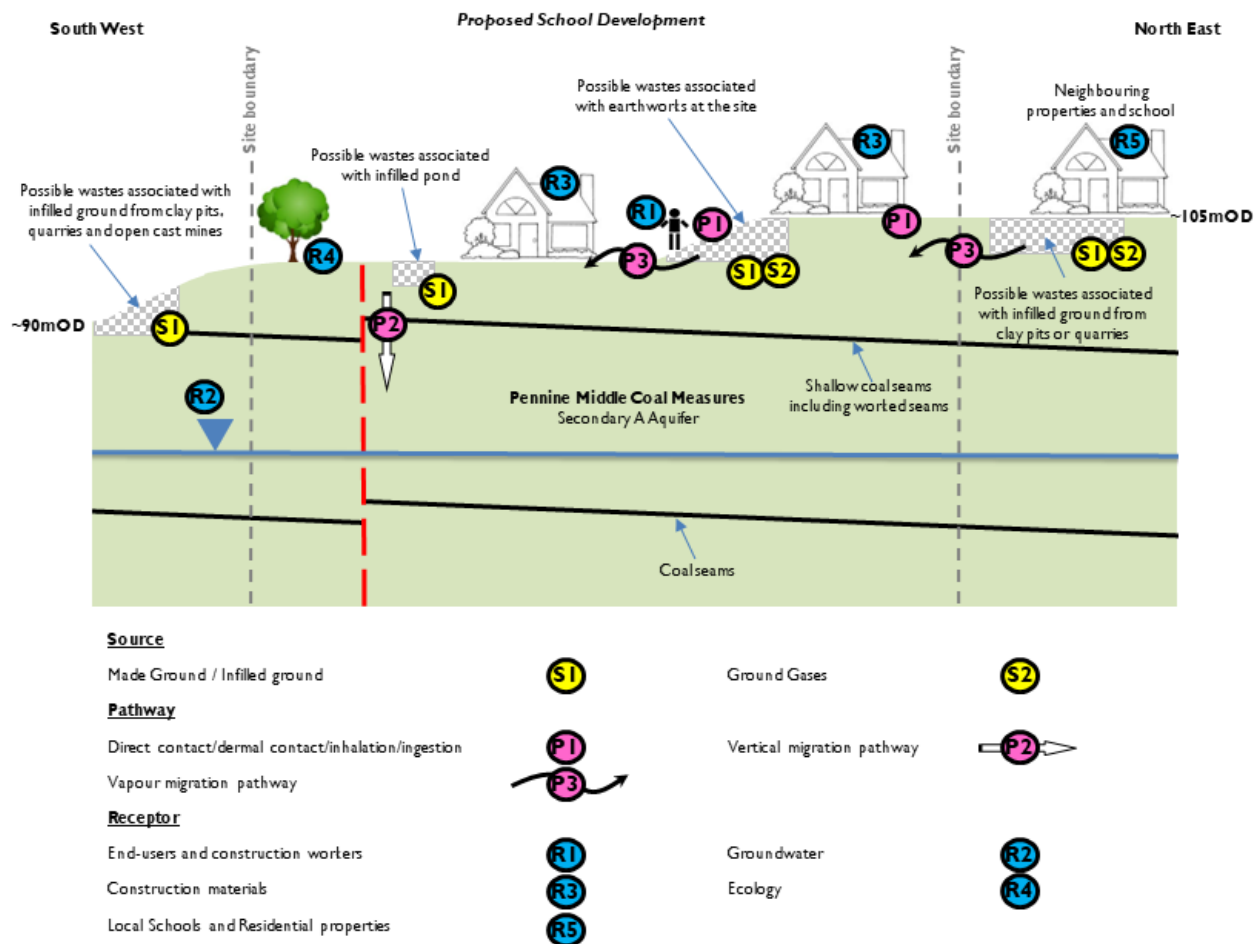
The vertical leaching of contaminants from any Made Ground into the groundwater is a potential pathway for contaminants to impact groundwater. The fault that intersects the site may also act as a pathway for contaminants to travel into groundwater.

Other Pathways

Other potential pathways that are possibly less significant to the site but still require consideration are potential phytotoxic effects on sensitive landscaping plants, chemical attack on foundations and services, potential for surface run-off to transport soils off-site during construction works and permeation of contaminants through domestic water pipes.

Initial Conceptual Site Model

In accordance with BS 10175 and LCRM, a schematic Initial Conceptual Site Model has been developed based on the source-pathway-receptor data presented above. Further details of the risk assessment methodology are presented in Appendix C.



