

Phase 1 & Phase 2: Geo-Environmental Assessment

Lees Hall Road, Dewsbury

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PHASE 1 & PHASE 2 GEO-ENVIRONMENTAL ASSESSMENT

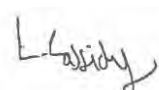
LEES HALL ROAD, DEWSBURY

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1 EXECUTIVE SUMMARY

Site Address	Lees Hall Road, Dewsbury
Site Description	The site is an irregular shaped parcel of land of uneven topography located to the north of Lees Hall Road. The site is undeveloped and appeared to have been recently cleared of vegetation, with piles of cuttings noted. Flytipping and littering were prevalent across the site, whilst evidence of bonfires were also present. The site slopes down steeply towards the northeast, with the land to the east of the site situated at a lower level.
Site History <i>On Site</i>	The earliest maps (1855) show that the site featured structures in the northeast, with additional structures added by the 1890s.
<i>Offsite</i>	From the earliest mapping the area around the site was predominantly rural with a large glass works present to the north with a canal beyond this. Rapid industrialisation occurred with terraced housing and additional works, including a gravel pit immediately north, developed by the 1950s.
Proposed End Use	The proposed development is outlined to be residential consisting of dwellings with associated soft landscaping, parking and access roads.
Environmental Setting <i>Landfill & Waste</i>	There are six Landfill records within 500m of the site, the nearest of which was 104m east of the site.
<i>Regulated Industries</i>	There are sixteen contemporary trade directory entries within 500m of the site. There are no recorded fuel station entries within 500m of the site.
<i>Geology</i>	The solid geology beneath the site is likely to mostly comprise Pennine Lower Coal Measures of mudstone, siltstone and sandstone. The drift deposits are expected to comprise sand and gravel (with clays and silts in the north).
<i>Hydrogeology</i>	Using the Environment Agency's Policy and Practice for the Protection of Groundwater the solid geology beneath the site is classified as a Secondary Aquifer – A. The overlying drift is a Secondary Aquifer - A. The site does not lie within a Source Protection Zone. There are nineteen Water Abstractions located within 1km of the site.
<i>Hydrology</i>	The nearest surface water feature is located 57m south of the site.
<i>Flooding</i>	The Envirocheck Report states the site is not at risk of Flooding from Rivers and the Seas without defences, but is at risk from Extreme Flooding. There are no flood defences, flood water storage areas or areas benefiting from flood defences and flood storage present within 250m of the site.
<i>Radon Gas</i>	The Envirocheck report indicates that the site is located within an Intermediate Probability Radon Area (1-3% of properties at or above the Action Level). No radon protection measures are necessary for new buildings or extensions on the site.
Preliminary Mining Assessment	The coal mining report indicates coal is expected at or near the surface which may have been worked.
Fieldwork	• 6no small percussive boreholes (BH1 to BH6) drilled to a maximum depth of 5.00mbgl with 3no. monitoring pipes in BH2, BH5 and BH6. • 3no rotary boreholes (RBH1 to RBH3) drilled to a maximum depth of 30.00mbgl.
Ground Conditions	• Made ground was encountered to depths of between 0.80mbgl and 3.90mbgl. • Very soft to firm consistency slightly gravelly sandy low to medium strength silty clay was generally encountered down to a maximum depth of 5.00mbgl. • Very loose to loose clayey silty sand generally encountered, in turn underlain by sands and gravels to a maximum depth of 16.20mbgl. • Rockhead of mudstone encountered between 10.50 and 16.20mbgl, proven to 30.00mbgl, locally interbedded with sandstone. • Intact coal seams encountered within RBH2 (20.60-21.40m) and RBH3 (21.10-22.40m). • Groundwater, where encountered, was noted between 2.00m and 3.40m.
Contamination Testing Results	• Three made ground samples tested. • Elevated lead (2no samples), arsenic (1no sample) and PAHs (all three samples). • No asbestos fibres. • Slightly alkaline pH.
Contamination Analysis	• Given the site's proposed residential land use, the levels of contamination recorded on site may pose a risk to the current and future users of the site. • If any zones of odorous, brightly coloured or suspected contaminated ground or groundwater are encountered then work should cease in that area until the material has been investigated. The results of the investigation will therefore determine whether or not remediation will be required. • Made ground classed as slightly contaminated with respect to construction workers. PPE for workers. Damping down of site during dry windy conditions. • Clean cover system required for all proposed areas of soft landscaping, to 0.60m based on guidance from YALPAG. • Controlled waters unlikely to be at risk.

	• With respect to utilities pH was elevated; as a minimum all services should be laid in clean trenches. • Sub surface concrete should be designed to DS-1 ACEC (Class AC-1s). This assumes static groundwater conditions.
Geotechnical Testing Results	• Cohesive deposits low to medium strength, based on SPT N values. • Cohesive materials on site have a high volume change potential. • Moisture contents between 12 and 63%. • Sulphates between 10-89mg/l, pH slightly alkaline.
Mining Assessment	• No loss of flush recorded during drilling. • All coal encountered was intact. • Conservatively assuming the coal represents pillars, ratios of 8.15 and 12.63 have been calculated. • Recommended to adopt reinforcement of foundations, depending on the foundation solution utilised. • Client should consider further proof drilling to ca. 25.00mbgl.
Geotechnical Analysis & Foundation Recommendations	• Ground conditions encountered are likely to preclude conventional foundations. • Recommended to adopt piled/mini-piled foundations or ground improvement. • Further drilling may be required to facilitate foundation design. • Normal earthworks plant for excavations.
Recommended Further Works	• Deeper cable percussive boreholes to enable pile/ground improvement design to ca. 15mbgl. • Follow-on rotary probe boreholes to ca. 25mbgl.

1 PHASE 1 DESK STUDY - INTRODUCTION AND SCOPE OF INVESTIGATION

1.1 Phase 1 Desk Study

Solmek were instructed by Design Studio North to undertake a desk study on a parcel of land at Lees Hall Road, Dewsbury Green, Rothwell. The site is expected to be developed with new housing with associated parking and soft landscaping.

Sources of information, including previous work undertaken at the site, are detailed below:

- *TA Associates Coal Mining Risk Assessment (2296) October 2016.*

Reference should be made to the above report for details of the site's mining history and geological context.

The following steps may be required in the investigation and remediation of potentially contaminated land:

Phase 1: Desk Study
Phase 2: Intrusive Investigation
Phase 3: Remediation Statement
Phase 4: Validation Reports

Phases 1 and 2 are generally required in the redevelopment of most sites. Phases 3 and 4 are subject to the findings of the initial stages. This report represents Phase 1 of the site investigation.

The purpose of this Phase 1 Desk Study is to evaluate likely ground conditions and significant environmental issues at the site, and to plan the scope of subsequent phases of investigation.

This report may be regarded as a Preliminary Risk Assessment in accordance with the Environment Agency's guidance document *Model Procedures for the Management of Land Contamination* (CLR 11, 2004).

This Phase 1 Desk Study has been undertaken with due regard to current contaminated land guidance issued by the Royal Institution of Chartered Surveyors (RICS) together with BS 10175:2011+A1:2013, "*Investigation of Potentially Contaminated Land - Code of Practice*" and relevant sections of BS 5930: 2015, "*Code of Practice for Ground Investigations*".

The objectives of the investigation are as follows:

- Determine the land use history of the site from an inspection of available Historical Maps
- Determine the environmental setting of the site from available sources
- Determine whether past mining may have had an influence on the site
- Determine whether the site has previously been used for purposes that may have given rise to significant ground contamination
- Provide recommendations for further investigation.

2 SITE WALKOVER AND DESCRIPTION

2.1 Site Description

A site inspection, as recommended in BS 5930 and BS 10175, was undertaken on 15th October 2020. The site is centred at Ordnance Survey Co-ordinates 423660, 419660 and covers approximately 0.27Ha.

The site is an irregular shaped parcel of land of uneven topography located to the north of Lees Hall Road.

The site is undeveloped and appeared to have been recently cleared of vegetation, with piles of cuttings noted. Flytipping and littering were prevalent across the site, whilst evidence of bonfires were also present.

The site slopes down steeply towards the northeast, with the land to the east of the site situated at a lower level.

The surrounding areas of the site are residential to the west and south whilst disused overgrown land is present to the north and east.

2.2 Off Site Features

The site is bordered by housing to the west, south and east, with disused land present to the north.

3 SITE HISTORY

3.1 Map Descriptions

In order to determine the history of the site, previous editions of Historical Maps and Ordnance Survey Plans were inspected. The Historical Maps are presented in Appendix B.

