

HIGHAM LANE, DODWORTH (REDROW HOMES YORKSHIRE LIMITED)

SUMMARY OF GEOENVIRONMENTAL ISSUES

The site is located off Higham Lane in Dodworth, approximately 3.5km southwest of Barnsley Town Centre (NGR SE 315 057) and comprises a single parcel of land of approximately 1.2 hectares (2.9 acres). The majority of the site (Area A) comprises grassed paddocks. The northeastern region of site (Area B) is occupied by a single storey dwelling with associated gardens. An operational rail-line runs on an embankment along the northern site boundary. The historical records indicate that the site has remained undeveloped (with exception of a dwelling), since the early 1960's.

Encia were commissioned by Redrow Homes (Yorkshire) Limited to provide a geoenvironmental appraisal of the site. It is understood that the site is to be redeveloped with two storey houses; a proposed layout is not currently available. Encia's investigation included a ground investigation comprising 11 trial pits.

A summary of salient geoenvironmental issues is provided in the table below.

Issue	Remarks
Made Ground Natural Ground	No made ground was encountered at the site. Topsoil encountered in each trial pit to between 0.2 and 0.4m bgl (average 0.3m bgl). Typically firm becoming stiff gravelly clay (Weathered Coal Measures) to depths of between 2.3m and 2.6m bgl and underlain by weak mudstone (Coal Measures).
Contamination	Arsenic contamination within the topsoil requires 300mm soil cover; this though could be reduced following bioavailability testing.
Hazardous Gas Mining & Quarrying	Basic radon protection measures are required at this site. No mining/quarrying issues.
Preparatory Works	Demolition of dwelling, grubbing up of foundations, general site clearance and stripping of topsoil across site.
Foundations	Shallow strip footings should be suitable for new dwellings at this site. Foundations will require deepening where influenced by trees in accordance with NHBC Standards, Chapter 4.2.
Groundwater & Excavations	No groundwater was encountered in any of the trial pits during the investigation Excavations at the site should remain stable in short term
Flooding & Drainage	Site falls outside of extent of extreme flood. However the site area is in excess of 1 hectare, therefore a PPG25 Flood Risk Assessment may be required. A drain exists at the site. The prior consent of the EA is required for any proposal to divert, culvert or otherwise obstruct the flow of water in any watercourse. Visual inspection of underlying soils indicates that soakaways would not be a suitable drainage solution for new dwellings constructed at the site.
Highways	For access roads and pavement areas constructed over natural ground a CBR value of 5% is considered appropriate.

Significant developer abnormalities relating to geoenvironmental issues at the site are:

- Demolition of existing buildings (dwelling & out buildings) & grubbing up of foundations.
- Foundations will require deepening near trees (tree survey required).

The following further work is required:

- Bioavailability testing on topsoil samples to further assess the risk from arsenic and confirm the requirement for cover.
- Post vacation site investigation in Area A (within footprint of existing dwelling)
- Flood Risk Assessment.
- Tree Survey.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

GEOENVIRONMENTAL APPRAISAL

of land at

HIGHAM LANE, DODWORTH

Prepared for

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APPENDICES

Appendix A - General Notes

01	Environmental Setting
02	Ground Investigation Fieldwork
03	Geotechnical Testing
04	Contamination Laboratory Analysis & Interpretation (including WAC)

Appendix B - Drawings

Drawing No.	Title
9374/1	Site Location Plan
9374/2	Site Features
9374/3	Preliminary Conceptual Site Model
9374/4	Trial Pit Location Plan
9374/5	Revised Conceptual Site Model

Appendix C - Search Responses & Other Correspondence

From	To	Date	Content
Coal Authority	Encia	16 th February 2007	Mining Report
BGS	Encia	16 th February 2007	Radon Report
Environment Agency	Encia	9 th March 2007	Environment Search
Barnsley MBC	Encia	19 th March 2007	Environment Search

Appendix D - Commission

Appendix E - Historical OS Plans

Appendix F - Trial Pit Logs

Appendix G - Geotechnical Test Results

Appendix H - Chemical Test Results

FOREWORD (Geoenvironmental Investigation Report)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Encia Consulting Limited (Encia); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

The report presents observations and factual data obtained during our site investigation, and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Encia prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Encia cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in this report (including review of any third party reports) are based on information obtained from a variety of sources as detailed within this report, and which Encia believes are reliable. All reasonable care and skill has been applied in examining the information obtained. Nevertheless, Encia cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geo-environmental consultants. Encia does not provide legal advice and the advice of lawyers may also be required.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Encia, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy.