The model shows the predicted geology and topography, the major on site potential contamination sources and vulnerable receptors. Levels shown are relative to Ordnance Datum and are based on published data previously presented in the report, although the drawing may not be considered to scale. The information presented above represents the preliminary conceptual ground model that may need to be revised based on information obtained as part of any future intrusive investigation. A number of sensitive receptors and potential pathways and sources (in association with a list of likely contaminants) have been identified.

The ground model and proposed end use described above have been broadly considered in relation to Nathaniel et al. 2015, The LQM/ClEH S4ULs for Human Health Risk Assessment. The proposed development generally does not conform to the conceptual models defined in Nathaniel et al. 2015. However, for the purpose of this geoenvironmental assessment, the site is closest to public open space (parkland) and residential without home grown produce.

Potential Contaminant Linkages Assessment

For each contamination source there are potential contaminant linkages with all receptors. However, in the context of this site, not all of the contaminant linkages are plausible. The likelihood of the various pathways linking the contaminants to the receptors is presented in the table below:

The preliminary contaminant linkage assessment is based on current available guidance published by a number of sources and is summarised in Appendix 4. The preliminary hazard assessment is a qualitative assessment of the risks posed by each viable pollution link identified. The hazard assessment leads to a recommended subsequent activity that could be:

- Action Required (AR) in the short term to break existing contaminant-pathway-receptor (CPR) link;
- Site Investigation Required (SIR) with objectives for risk estimation; or
- No Action Required (NAR) at this stage.

Hazard Identification				Hazard Assessment			
Link	Contaminant	Pathway	Receptor	Probability	Consequence	Risk	Contaminant Linkage Assessment
1	Contaminated soil / groundwater	Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	A- Humans using the site during construction.	Medium/ Reasonably foreseeable	Medium	Medium	SIR: Proposed development areas include over the footprint of some of the existing school buildings, over a historical infilled pond and where earthworks have been undertaken to raise ground levels. Potential for contaminants to be present in made ground and demolition wastes. Confirmation of contaminant status in existing school footprint required.
		Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	B- Humans using the site after development completion.	Low to Medium	Medium	Medium	SIR: As above.
		Downward migration / Via faulting below site	D – Secondary A Aquifer	Low	Medium	Low to Medium	SIR: Sources present both on and off site. Likely low permeability of bedrock materials. Groundwater quality may also be relatively poor due to the potential shallow mine working and oxidation of sulphide minerals. Fault present beneath the site.
		Inhalation	B- Humans using the site after development completion.	Low to Medium	Medium	Medium	SIR: Potential for petroleum hydrocarbons and other volatile contaminants as well as asbestos fibres.
5	Gas – methane & carbon dioxide	Inhalation, direct contact	E- Ecology (Flora/Fauna)	Low	Negligible	Low	NAR
6		Inhalation, direct contact	B - Humans using the site after development completion.	Medium/ Reasonably foreseeable	Medium	Medium	SIR: Sources identified on or off-site for potential ground gases. The Coal Authority Report indicates no mine gas issues. However evidence found for shallow worked coal seams beneath the site. Ground gas monitoring required to give an assessment for the site.
7	Contaminated soil / waste / groundwater	Secondary A Aquifer	E- Ecology (Flora/Fauna)	Negligible	Negligible	Low	NAR
8	Contaminated groundwater	Direct contact	F- Building structures.	Negligible	Mild	Low	NAR

9.0 GEOTECHNICAL HAZARDS ASSOCIATED WITH THE DEVELOPMENT

In addition to the environmental hazards, there are also geotechnical hazards associated with the stability of the ground (including load bearing capacity, slope stability and effects of ground (mining) cavities). Local Authorities follow the NPPF (2021) which requires that “site is suitable for its new use taking account of ground conditions and land instability....includes risks arising from natural hazards or former activities such as mining...” A summary of the geotechnical hazards and considerations is provided below:

Geohazards	
Compressible Ground	No hazard potential indicated for compressible ground stability in the Envirocheck Report. It is possible that compressible ground could be present in any Made Ground or the clay soils making up the weathered bedrock.
Collapsible Soils	Very low hazard potential indicated.
Swelling Clay	No or a very low hazard potential indicated. This is likely within the clay soils in the upper parts of the weathered bedrock.
Running Sand	No hazard potential indicated.
Ground Dissolution	No hazard potential indicated.
Landslip	A very low hazard potential indicated. The site is constructed on a series of plateaus.
Mining & Quarrying	There is evidence of deep coal mining and unrecorded shallow coal workings present below the site. There is no evidence of mineral extraction or quarrying at the site.