Table 1 presents a summary of the history of the area which includes plots from 1855 to 2020. The summary focuses on the historical land uses and changes relevant to the site and the proposed end use. Measurements are taken from the nearest boundary of the site and all distances quoted are approximate.

TABLE 1: SUMMARY OF SITE HISTORY

OS Map Edition	On-site Features	Off-site Features
1855 1:10,560	The site appears to have structures in the northeast.	A road runs along the south of the site. A large glass works is present 150m to the north, with another glassworks present 500m east. The surrounding area is largely rural. A canal is present 200m north of the site. A railway line is present 150m west of the site.
1893 1:2,500 & 1894 1:10,560	A building is present in the centre of the site with housing present in the west. A drainage feature appears to run through the site.	The glass works to the north has expanded with railway sidings also noted. Thornhill Iron Works is noted 150m north of the site. Terraced housing has been constructed west, east and south of the site. Inghams pit is 1km south of the site.
1907 1:2,500 & 1908 1:10,560	Additional houses are present in the south of the site.	A gravel pit is noted immediately north of the site. Terraced housing has been constructed 200m northeast of the site.
1922 1:2,500	No significant change.	No significant change.
1930-1931 1:10,560	No significant change.	Allotment gardens are now present 50m south of the site. The glass works are now labelled as Thornhill Iron & Steel works.
1937 1:2,500 & 1938 1:10,560	No significant change.	House construction has begun 600m east of the site.
1948 1:10,560	No significant change.	Terraced housing has been constructed between 250m and 750m west of the site. Houses have been constructed 600m east of the site.
1955 1:1,250 & 1955-1957 1:10,000	A ruin is noted in the south of the site.	A slurry bed is noted 30m north of the site. Thornhill Iron & Slurry works has expanded. A sports ground is present 100m northeast of the site.
1966-1967 1:10,000 & 1960-1971 1:1,250 & 1967-1969 1:2,500	No significant change.	Houses have been constructed between 50m and 250m south of the site. The Iron & Steel works to the north are now labelled as "Works".
1982-1984 1:10,000	No significant change.	A large works has been constructed 150m northwest of the site.
1992-1993	No significant change.	The works to the north have been demolished.

1:10,000 7 1993 1:1,250		
2000 1:10,000	No buildings are now present in the north of the site.	Allotment gardens are present to the east of the site.
2020 1:10,000	No significant change.	No significant change.

4.2 Potential Contamination Sources Identified via Historical Plans

Contamination from historical land uses within a 250m radius of the site have been identified:

Made ground from materials used to infill depressions and form a level area for access or building. This may include brick, concrete, timber, ash, slag, coal and metals.

Construction/demolition waste from construction and demolition immediately around the site over the documented history. This may include brick, concrete, timber, asbestos and metals. Historically road construction used ash as a sub-base material.

Iron Works contaminants that may arise from forges typically include metals such as lead, arsenic, cadmium or zinc and organic pollutants such as fuels, oils or PAHs.

4 ENVIRONMENTAL SETTING

4.1 Information Sources

The environmental setting of the site was determined through reference to the following:

- Envirocheck Report (including historical map extracts)
- British Geological Survey (BGS): 1:50 000 geological map series sheet 77 Huddersfield Solid and Drift Edition (2003)
- BRE Publication BR211 Radon: Guidance on Protective Measures for New Dwellings

4.2 Landfill and Waste

The Envirocheck Report indicates that there is one Registered Landfill Site located within 500m of the site. This was located 104m east of the site at the Steelworks solely for waste produced on the site including construction, demolition, inert and non-hazardous wastes.

The Envirocheck Report indicates that there are no BGS Recorded Landfill Sites located within 500m of the site.

The Envirocheck Report indicates that there are 4no Historical Landfill Sites located within 500m of the site. This was located 24m northeast of the site, dated between 31st December 1947 and 30th June 1989, with deposited waste including Inert, Industrial and Commercial waste.

The Envirocheck report indicates that there are no Local Authority Recorded Landfill sites located within 500m of the site.

The Envirocheck Report indicates that there are no Waste Treatment, Transfer and Disposal Sites entries located within 500m of the site.

The Envirocheck Report indicates that there is one Licenced Waste Management Facility located within 500m of the site. This is located 456m northwest of the site at Thornhill Quarry landfill.

4.3 Regulated Industries

The Envirocheck Report indicates that there are sixteen Contemporary Trade Directory Entries located within 500m of the site. The nearest of these was located 171m west of the site and related to Concrete and Mortar

ready mixed.

The Envirocheck Report indicates that there are no Recorded Fuel Sites located within 500m of the site. The Envirocheck Report indicates that there are no records of Integrated Pollution controls located within 500m of the site.

The Envirocheck Report indicates that there are no records of Integrated Pollution Prevention and Control entries located within 500m of the site.

The Envirocheck Report indicates that there are two Local Authority Pollution Prevention and Control site located within 500m of the site. The nearest of these is located 233m northwest of the site at Redland Readymix Ltd, relating to the blending, packing, loading and use of bulk cement.

The Envirocheck Report indicates that there are no sites dealing with Hazardous, Explosive or Radioactive Substances located within 500m of the site.

The Envirocheck Report indicates that there are no Substantiated Pollution Incidents or Sites Determined as Contaminated Land under Part 2A EPA 1990 entries located within 500m of the site.

4.4 Geology

The site is shown to be underlain by solid geology of Pennine Lower Coal Measures of Mudstone, Siltstone and Sandstone.

The site is located within an area of Alluvium (clay, silt, sand and gravel) in the northeast, and River Terrace Deposits (sand and gravel) in the southwest.

A fault is present 500m to the south. Several other faults are present within 1km.

The Middleton Little coal seam subcrops beneath the site.

4.5 Mining & Quarrying

The site is within a Coal Mining Affected Area as defined by the Coal Authority, as a result a coal mining search report was required to assess the risks posed by historic and possible future coal mining to any current or future developments on the site.

The coal mining search report conducted by TA Associates dated 6th October 2016 is presented in Appendix D.

The mining report highlights that the site is situated in an area where two seams have been worked within the likely zone of physical influence on the surface. These are indicated to be at depths of between 110 and 220m, last worked in 1931.

The report highlights that the site is not situated within the boundary of a former opencast coal mining site. Neither is the site located within 200m of a currently operating opencast coal mine or 800m of a future opencast coal mine.

The report follows on to state that they have no knowledge of any mine entries within 20m of the site or the boundary of the site.

The report states that the site is in an area where the Coal Authority believes there is coal at or close to the surface, and workings within these coal seams should be considered.

The Envirocheck Report indicates that there are 13no BGS recorded Mineral Sites located within 1km of the site. The nearest is located 496m south-west of the site with the commodity listed as Common Clay and Shale (Opencast).

The site is not within 1km of a Non-Coal mining area of Great Britain, a Man-Made Mining Cavity, a Natural Cavity or a Brine Compensation area.

4.6 Geological Hazards and Instability

The Envirocheck report presents the maximum hazard ratings of ground stability hazards located on site as follows:

- Negligible hazard is posed by Ground Dissolution
- Very low hazard is posed by Collapsible Deposits, Landslides and Shrinking or Swelling Clay
- Low hazard is posed by Running Sand
- Moderate hazard is posed by Compressible Deposits

4.7 Hydrogeology

Using the Environment Agency's Policy and Practice for the Protection of Groundwater the solid geology beneath the site is classified as a Secondary Aquifer – A. The overlying drift is classified as a Secondary Aquifer – A.

The groundwater vulnerability combined classification is provided as Secondary Bedrock Aquifer – Medium Vulnerability.

The site does not lie within a Source Protection Zone.

The Envirocheck Report indicates that there are nineteen Water Abstractions located within 1km of the site. The nearest of these is located 584m north of the site at Lafarge Aggregates, with the water used for dust suppression.

4.8 Hydrology

The nearest surface water feature is an unnamed river located 57m south of the site.

The Envirocheck Report states there are four Licensed Discharge Consents entries within 500m of the site. The nearest of these is a storm tank/CSO located 124m northeast of the site.

The Envirocheck Report states there are no Records of Water Industry Act Referrals (potentially harmful discharges to the public sewer) located within 500m of the site.

4.9 Flooding

The Envirocheck Report states the site is not at risk of Flooding from Rivers and the Seas without defences, but is at risk of Extreme Flooding.

The Envirocheck Report indicates that there are no flood defences, flood water storage areas or areas benefiting from flood defences and flood storage present within 250m of the site.