It should be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

This report assumes that ground levels will not change significantly from those existing at present and that houses will be of two storey construction. If this is not to be the case, then some modification to this report may be required.

Encia Consulting Limited cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remedial options.

Encia reserve the right to amend their conclusions and recommendations in the light of further information that may become available.

GEOENVIRONMENTAL APPRAISAL

of land at

HIGHAM LANE, DODWORTH

1 INTRODUCTION

1.1 The Commission and Brief

1.1.1 Encia Consulting Limited (Encia), were commissioned by Redrow Homes (Yorkshire) Limited to carry out a geoenvironmental appraisal of land at Higham Lane, Dodworth.

1.1.2 Correspondence regarding Encia's appointment, including the brief for this investigation, is included in Appendix D. The agreed scope of works included:

- a site walkover and inspection
- an assessment of the land use history
- determination of the site's environmental setting
- an intrusive ground investigation comprising eleven trial pits
- assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
- a qualitative assessment of contamination risks, with respect to potential receptors
- the provision of recommendations with respect to site preparatory and remedial works

1.2 The Proposed Development

1.2.1 It is understood that consideration is being given to redevelopment of the site with two storey domestic dwellings, associated gardens, POS and adoptable roads and sewers. No site layout has been provided to Encia at this stage.

1.3 Report Format and Limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on:

- Assessment of the site's environmental setting.
- Ground investigation fieldwork (including techniques, in-situ testing and sampling).
- Geotechnical Testing.
- Contamination Testing (including current guidance, notes about organics analyses, and WAC).

1.3.2 General notes and limitations relevant to all Encia geoenvironmental investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

1.3.3 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to enable Redrow Homes to obtain budget costs for the necessary site preparatory and remedial works.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site location is shown on Drawing Number 9374/1 presented in Appendix B to this report. Site details are summarised in the Table below.

Detail	Remarks
Location	3.5km southwest of Barnsley Town Centre
NGR	NGR SE 315 057
Area	1.2ha (2.9 acres)

2.2 Site Features

2.2.1 An Encia Engineer completed a walkover survey of the site in February 2007. A photographic record of salient site features at the time of the walkover survey is included on Drawing Number 9374/2 presented in Appendix B to this report.

2.2.2 The site comprises an irregular shaped single parcel of land which can be divided into two areas.

2.2.3 **Area A:** comprises a single storey dwelling with associated garden areas fronting onto Higham Lane. The property was occupied and there was no access to this region of site during the investigation.

2.2.4 **Area B:** comprises grassed paddocks currently used for equestrian grazing. Two single storey, block built, stable buildings exist in the east of Area A.

2.2.5 A drain exists along the northern boundary of the site, which also crosses through the central region of Area A in a northwest-southeast direction. There was no observable flow in the drain, however standing water was observed in the drain at the time of the investigation.

2.2.6 Semi-mature trees/hedgerows exist along the southern and northern boundaries of Area A.

2.2.7 Hedgerows and several mature/semi mature trees exist within the garden areas of Area B.

2.2.8 Existing salient features are summarised in the Table below and shown on Drawing Number 9374/2 presented in Appendix B to this report.