Geotechnical Design Considerations	
Site Clearance	It is understood that the development options being considered will entail the demolition of the existing school buildings to facilitate the construction of the new schools. The floor slabs of any buildings including any basement structures, in addition to any areas of hardstanding, will require breaking out and removing in order to facilitate the redevelopment. Similarly, foundations of any removed buildings should be grubbed out to prevent hard spots.
Trees	Trees are present at various locations across the site including along the western and southern boundaries as well as in the north western corner just to the north of the tennis courts and in a landscaped area just to the south of the main William Allitt buildings. The design of future foundations needs to take account of the trees on the site should the new buildings be located close to them as well as with respect to any trees that are proposed on the site as part of the development.
Existing Buildings / Obstructions	All the permanent school buildings and structures are still present on site with associated foundations and floor slabs and basements. The foundation type and depth is unknown, however, it is probable that they are pads or strip foundations as most buildings on site are of 1- to 2-storey. There is also the possibility of piled foundations following subsidence of historic buildings at the site.
Foundations	New permanent and temporary buildings are proposed across the site as part of the proposed redevelopment. Depending on the applied structural loadings as well as the strength and compressibility of the bearing strata, the use of spread / pad foundations bearing into the natural soils should be suitable for proposed one to two storey buildings. For three storey buildings it may be necessary to extend the depth of any foundations, possibly entailing the use of piled foundations. The foundations should be taken below any Made Ground and broken out hardstanding and obstructions (old floor slabs and foundations etc.). The foundations must take into account the presence of the existing trees and any that are proposed. The volume change potential of clay soils of the weathered bedrock needs to be determined, although a previous investigation is understood to have classified these soils as having a medium volume change potential. The potential variation in the weathering of the bedrock and the depth to the rock and hence any effect on the foundation design needs to be confirmed to avoid any differential settlement. Should an extensive thickness of Made Ground be found, then deeper foundations, such as vibro (stone) columns or piles may be necessary. Ground investigations will be required in order to fully inform the design of the development foundations to take account of the thickness of any Made Ground, coal workings and faults within the bedrock. Piled foundations may be required due to shallow coal workings.
Floor Slabs	The preferred solution for the floor slab typically depends on the type of foundation adopted with a suspended floor slab being used where the structural loads are carried on piled foundations and a ground bearing floor slab where strip / pad foundations are adopted. Where shallow foundations are adopted, ground bearing slabs should be placed on natural strata and any Made Ground is either removed or treated. However, the presence of trees must also be considered as part of the design and this may result in suspended floor being more suitable. Ground investigations will be required in order to fully inform the design of any floor slabs.
Groundwater	Shallow groundwater may be present within the upper 2m bgl. Ground investigation will be required to determine whether any groundwater control measures will be required during construction.

Earthworks	As part of the site clearance works and as a result of the development proposals, earthworks are likely to be required to produce the development platforms due to present stepped nature of the site.
Slopes	Due to the sloping nature of the site, slopes separating the various areas of the site are present, although no signs of instability were noted. Depending on the chosen redevelopment works new slopes will likely be created. The stability of such slopes will need to be considered as part of the redevelopment design and appropriate ground investigation carried out to facilitate such design.
Retaining Walls	Low-height retaining walls are present in places across the site separating the various areas of the site. Depending on the chosen redevelopment works new retaining structures may be required. The design of any new retaining structures will need to be considered as part of the redevelopment design and appropriate ground investigation carried out to facilitate such design.
Pavements / Hard Standing	Depending on the development levels, the formation levels for areas of hard standing and for road pavements may be variable due to the nature of any Made Ground present and any variations in the weathering of the bedrock. This needs to be confirmed by the investigation.
Chemically aggressive ground conditions	Adverse pH and sulphate levels are unlikely but this needs to be confirmed as part of the investigation, particularly in Made Ground and bedrock taking due account of the guidance in BRE SD1.
Mine Workings	There is evidence from the GRM Development Solutions investigations (summarised in the Stage 1 Feasibility Study issued by Mott MacDonald) for shallow coal workings to be present below the site. These workings are also possibly the cause of historical subsidence at the site. Ground investigation will be required in order to further assess the extent of any unrecorded shallow workings and to fully inform the design of the development. A copy of the GRM Development Solutions ground investigation report and the two ground investigation reports referred to by the Coal Authority should be obtained to further inform the design. A Coal Mining Risk Assessment Report should also be sought for the site.

The Geotechnical Risk Register is included in Appendix 5. This should be reviewed and refined following the preliminary investigation proposed in Section 10 below and further developed as the geotechnical design and assessment progresses.