4.10 Sensitive Land Use

An Area of Adopted Green Belt for Kirklees Metropolitan Borough Council is located 275m south of the site.

An Area of Unadopted Green Belt for Kirklees Metropolitan Borough Council is located 406m south of the site.

A Local Nature Reserve (Sparrow Wood) is located 801m northeast of the site.

A Nitrate Vulnerable Zone for surface water is located 976m northwest of the site.

The site does not lie within 2km of any other form of Designated Environmentally Sensitive Sites or Protected Areas.

4.11 Radon Gas

The Envirocheck report indicates that the site is located within an Intermediate Probability Radon Area (1-3% of properties are at or above the Action Level).

In accordance with the procedure described in BRE Publication BR211 Radon: Guidance on Protective Measures for New Dwellings, no radon protection measures are necessary for new buildings or extensions.

5 PHASE 2 SITE INVESTIGATION - SITE DESCRIPTION AND FIELDWORK

5.1 Authorisation

The site investigation described in this report was carried out by Solmek to the instructions of Design Studio North, on land located at Lees Hall Road, Dewsbury.

5.2 Scope of Works

The site is expected to be developed with new residential housing with associated parking and soft landscaping.

A geotechnical and environmental investigation including a ground gas risk assessment was requested. The fieldwork and testing was generally carried out according to the recommendations of BS5930: 2015 “Code of Practice for Ground Investigations” and where applicable BS EN 1997-2:2007 with soil descriptions to BS EN 14688-1:2013 where applicable. The information provided in this report is based on the investigation fieldwork, and is subject to the comments and approval of the various regulatory authorities.

There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Solmek reserve the right to alter conclusions and recommendations should further information be available or provided. Any schematic representation or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

6 FIELDWORK

6.1 Fieldwork

The fieldwork was carried out on 15th October and 23rd November 2020. The extent of the investigation was:

- 6no small percussive boreholes (BH1 to BH6 inclusive) to a maximum depth of 5.00m below ground level (bgl).
 - o The boreholes were evenly spread around the site to achieve maximum site coverage.
- Gas monitoring wells were installed in BH's 2, 5 & 6.
 - o The wells were spaced at <25m centres evenly around the site in accordance with CIRIA C665.
- 3no rotary openhole boreholes (RBH1 to RBH3) to a maximum depth of 30.00mbgl.
 - o The boreholes were drilled to investigate the presence of historical mine workings.
 - o The boreholes were evenly spread around the site to achieve maximum site coverage
- Insitu testing in the exploratory positions as Standard Penetration Tests (SPTs).
- Retrieval of samples for geotechnical and chemical testing.

The boreholes were backfilled with clean arisings or installations upon completion.

Descriptions of the strata encountered in the boreholes together with details of sampling and groundwater are presented in Appendix B of this report. A plan showing the location of the boreholes can be found in Appendix A (Figure 2).

7 GROUND CONDITIONS

A summary of the ground conditions encountered is given below.

7.1 Made Ground

Made ground was variable across the site and was generally encountered to a minimum depth of 0.80mbgl (BH2) and a maximum depth of 1.80mbgl (BH4), although deeper made ground was encountered in the southeast of the site, within BH6 and RBH1, to depths of 2.60 and 3.90mbgl respectively. The made ground broadly consisted of gravelly topsoil underlain by locally clayey sandy gravel, with the gravel comprising

brick, ash, sandstone, mortar and concrete.

The base of made ground was not proven within BH1 (0.80mbgl) or BH6 (2.60mbgl).

7.2 Natural Deposits

Proven to underlie the made ground deposits across the site, natural ground generally initially comprised very soft to firm consistency slightly gravelly sandy low to medium strength silty clay, which was proven depths of between 2.60 and 5.20mbgl.

This was generally underlain by granular deposits, generally as very loose clayey/silty sand (not present within RBH1). Within the three rotary boreholes, sand and gravels were encountered between 4.30 and 5.20mbgl and proven to a maximum depth of 16.20mbgl.

7.3 Solid Geology

Rockhead of mudstone was generally encountered within RBH1 and RBH3 between 10.50 and 16.20mbgl. The boreholes were continued to 30m, generally consisting of mudstone (locally interbedded with sandstone). No loss of flush, voids or broken rock were encountered, although intact coal was present within RBH2 (20.60-21.40m) and RBH3 (21.10-22.40m).

7.4 Groundwater

Groundwater was recorded within BH2 to BH6 between 2.00 and 3.40mbgl. No groundwater was recorded within the three rotary boreholes however the drilling flush is likely to have masked groundwater seepages.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities. Therefore, water levels significantly higher than those found during this investigation may be encountered.

8 CONTAMINATION TESTING RESULTS

The proposed development of the site is to involve the construction of residential homes with associated gardens, parking and access roads. The chemical samples were generally retrieved in line with BS ISO 18400-105:2017 "Soil Quality. Sampling". The chemical results are presented in Appendix F.

8.1 Contamination Testing and Rationale

To provide information upon the possibility of ground contamination three samples of made ground were selected for shallow contamination testing. Given the end use being Residential with Home Grown Produce, three samples are considered appropriate for testing. The samples selected are detailed below:

- BH1 – 0.20-0.40m (Made ground – granular fill)
- BH2 – 0.20-0.40m (Made ground – topsoil)
- BH5 – 0.40-0.60m (Made ground – granular fill)

The samples selected are considered to provide coverage of both the made ground and shallow natural strata from across the site that would be most likely to be exposed during future site works. The samples were tested for the following contaminant suites:

- 3no Metals, semi-metals, non-metals, inorganic determinants
- 3no Asbestos identification screenings
- 3no Speciated Polyaromatic Hydrocarbons (PAHs)
- 1no Total Petroleum Hydrocarbon Criteria Working Group fractions (TPHCWG)

8.2 Test Results

Based on the proposed development at the site, the test results have been compared to a series of Land Quality Management (LQM) Suitable for Use Levels (S4UL) based on a residential with home grown produce land use. These are the most up to date thresholds published in December 2014.

The value for lead has been compared with the Category 4 Screening Level (March 2014) developed by Contaminated Land: Applications In Real Environments (CL:AIRE).

The test results are presented in Appendix F, and a summary is provided below in Tables 2 and 3.

TABLE 2: SUMMARY OF INORGANIC CONTAMINATION TESTING RESULTS

Determinand	Units	Number of Samples above Level of Detection	Minimum Recorded Level	Maximum Recorded Level	Residential with HGP Threshold Value	Number of Results Exceeding Threshold Value
Metals						
Cadmium	mg/kg	3	0.26	0.67	11	0
Chromium	mg/kg	3	32	210	910	0
Copper	mg/kg	3	31	78	2400	0
Lead	mg/kg	3	170	360	200*	2
Mercury	mg/kg	3	0.26	0.46	40	0
Nickel	mg/kg	3	26	62	180	0
Zinc	mg/kg	3	65	170	3700	0
Semi metals and non metals						
Arsenic	mg/kg	3	23	58	37**	1
Boron	mg/kg	2	<0.4	0.77	290	0
Selenium	mg/kg	2	<0.2	0.65	250	0
Inorganic chemicals						
Cyanide (Total)	mg/kg	0	<1	-	1.49**	0
Sulphate (2:1 Water Soluble)	mg/l	2	<10	26	2000^	0
Other						
pH	pH	-	7.8	9.2	5.5^	0
* Category 4 Screening Levels, March 2014 ** CLEA Software Version 1.06 (pH7 and 1%SOM) ^ EA Threshold Values HGP Home Grown Produce						

8.3 Metals, Semi Metals and Non Metals

The sample from BH1 (0.20-0.40m) recorded elevated lead whilst BH2 (0.20-0.40m) recorded elevated lead and arsenic. No other samples indicated raised levels of contamination above the S4UL threshold values, based on the three samples tested.

8.4 Inorganic Chemicals

Soluble sulphates (potentially aggressive to foundation concrete) were recorded between <10 and 26mg/l. None of the samples were elevated above levels affecting human health or the BRE Special Digest 1 500mg/l limit for the sulphate classification of concrete.

The results of the pH testing were between 7.8 and 9.2, which is consistent with slightly alkaline conditions.

8.5 Organic Chemicals

The organic thresholds vary depending on the levels of soil organic matter (SOM).

The average SOM recorded across the site was 9.1% therefore a SOM of 6% has been used to determine the S4UL thresholds. Table 3, below, summarises the results.

TABLE 3: SUMMARY OF ORGANIC CONTAMINATION TESTING RESULTS

Determinand	Units	Number of Samples above Level of Detection	Minimum Recorded Level	Maximum Recorded Level	Residential with HGP Threshold Value at 6% SOM	Number of Results Exceeding Threshold Value
TPH Aliphatic Fractions						
Aliphatic (C5-C6)	mg/kg	0	<1	-	160	0
Aliphatic (C6-C8)	mg/kg	0	<1	-	530	0
Aliphatic (C8-C10)	mg/kg	0	<1	-	150	0
Aliphatic (C10-C12)	mg/kg	1	3.4	3.4	760	0
Aliphatic (C12-C16)	mg/kg	1	3.4	3.4	4300	0
Aliphatic (C16-C21)	mg/kg	0	<1	-	110000	0
Aliphatic (C21-C35)	mg/kg	1	13	13	110000	0
Aliphatic (C35-C44)	mg/kg	0	<1	-	110000	0
TPH Aromatic Fractions						
Aromatic (C5-C7)	mg/kg	0	<1	-	300	0
Aromatic (C7-C8)	mg/kg	0	<1	-	660	0
Aromatic (C8-C10)	mg/kg	0	<1	-	190	0
Aromatic (C10-C12)	mg/kg	0	<1	-	380	0
Aromatic (C12-C16)	mg/kg	0	<1	-	660	0
Aromatic (C16-C21)	mg/kg	1	21	21	930	0
Aromatic (C21-C35)	mg/kg	1	290	290	1700	0
Aromatic (C35-C44)	mg/kg	0	<1	-	1700	0
Speciated PAH						
Naphthalene	mg/kg	3	1	3.9	13	0
Acenaphthylene	mg/kg	3	0.94	4.6	920	0
Acenaphthene	mg/kg	3	0.89	4.8	1100	0
Fluorene	mg/kg	3	0.73	6.5	860	0
Phenanthrene	mg/kg	3	6.8	41	440	0
Anthracene	mg/kg	3	1.6	12	11000	0
Fluoranthene	mg/kg	3	8.8	54	890	0
Pyrene	mg/kg	3	8.7	53	2000	0
Benzo[a]anthracene	mg/kg	3	3.9	21	13	1
Chrysene	mg/kg	3	4.8	22	27	0
Benzo[b]fluoranthene	mg/kg	3	4.9	25	3.7	3
Benzo[k]fluoranthene	mg/kg	3	1.8	10	100	0
Benzo[a]pyrene	mg/kg	3	4	22	3	3
Benzo[g,h,i]perylene	mg/kg	3	2.5	13	41	0
Dibenzo(a,h)Anthracene	mg/kg	3	0.75	6.8	0.3	3
Indeno(1,2,3-c,d)Pyrene	mg/kg	3	2.4	13	350	0
Total PAH	mg/kg	3	55	310	50*	3
Total Phenol	mg/kg	0	<0.3	-	1100	0
* EA Threshold Values						

Concentrations of benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene and total PAH were elevated within all three samples, whilst benzo(a)anthracene was elevated within BH5 (0.40-0.60m) only.

8.6 Asbestos

From the three samples subject to asbestos screening, no asbestos fibres were recorded in any of the samples.

8.7 Environmental Protection Act 1990: Part 2A Revised Statutory Guidance (April 2012)

This revised document explains how the Local Authority should decide if land, based on a legal interpretation, is contaminated. The document replaces the previous guidance given in Annex 3 of DEFRA Circular 01/2006, issued in accordance with section 78YA of the 1990 Environmental Protection Act.

The main objectives of the Part 2A regime are to “*identify and remove unacceptable risks to human health and the environment*” and to “*seek to ensure that contaminated land is made suitable for its current use*”. Part 2A

uses a risk based approach to defining contaminated land whereby the “risk” is interpreted as *“the likelihood that harm, or pollution of water, will occur as a result of contaminants in, on or under the land”* and by *“the scale and seriousness of such harm or pollution if it did occur”*.

For a relevant risk to exist a contaminant, pathway and receptor linkage must be present before the land can be considered to be contaminated. The document explains that *“for a risk to exist there must be contaminants present in, on or under the land in a form and quantity that poses a hazard, and one or more pathways by which they might significantly harm people, the environment, or property; or significantly pollute controlled waters.”*

A conceptual model is used to develop and communicate the risks associated with a particular site.

To determine if land is contaminated the local authority use various categories from 1 to 4. Categories 1 and 2 include *“land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health.”* Categories 3 and 4 *“encompass land which is not capable of being determined on such grounds”*.

See Appendix H for additional notes on contamination guidelines.

9 CONCEPTUAL MODEL & CONTAMINATION ANALYSIS

The contamination conceptual model in Table 4 identifies the potential pollution linkages present on site based on source – pathway – receptor relationships.

TABLE 4: CONCEPTUAL MODEL

Source	Pathway	Receptor	Risk Rating	Comments
Asphyxiating or explosive ground gases - Made ground (<3.90m) - Shallow coal mining - Landfills within 250m	Ground gas migration - Migration through permeable soils - Inhalation	Future site users Adult and infant residents	Moderate /Low	Gas monitoring in progress, source risk rating subject to change.
		Users during development Construction workers	Low	
Areas of contamination hazardous to human health (Residential Thresholds) - Elevated lead within all three samples - Elevated arsenic within one sample - Elevated PAHs within all three samples	- Inhalation - Dust ingestion - Dermal contact	Future site users Adult and infant residents	Moderate	Moderate risk to end users, however this will be mitigated as long as contaminated areas are encapsulated beneath clean cover systems, proposed structure footprints or hard standing.
		Users during development Construction workers	Moderate	Mitigation measures required during construction. Consideration to be given to Health and Safety Executive: <i>Protection of Workers and the General Public During the Development of Contaminated Land</i> .
	- Inhalation - Dust ingestion	Users of surrounding sites Nearby residents	Moderate /Low	Potential moderate risk during remediation/construction from dust generation. Consideration to be given to dust suppression, in line with BRE: <i>The Control of Dust and Emissions from Construction and Demolition, Best Practice Guidance</i> .
	Leaching mobilised contaminants of	Solid geology Secondary Aquifer – A	Low	Limited contamination encountered however thick drift deposits are present, incorporating lower permeability bands, which will reduce the risk to the bedrock aquifer.
		Drift geology Secondary Aquifer – A	Low	The variable permeability and medium sensitivity aquifer is not considered to be at risk.
	- Drainage - Lateral migration - Accumulation of contaminated sediment	Surface water features Unnamed river 57m south	Low	Distant low sensitivity watercourse not considered to be at risk.
Areas of phytotoxic contamination	Uptake via roots and leaf surfaces	Vegetation None on site or proposed	Moderate /Low	Phytotoxic levels of lead within two samples. Imported topsoil required.
Areas of contamination above service fabric or BRE Special Digest 1 thresholds	Direct contact	Construction Materials Concrete	Low	Ground not aggressive to concrete.
		Construction Materials Service Fabric	Moderate	Copper piping to be avoided and prudent to lay any service within a clean bedding.

In general terms, future householders, construction workers and construction materials are **potentially most** at risk as pollution linkages may be present for each of these receptors. Users of the site, users of the surrounding sites, controlled waters and vegetation are considered to be at **potentially less** of a risk.

Mitigation measures to reduce the risks identified for each receptor are discussed in the following sections.

9.1 Users of the Site Once Development is Complete

The users of the site, particularly construction workers, are likely to be exposed to contaminants present in the soils beneath the site during redevelopment work. **Potential** exposure pathways include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatised compounds, and inadvertent soil ingestion. Moreover a risk to ground/surface water receptors exists through leaching of contaminants.

To establish if the levels of contaminants present on site may pose a risk to the health of the future users of the site the results of the contamination testing have been compared to a series of LQM/CIEH S4UL based on residential with home grown produce.

The levels of contaminants across the site are generally elevated, with exceedances recorded within all three samples:

- BH1 (0.20-0.40m) recorded elevated lead, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene and total PAH
- BH2 (0.20-0.40m) recorded elevated lead, arsenic, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene and total PAH
- BH5 (0.40-0.60m) recorded elevated lead, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene and total PAH

The new development is expected to comprise new residential properties with associated gardens/access roads. Based on the **shallow** soil contamination testing, it is considered that the levels of contamination may pose a risk to future users of the site, as soft landscaping is proposed in the final development. This pollutant linkage however will be severed as long as all contaminated areas are covered either by buildings, hardstanding, or a clean cover system.