A detailed ground investigation is imperative in the redevelopment of the site. The investigation proposed in Section 10 is only preliminary in nature and should be supplemented by further investigation as appropriate. Contractors for the scheme should obtain any additional investigation work that may be required to prepare their own detailed Ground Investigation Report and Geotechnical Design Report to Eurocode 7 and to prepare their own contaminated land risk assessment in line with Land Contamination Risk Management (LCRM, 2020) guidance including further ground investigation and risk assessment, remediation options appraisal and remediation strategy and verification (if required), which are to be used as the basis of the contractors detailed design.

10.0 CONCLUSION & RECOMMENDATIONS

Environmental Risk Assessment

The results of the risk assessments indicate that there are potentially significant source of contaminants present at the site, primarily related to previous on site developments, demolition of previously existing structures, an infilled pond and the earthworks. Source of contaminants may be associated with demolition wastes, petroleum hydrocarbons and coal ash. There is a moderate risk to receptors including human receptors during construction and to site users following development.

Potential sources of ground gases have been identified both on and close to the site primarily related to the infilled pond, on site earthworks, local historic collieries / quarries / clay pits, historic open cast mining, landfills and the shallow worked coal seams beneath the site. There is a medium risk to site users following construction. Part of the site is shown as having an intermediate radon risk potential and therefore it is recommended that either basic radon protection should be installed, or a BRE Radon Report is obtained to give definitive guidance on the requirement for protection measures.

There is potential for contaminants in Made Ground to migrate vertically into the underlying aquifer in the Bedrock.

If any soils are to be removed from site and disposed of at a Permitted facility, these should be chemically analysed to ensure appropriate waste classification and characterisation.

Geotechnical Risk Assessment

The risk assessment has concluded that there are potential geotechnical risks associated with the proposed

redevelopment relating to the potential for shallow coal working to be present. Coal Authority records show that the shallowest worked seam is at a depth where any collapse of workings is unlikely to crown at the surface. However, unrecorded shallow workings have been identified during a previous investigation at the site and are likely to have been subject to informal coal abstraction prior to records being kept. A Coal Authority Coal Mining Report obtained for the site also indicates the probable presence of unrecorded shallow workings.

Information is required in order to design appropriate foundations and floor slabs for the proposed development, as well as assess the potential for aggressive ground conditions for concrete design purposes.

Bulk earthworks (cut and fill) are likely to be required depending on the redevelopment option adopted, to accommodate changes in the site levels to create the development plateaus, information will be required to assess the soils compaction characteristics etc. and examine any slopes / retaining structures. Information will also be required to facilitate the design of any slopes or retaining structures formed as part of the works.

Identified Geotechnical and Geoenvironmental Abnormal Conditions.

The following Geotechnical Abnormal Conditions have been identified:

- The possible requirement for pile foundations with a suspended floor slab for the development should extensive and a variable thickness of Made Ground deposits be present including the backfill to historic ponds and associated with the basements on site, and due to shallow coal workings being present;
- Potential below ground obstructions associated with boulders of bedrock and anthropogenic materials from the basements on-site;
- Potential variable depth to rockhead;
- Shallow unrecorded coal workings;
- Swelling / shrinking soils are likely within the clay soils of the weathered bedrock that may require the deepening of foundations and the use of suspended floor slabs;
- Presence of a fault crossing the site.

The following Geoenvironmental Abnormal Conditions have been identified:

- Elevated concentrations of contaminants may be present associated with the previous use and subsequent demolition of former buildings and structures on site as well as infilled ground both on and off the site. This may include ash, petroleum hydrocarbons and construction and demolition materials resulting from the redevelopment as well as from waste.
- Potential for ground gases to be present associated with fill material both on and off the site and the shallow worked coal seams beneath the site.

Recommendations for Further Works and Proposed Investigation Strategy

Re-use of soils

It is recommended that a UI exemption is applied for in order to re-use up to 1,000 tons of soil at the site. If any cut/fill operations will exceed the limit of a UI exemption, then soils should be assessed and re-used in accordance with the requirements of the CL:AIRE Definition of Waste: Code of Practice (DoWCoP). The works requires are as follows:

- A baseline contaminant assessment should be undertaken in order to allow screening of clean naturally occurring soils for importation to assess for potential increased contaminant loading;
- As most developments require a portion of excess soil to be sent to a landfill sites, we would make an assessment of the Made Ground and natural strata to classify them in accordance with Landfill Waste Acceptance Criteria;
- If soils are re-used in accordance with the CL:AIRE DoWCoP these soils may potentially still be classified as waste until a Verification Report has been submitted; and
- If contamination is found during excavation or construction, stop work and make excavations safe and contact an experienced geoenvironmental engineer to re-assess potential risks.