9.2 Construction Workers and Users of Surrounding Sites

Short term human exposure to contaminants present in soils can occur via several pathways during the construction and ground works phase of the development. These include dermal absorption after contact with contaminated ground, inhalation of soil or dust (including windblown dust), inhalation of volatised compounds, inadvertent soil ingestion and contact with contaminated groundwater.

Raised levels of lead, arsenic and PAHs were detected. It is considered that such levels of contamination may pose a risk to construction workers and users of surrounding sites. As good practice, full PPE must be employed in accordance with Health and Safety Executive: *Protection of Workers and the General Public During the Development of Contaminated Land* and safeguards should be taken to limit dust during ground works, and access to the public should be restricted. Construction workers should use gloves as a precaution when handling any fill materials. Provision of suitable hygiene facilities are needed for site workers.

Although asbestos was not detected from the soil samples subjected to testing within this investigation, the possibility still exists that asbestos containing materials may still be present on site and currently lie undetected. It is therefore advised that a 'watching brief' is undertaken during the initial site strip and any excavation works and advice sought if asbestos is found or suspected.

During dry weather, any excavations may require clean water to be sprinkled at shallow depth to prevent excess dust escaping to off-site receptors. Monitoring of dust concentrations during construction should be given careful consideration to ensure occupational exposure levels are not exceeded. Works should be undertaken in line with BRE: *The Control of Dust and Emissions from Construction and Demolition, Best Practice Guidance*.

9.3 Vegetation

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient

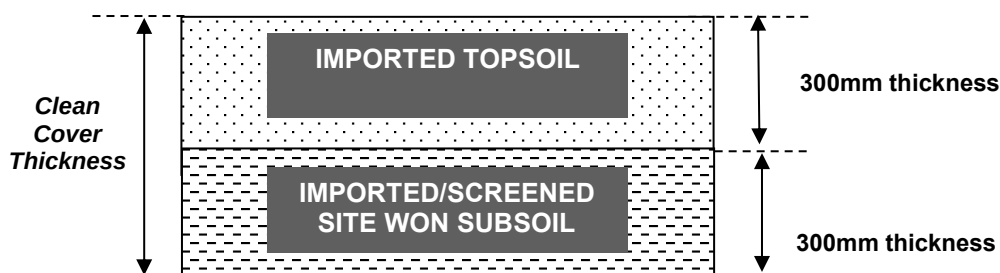
deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants identified as being highly phytotoxic include boron, cadmium, copper, nickel, and zinc.

To establish if the levels of contaminants present on site may pose a risk to vegetation the results of the contamination testing have been compared to a series of threshold values published in “*Code of Good Agricultural Practice for the Protection of Soil*”. Phytotoxic levels of lead were recorded within BH1 and BH2.

During the initial site strip, proposed soft landscaped areas should be excavated to 0.60mbgl or natural ground (whichever is the shallowest). Any deleterious materials encountered (i.e. ash, slag, brick rubble and concrete) should be removed and placed beneath areas of permanent hardcover. Topsoil and subsoil from around the site is deemed unsuitable for re-use given the elevated levels of lead, arsenic and speciated PAH. Further testing and screening may render materials suitable for re-use, depending on results.

The cover system should include imported topsoil, to a depth of 300mm over either natural ground or clean imported subsoil at least 300mm in thickness. Appropriate certification would be required to ensure that the onsite or imported materials are clean and free from deleterious materials in accordance with the Local Authority Guidelines ‘*Verification Requirements for Cover Systems, Technical Guidance for developers, Landowners and Consultants*’ (Yorkshire and Lincolnshire Pollution Advisory Group Version 3.4 – November 2017). Details of the clean cover system must be presented in a Phase 3 Remediation Statement.

The diagram below gives an overview of the minimum thicknesses of clean cover system that should be placed by the site operatives in soft landscaped areas.



9.4 Ground and Surface Water

The principal pathway by which soil contamination may reach the water environment is through a slow seepage or leaching to groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology.

From the site investigation undertaken, ground conditions broadly comprise locally deep (up to 3.90m) made ground over drift deposits initially consisting of locally sandy locally gravelly silty clays, underlain by granular deposits at depth. The cohesive deposits can be considered to have a low permeability, whilst the underlying granular deposits can be considered to have a moderate to high permeability, designated as a Secondary Aquifer – A.

The published geology indicates the site is underlain by solid geology of Pennine Lower Coal Measures, with rockhead between 10.50 and 16.20mbgl. The rockhead generally comprise mudstone, which can be considered to have a low permeability, designated as a Secondary Aquifer – A.

No surface water features are present on the site however an unnamed river is present 57m south and a canal is present ca. 150m northeast of the site.

Contamination (lead, arsenic and PAHs) was encountered across the site, however this was within the shallow made ground which is underlain by a substantial thickness of clay, serving as a containment layer. Furthermore, the mobility of PAHs is likely to be low, due to their low solubility and high preference for sorption to organic carbon.

Given the low permeability deposits underlying the site and the distance to surface waters, the development is considered to represent a low risk to groundwater or surface water receptors.

9.5 Construction Materials

Materials at risk from potential soil contamination include inorganic matrices such as cement and concrete and also organic material; e.g. plastics and rubbers. Acid ground conditions and elevated levels of sulphates can accelerate the corrosion of building materials. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum-based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

9.5.1 Concrete Classification

BRE Special Digest One: “Concrete in Aggressive Ground”: 2005 3rd Edition has been used to assess the risks posed to underground concrete and to establish the design measures required to mitigate the risks. The results of the pH and water-soluble sulphate tests (when converted to total potential sulphate) fall into Class DS-1 ACEC (Class AC-1s) requirements for concrete protection. This assumes static groundwater conditions.

9.5.2 Water Supply Pipes Material Selection

The levels of potential contaminants should be compared to thresholds supplied in the UK Water Industry Research (UKWIR) publication “Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites” (January 2011). A Brownfield Site is defined in the document as “Land or premises that have previously been used or developed that may be vacant or derelict”. It should be noted that Brownfield sites may not be contaminated. The guidance does not apply to Greenfield Sites however water companies may have their own assessment criteria which should be checked by the developer.

Level of acidic to alkaline pH (7.0 to 9.2) were recorded across the site at depths of between 0.20mbgl and 2.00mbgl within the made ground and natural samples.

The concentrations of the selected determinants should be compared to the pipe material selection table in Appendix H, and consultation with the appropriate utility supply company is required to identify the most suitable service fabric. However, the pH levels preclude the use of copper pipes.

9.6 Unexpected Contamination and WAC Testing

If during the initial site strip or subsequent ongoing construction activities, any zones of odorous, brightly coloured or suspected contaminated ground are encountered, then the following procedure should be followed:

- Stop work in the affected area
- Contact Solmek and provide pictures of the affected area
- Solmek can visit site to investigate the material and provide guidance
- If required – Solmek can sample and test the material
- Once test results are returned, this will determine whether or not remediation will be required

During the site strip and construction activities, material may be required to be removed from site. The current legislation on waste involves the categorization of materials into Inert Waste, Stable Non-Reactive Hazardous Wastes and Hazardous Wastes. The determination of the category depends on DEFRA landfill directive Waste Acceptance Criteria (WAC) testing. Material taken off site may be subject to WAC testing by the appropriate waste disposal company. The decision on whether or not to accept waste, or whether further testing is required, is at the discretion of the waste disposal company.

10 GROUND GAS ASSESSMENT

The proposed development includes the construction of residential housing.

Ground gases such as carbon dioxide (CO₂), methane (CH₄), carbon monoxide (CO) and volatile organic compounds (VOCs) can be classed as a form of contamination where there is a potential risk to human health.

For this report, gas monitoring is via measuring emissions from three standpipes (BH2, BH5 & BH6) that were installed during the sitework. The gas monitoring will consist of six visits over a period of three months. The gas monitoring results will be presented as an addendum to this report.

11 GEOTECHNICAL TESTING AND ANALYSIS

Samples taken from the boreholes underwent a series of geotechnical tests (BS 1377:1990) to aid foundation design and soil description. In addition, insitu Standard Penetration Tests (SPTs) were undertaken at regular intervals during drilling. The geotechnical results are presented in Appendix G.

11.1 Strength and Density

Standard Penetration Tests undertaken within the natural cohesive deposits yielded N values of between 4 and 8. Using the Terzaghi and Peck (1967) correction, these N values can be multiplied by five to provide approximate shear strengths, with these results indicating very low to medium strength deposits.

Standard Penetration Tests undertaken within the natural granular deposits yielded N values of 3, indicative of very loose deposits.

11.2 Moisture Contents

Four samples recovered from the boreholes have been subject to moisture content tests to determine the moisture profile at depths of between 1.40 and 2.00mbgl. Moisture levels were between 12% and 63%.

11.3 Atterberg Limit Determinations

Four Atterberg Limit Determination tests were carried out on samples of cohesive material to classify the fine grained soils. The results were compared to the Casagrande Chart published in BS 5930 and showed the samples to generally be clays and silts of low to extremely high plasticity.

The Plasticity Indices ranged from 10 to 46 with equivalent moisture contents recorded above and below the corresponding plastic limits. The cohesive material can be assessed as having a **high** shrinkage potential in relation to NHBC Guidance Chapter 4.2.

11.4 Particle Size Distribution and Sedimentation Testing

Two samples from the boreholes (BH2 1.40-1.60mbgl and BH5 1.40-1.60mbgl) were subject to Particle Size Distribution (PSD) tests in accordance with BS1377 Part 2 to aid soil descriptions. The results have been used to prepare precise soil descriptions in accordance with BS5930:2015 Section 6 and are presented in Appendix G.

11.5 pH and Sulphate Results

Three natural samples from the boreholes were tested for acidity and soluble sulphate content to assess whether the material may be potentially aggressive to building fabric. The results of the testing for pH ranged from 7.0 to 8.4 indicating slightly alkaline conditions. Soluble sulphates were recorded at levels ranging from 10mg/l to 89mg/l.

11.6 Mining Assessment

The ten times seam thickness rule states that where competent rock exceeds ten times the extracted seam thickness then no major crown holing should occur at the surface (Structural Foundations Manual; M. F. Atkinson, *Spon Press* 2003). If the competent rock cover is less than ten times the extracted seam thickness, then recommendations suggest the workings must be grouted using a mixture of pulverised fuel ash (PFA) and cement placed into the area under pressure. For a transition zone of 6-10 times the seam thickness, it may be acceptable to consider the use of raft foundations subject to approval from the regulatory authorities. However, the use of 6 to 10 times the seam thickness is not appropriate for steeply dipping seams and where strong flowing water is encountered.

Within the three rotary boreholes, no voids or broken rock were encountered and flush returns remained at

100% throughout drilling. The coal seams encountered were intact (20.60-21.40m within RBH2 and 21.10-22.40m within RBH3).

It is prudent to consider the conservative possibility that the intact coal encountered represents pillars, with potential for workings of similar thickness present elsewhere. Therefore, ratios have been provided for each of these seams, as well as the related foundation solution required by such a ratio.

TABLE 5: SUMMARY OF ENCOUNTERED COAL SEAMS

Borehole Reference	Depth (mbgl)	Remarks	Flush Returns (%)	Overlying Solid Geology Thickness	Seam Thickness (m)	Ratio	Foundation Type
RBH2	20.60-21.40	Coal - Intact	100%	10.10	0.80	12.63	No mitigation required
RBH3	21.10-22.40	Coal - Intact	100%	10.60	1.30	8.15	No mitigation required

The ratios above indicate that the ratio within RBH3 only is potentially adverse, however the above calculation was conservative based on the assumption that the intact coal represents pillars.

Depending on the foundation solution utilised, it would be prudent to consider reinforcement of all foundations, and the client should consider undertaking further proof drilling works to ca. 25.00mbgl.

11.7 Foundations

Detailed design loads have not been made available to Solmek, however given the deep made ground present locally, and the low strength natural deposits encountered across the site, conventional footings are not considered to be suitable for this development. Consideration should therefore be given to mini-piles or ground improvement.

11.7.1 Raft Foundations

Given the ground conditions encountered, conventional foundations may be unsuitable, therefore a raft could be considered. Detailed design loads and raft sizes have not been made available to Solmek. To accommodate raft foundations, it would be recommended to over-excavate into the made ground and replace the excavated made ground with 150mm layers of granular fill, compacted in accordance with Specification for Highway Works.

11.7.2 Ground Improvement

For the proposed houses, the strengths/densities of the alluvial deposits means settlement of shallow foundations is likely to be unacceptably high. As a possible option, ground improvement techniques such as vibro-replacement (i.e. stone columns) could be considered. This has the potential to firm up the shallow loose or soft deposits and hence reduce potential settlement. This would potentially allow the use of shallow foundations, such as strip footings, for the housing. However, it is recommended to seek consultation from a specialist ground improvement contractor who can advise on the suitability of possible techniques, and the further information on ground conditions that may be required.

11.7.3 Mini-Piles

Depending on the detailed proposals, the encountered ground conditions means consideration should be given to piled or mini-piled foundations. Information provided in this report should be made available to a competent piling contractor who can design appropriate foundations in accordance with Section 7: Pile foundations of BS EN 1997 – 1:2004 which applies to end-bearing piles, friction piles, tension piles and transversely loaded piles installed by driving, by jacking, and by screwing or boring. The piling contractor will need to take into consideration the possible effects of negative skin friction from made ground and soft/loose alluvial deposits. Allowance should be made for breaking through known and unknown buried obstructions.

The precise method of pile installation and the applicability of proprietary systems, diameters and depths required would need to be determined by a specialist piling contractor.

Solmek advise that deeper boreholes will be required in order to fully design piled foundations as well as ground improvement techniques.

11.7.4 General Foundation Comments

Prior to placing foundation concrete, obvious soft or loose spots should be removed and replaced with suitably recompacted hardcore or lean mix concrete. In addition, all excavations should be inspected to ensure that they fully penetrate areas of disturbed ground.

Further advice should be sought from Solmek if unexpected ground conditions are encountered during redevelopment.

11.8 Excavation

Based on the nature of the ground conditions encountered, excavations should be within the capacity of normal earthworks plant although breaking out of relic foundations (BH1) and other obstructions should be anticipated. Stability of excavations will be poor in the made ground but should improve in the natural clay. Excavation sides should be designed, constructed and supported in accordance with the recommendations given in CIRIA Report No. 97: "Trenching Practice".

11.9 Groundwater

Groundwater was recorded within BH2 to BH6 between 2.00 and 3.40mbgl. No groundwater was recorded within the three rotary boreholes however the drilling flush is likely to have masked groundwater seepages.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities. Therefore, water levels significantly higher than those found during this investigation may be encountered.

SOLMEK

APPENDIX A:
Drawings and Photographs



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Title
Site Location Plan
Project
Lees Hall Road, Dewsbury
Client
Design Studio North
Date
December 2020
Fig No.
Figure 1
Scale
On map
Key
Approx. Site Boundary
N
Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com 



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Title	Exploratory Hole Location Plan
Project	Lees Hall Road, Dewsbury
Client	Design Studio North
Date	December 2020
Fig No.	Figure 2
Scale	On map
Key	Approx. Site Boundary Approx. BH Location Approx. RBH Location
N Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com SOLMEK	



Title	Drift Geology Map
Project	Lees Hall Road, Dewsbury
Client	Design Studio North
Date	December 2020
Fig No.	Figure 3
Scale	Scale on map
Key	Site Boundary River Terrace Deposits – Sand and Gravel Alluvium – Clay, Silt, Sand and Gravel N
Solmek Ltd. 12 Yarm Road Stockton-on-Tees TS18 3NA Tel: +44 (0) 1642 607083 Fax: +44 (0) 1642 612355 e-mail: south@solmek.com www.solmek.com	

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APPENDIX B: Historical Maps

Historical Mapping Legends

Ordnance Survey County Series 1:10,560

	Gravel Pit		Sand Pit		Other Pits
	Quarry		Shingle		Orchard
	Osiers		Reeds		Marsh
	Mixed Wood		Deciduous		Brushwood
	Fir		Furze		Rough Pasture
	Arrow denotes flow of water		Trigonometrical Station		
	Site of Antiquities		Bench Mark		
	Pump, Guide Post, Signal Post		Well, Spring, Boundary Post		
	Surface Level				
	Sketched Contour		Instrumental Contour		
	Main Roads		Minor Roads		
	Sunken Road		Raised Road		
	Road over Railway		Railway over River		
	Railway over Road		Level Crossing		
	Road over River or Canal		Road over Stream		
	Road over Stream				
	County Boundary (Geographical)				
	County & Civil Parish Boundary				
	Administrative County & Civil Parish Boundary				
	County Borough Boundary (England)				
	County Burgh Boundary (Scotland)				
	Rural District Boundary				
	Civil Parish Boundary				