Proposed intrusive investigation strategy

In order to make a quantitative assessment of the potential risks and so any required remedial measures can be designed, we recommend that a Phase 2 Investigation is carried out in accordance with BS 10175: 2011+A2:2017. This should be combined with a geotechnical investigation carried out in accordance with BS 5930:2015+A1:2020 to assist with the proposed development design. We recommend that the aims of future investigations are:

- Investigate the presence of shallow coal workings.
- Determine whether any contaminative substances are present at the site associated with any Made Ground at the site.
- To confirm the depth and extent of any Made Ground that may be present across the site.
- Determine the geotechnical properties of the natural soils at the site, and any Made Ground that may be present, to allow for the design of foundations for any proposed development, the aggressiveness of the soils to buried concrete and provide information for pavement / hard-standing design and any earthworks that may be required including slopes and retaining structures.
- Determine the presence of any groundwater and also determine whether it has been impacted by off-site sources.
- Determine the presence of any ground gases on the site.

It is also recommended that a Coal Mining Risk Assessment Report is also obtained along with copies of the two ground investigation reports referred to in the Coal Authority report in Appendix 3 as well as the GRM Development report referred to in Section 7.0 of this report.

Once the redevelopment option has been confirmed and in order to fulfil the aims detailed above, we recommend that a preliminary investigation comprises:

- Exploratory holes comprising either combined Cable Percussive and Rotary Boreholes or Dynamic Sample Rotary Boreholes, and additional Dynamic Sample holes. The shallow sections of the boreholes should progress to rockhead, with the recovery of samples for geotechnical laboratory analysis and undertaking SPTs. The rotary sections of the boreholes should be progressed to a depth of 15m below rockhead with rotary cores being recovered. At least three should be further progressed by open-hole drilling to a depth of 40m. Dynamic Sample holes, to a depth of 4m, should be utilised to help characterise the upper soils and investigate potential areas of contamination such as the location of the historic pond in the area of the playing fields.
- In situ testing comprising DCP tests for areas of hardstanding and potential playing areas.
- Recovery of samples from boreholes to undertake chemical testing including asbestos, heavy metals, TPH, PAHs;
- Soil leaching tests of Made Ground materials to assess any potential impact to the underlying Secondary aquifer, if shallow groundwater is not encountered;
- Recovery of samples of the appropriate Sample Class for classification, strength, compressibility, earthworks classification and buried concrete classification;
- Sampling of 'natural' soils to allow the establishment of baseline soil chemical concentrations to allow assessment of any proposed soil importation via the CL:AIRE DoWCoP, if soil importation is likely to be required;
- For each contaminant identified, a quantified application of risk assessment models in accordance with LCRM;
- Installation of combined groundwater and ground gas monitoring wells and their subsequent confirmatory monitoring and sampling;
- Commissioning of a GIR and Phase 2 report following the completion of the intrusive investigations; and
- Review and update the Geotechnical Risk Assessment.

11.0 REFERENCES

- 1) Environmental Protection Act 1990: Part IIA, Contaminated Land Statutory Guidance, HM Government, April 2012.
- 2) BS 5930 : 2015 : Code of practice for site investigation. British Standards Institution.
- 3) BS 10175 : 2011+A2 2017: Investigation of potentially contaminated sites – Code of Practice. British Standards Institution
- 4) Building Research Establishment : 2010 : Part C.
- 5) Building Research Establishment : 2015 : Radon: Guidance on protective measures for new buildings.
- 6) Environment Agency : 2010 : GPLC1 – Guiding principles for land contamination. GPLC2 – FAQs, technical information and references. GPLC3 – Reporting checklists.
- 7) Environment Agency : 2020: Land Contamination Risk Management
- 8) HM Government : 2013 : The Building Regulations 2010. Part C. Site Preparation and resistance to contaminants and moisture. 2004 Edition with Amendments 2010 & 2013.
- 9) Ministry of Housing, Communities & Local Government: 2019 : National Planning Policy Framework, February 2019.
- 10) Statutory Instruments: 2012: Environmental Protection, England. Contaminated Land (England) (Amendment) Regulations 2012 No. 263 coming into force 6th April 2012.
- 11) Statutory Instruments: 2015: The Construction (Design and Management) Regulations 2015 (CDM 2015) coming into force 6th April 2015.
- 12) Nathaniel et al. 2015, The LQM/CIEH S4ULs for Human Health Risk Assessment.
- 13) CL:AIRE: Good Practice for Risk Assessment for Coal Mine Gas Emissions. October 2021.