Ordnance Survey Plan 1:10,000

	Chalk Pit, Clay Pit or Quarry		Gravel Pit
	Sand Pit		Disused Pit or Quarry
	Refuse or Slag Heap		Lake, Loch or Pond
	Dunes		Boulders
	Coniferous Trees		Non-Coniferous Trees
	Orchard		Scrub
	Bracken		Heath
	Marsh		Reeds
	Building		Glasshouse
	Sloping Masonry		Pylon
	Cutting		Embankment
	Road Under		Road Over
	Level Crossing		Foot Bridge
	Standard Gauge Multiple Track		Standard Gauge Single Track
	Siding, Tramway or Mineral Line		Narrow Gauge
	Geographical County		Administrative County, County Borough or County of City
	Municipal Borough, Urban or Rural District, Burgh or District Council		Borough, Burgh or County Constituency
	Civil Parish		
	Boundary Post or Stone		Police Station
	Church		Post Office
	Club House		Public Convenience
	Fire Engine Station		Public House
	Foot Bridge		Signal Box
	Fountain		Spring
	Guide Post		Telephone Call Box
	Mile Post		Telephone Call Post
	Mile Stone		Well

1:10,000 Raster Mapping

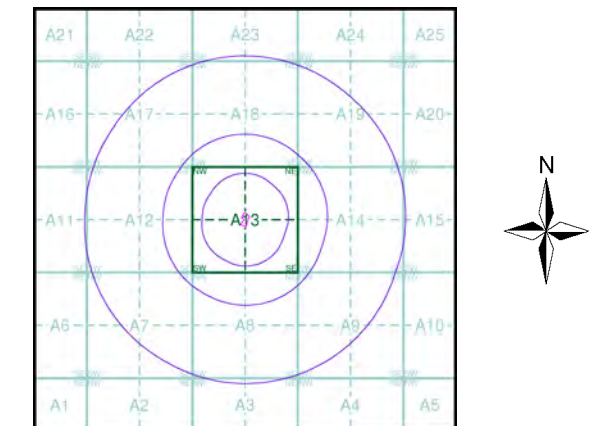
	Gravel Pit		Refuse tip or slag heap
	Rock		Rock (scattered)
	Boulders		Boulders (scattered)
	Shingle		Mud
	Sand		Sand Pit
	Slopes		Top of cliff
	General detail		Underground detail
	Overhead detail		Narrow gauge railway
	Multi-track railway		Single track railway
	County boundary (England only)		Civil, parish or community boundary
	District, Unitary, Metropolitan, London Borough boundary		Constituency boundary
	Area of wooded vegetation		Non-coniferous trees
	Non-coniferous trees (scattered)		Coniferous trees
	Coniferous trees (scattered)		Positioned tree
	Orchard		Coppice or Osiers
	Rough Grassland		Heath
	Scrub		Marsh, Salt Marsh or Reeds
	Water feature		Flow arrows
	Mean high water (springs)		Mean low water (springs)
	Telephone line (where shown)		Electricity transmission line (with poles)
	Bench mark (where shown)		Triangulation station
	Point feature (e.g. Guide Post or Mile Stone)		Pylon, flare stack or lighting tower
	Site of (antiquity)		Glasshouse
	General Building		Important Building



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Yorkshire	1:10,560	1855	2
Yorkshire	1:10,560	1894	3
Yorkshire	1:10,560	1908	4
Yorkshire	1:10,560	1930 - 1931	5
Yorkshire	1:10,560	1938	6
Yorkshire	1:10,560	1948	7
Ordnance Survey Plan	1:10,000	1955 - 1957	8
Ordnance Survey Plan	1:10,000	1966 - 1967	9
Ordnance Survey Plan	1:10,000	1972 - 1974	10
Ordnance Survey Plan	1:10,000	1982 - 1984	11
Ordnance Survey Plan	1:10,000	1989	12
Ordnance Survey Plan	1:10,000	1992 - 1993	13
10K Raster Mapping	1:10,000	2000	14
Street View	Variable		15

Historical Map - Slice A



Order Details

Order Number: 270445640_1_1
Customer Ref: S190445
National Grid Reference: 423660, 419660
Slice: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

Site at, Dewsbury, Kirklees



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



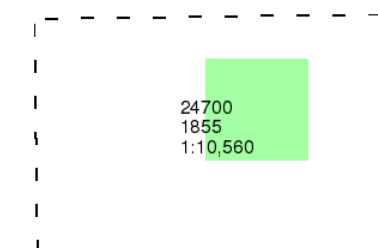
Yorkshire

Published 1855

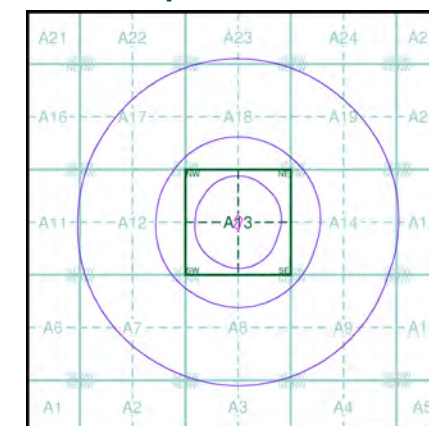
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: 270445640_1_1
Customer Ref: S190445
National Grid Reference: 423660, 419660
Slice: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

Site at, Dewsbury, Kirklees

Landmark
INFORMATION GROUP

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Yorkshire

Published 1894

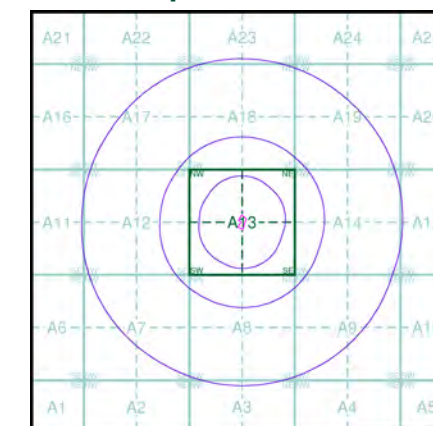
Source map scale - 1:10,560

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Map Name(s) and Date(s)

247NW 1894 1:10,560	247NE 1894 1:10,560
247SW 1894 1:10,560	247SE 1894 1:10,560

Historical Map - Slice A



Order Details

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Yorkshire

Published 1908

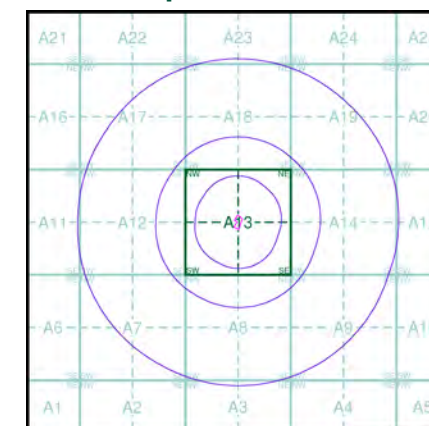
Source map scale - 1:10,560

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Map Name(s) and Date(s)

247NW 1908 1:10,560	247NE 1908 1:10,560
247SW 1908 1:10,560	247SE 1908 1:10,560

Historical Map - Slice A



Order Details

Order Number: 270445640_1_1
Customer Ref: S190445
National Grid Reference: 423660, 419660
Slice: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

Site at, Dewsbury, Kirklees



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Yorkshire

Published 1930 - 1931

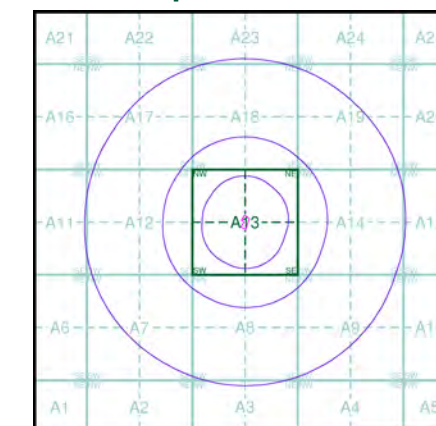
Source map scale - 1:10,560

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Map Name(s) and Date(s)

247NW 1931 1:10,560	247NE 1931 1:10,560
247SW 1930 1:10,560	247SE 1931 1:10,560

Historical Map - Slice A



Order Details

Order Number: 270445640_1_1
Customer Ref: S190445
National Grid Reference: 423660, 419660
Slice: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

Site at, Dewsbury, Kirklees

Landmark
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Yorkshire

Published 1938

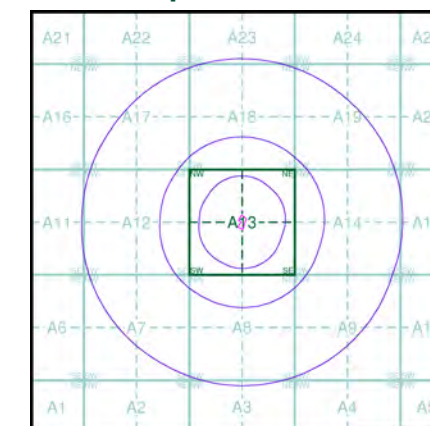
Source map scale - 1:10,560

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Map Name(s) and Date(s)

247NW 1938 1:10,560	247NE 1938 1:10,560
247SW 1938 1:10,560	247SE 1938 1:10,560

Historical Map - Slice A



Order Details

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Yorkshire

Published 1948

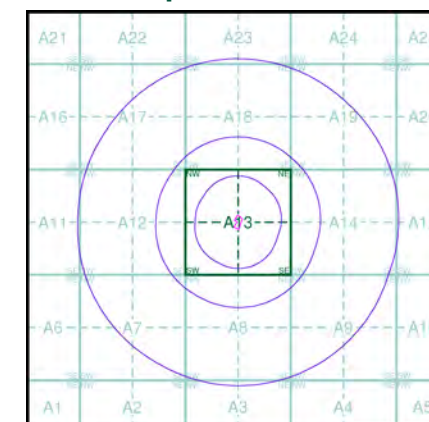
Source map scale - 1:10,560

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Map Name(s) and Date(s)

247NW 1948 1:10,560	247NE 1948 1:10,560
247SW 1948 1:10,560	247SE 1948 1:10,560

Historical Map - Slice A



Order Details

Order Number: 270445640_1_1
Customer Ref: S190445
National Grid Reference: 423660, 419660
Slice: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

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Ordnance Survey Plan

Published 1955 - 1957

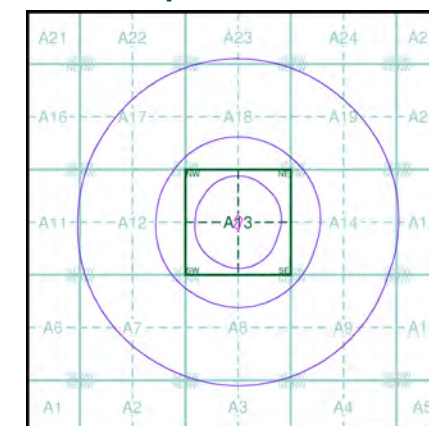
Source map scale - 1:10,000

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Map Name(s) and Date(s)

SE22SW	SE22SE
1955	1957
1:10,560	1:10,560
SE21NW	SE21NE
1955	1956
1:10,560	1:10,560

Historical Map - Slice A



Order Details

Order Number: 270445640_1_1
Customer Ref: S190445
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Slice: A
Site Area (Ha): 0.27
Search Buffer (m): 1000

Site Details

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Ordnance Survey Plan

Published 1966 - 1967

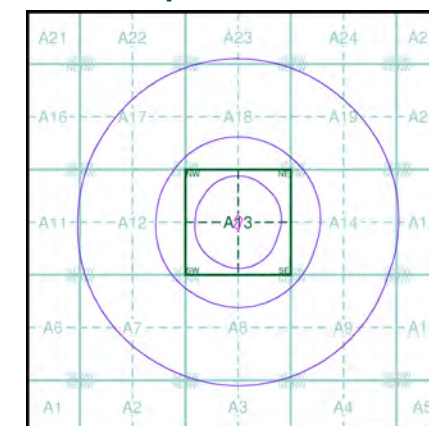
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Map Name(s) and Date(s)

SE22SW	1967	1:10,560
SE21NW	1966	1:10,560
SE21NE	1966	1:10,560

Historical Map - Slice A



Order Details

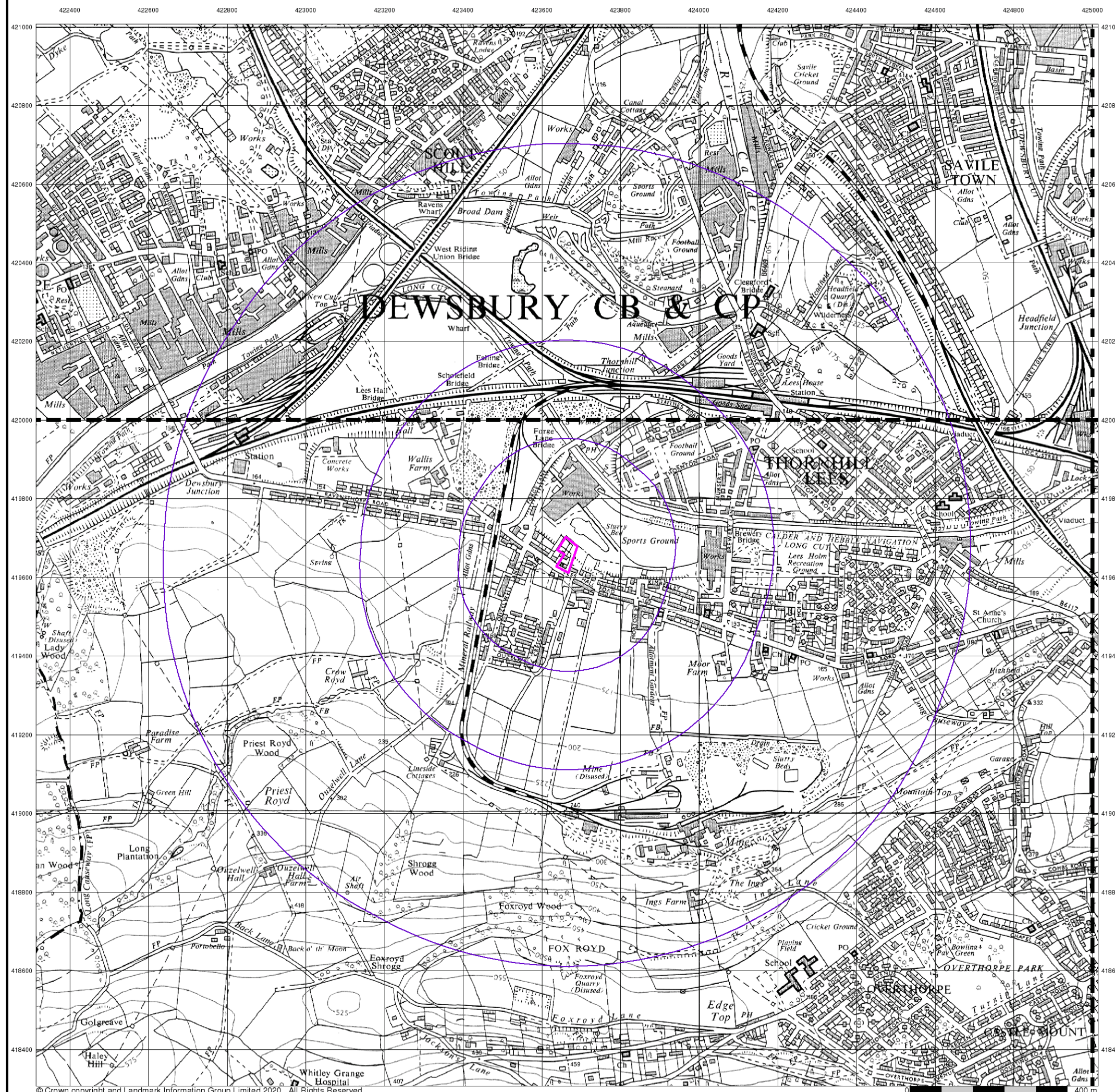
Order Number: 270445640_1_1
Customer Ref: S190445
National Grid Reference: 423660, 419660
Slice: A
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Ordnance Survey Plan

Published 1966 - 1967

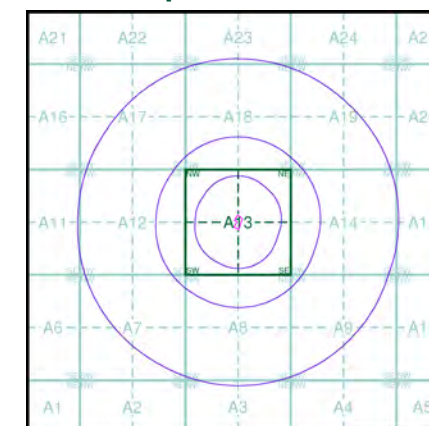
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Map Name(s) and Date(s)

SE22SW	1967	1:10,560
SE21NW	1966	1:10,560
SE21NE	1966	1:10,560

Historical Map - Slice A



Order Details

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