Feature	Remarks
Current Access	Off Higham Lane
Topography	Site slopes down from 136.5m AOD at the western boundary (Area A) to 129.9m AOD in central region of Area B (eastern region of site). The site rises from 129.9m (central region of Area B) to 134 m AOD (Higham Lane).
Nature of boundaries	North - 2m high metal mesh security fence & tree lined railway embankment beyond. East - Hedgerow & timber fence (Higham Lane). South - Timber fences and hedgerows. West - Timber fence.
Surrounding land uses	North - Railway line with Dodworth Bypass beyond. East - Higham Lane with housing beyond. South - Gardens with housing beyond (Hawthorne Crescent). West - Gardens with railway embankment beyond.

2.3 Japanese Knotweed

2.3.1 During the site walkover, we did not notice the presence of any Japanese Knotweed. However, it should be noted that we are not qualified ecologists and as such cannot guarantee the absence of Knotweed or other invasive vegetation.

3 SITE HISTORY

3.1.1 In order to investigate the development history and previous land uses at the site and immediate surrounding land, site centred extracts from Ordnance Survey (OS) plans dating back to 1855 were examined. These plans are presented in Appendix E to this report.

3.1.2 The Table below provides a summary of the salient points relating to the history of the site with respect to the proposed end use. It is not the intention of this report to describe in detail all the changes that have occurred on or adjacent to the site. Significant former uses/operations are highlighted in bold text for ease of reference.

Date(s)	Site	Surrounding Land
1855	Undeveloped fields	Undeveloped fields. Sheffield & Lincolnshire Railway line c.5m north of site boundary. Cliff Lane (sandstone) Quarry c. 200m south
1891-1894	No significant changes	Cliff Lane Quarry no longer shown Church Lane Colliery (with associated shafts, coke ovens and spoil tips) c.100m northwest. Reservoir c.60m north beyond railway embankment.
1906	No significant changes	Colliery now shown as 'Old Silkstone Collieries'
1931 - 1938	No significant changes	Aerial Cable shown running from colliery to spoil tip. Spoil tip has extended to northwest. Residential development c.20m south (Hawthorne crescent). Railway labelled as 'Penistone & Barnsley'
1956 - 1962	Site shown as allotment gardens. Several small buildings (sheds) occupy the northeastern region of site. Drain shown along northern site boundary, crossing through central region of Area B.	Significant expansion of spoil tip to northwest. Aerial Cable extends c.600m northwest from colliery.
1965 - 1971	The buildings (sheds) are no longer shown at the site. The drain is labelled as 'sinks'.	Colliery spoil tip labelled as 'Slag Heap'
1973 - 1979	Track shown along southern site boundary leading to Higham Lane.	'Slag Heap' to north is shown to have been planted with trees.
1982 - 1983	No significant changes	No significant changes
1990-1993	Building (dwelling) shown in northeastern corner of site.	Colliery/Mine and associated buildings no longer exist. Now shown as 'Fall Bank Industrial Estate'. Area of trees shown to north (former 'Slag Heap').
2000	No significant changes	'Dodworth Business Park' shown c.80m northwest
2004	No significant changes	No significant changes

4 ENVIRONMENTAL SETTING

4.1 General

4.1.1 Notes describing how the site's environmental setting has been assessed are included in Appendix A to this report. The responses received from the Coal Authority, Barnsley MBC, the BGS and the Environment Agency are presented in Appendix C.

Issue	Data reviewed	Summary
Geology	1:50,000 BGS map (Sheet 87 Barnsley) 1:10,000 BGS map (Sheet SE 30 NW)	No drift deposits are shown at the site. Solid - Coal Measures strata (mudstone, siltstone and sandstone). Coal seams: Lidget Coal underlies extreme northeastern corner of site (Area A) only. No evidence of workings. Joan Coal (0.6m thick) underlies Lidget Coal by approx 32m (sufficient solid cover). Deeper seams have sufficient solid cover.
Mining	Coal Authority Report BGS maps	Past and present workings - 6 seams of coal at 60m to 260m depth last worked in 1966. No present workings Mine entries - None. Opencast - None.
Quarrying	Local Authority Search Historical OS Plans	Historical plans indicate that Cliff Lane Sandstone Quarry existed c.200m south of the site between 1855 and 1891.
Radon	BRE Report BR211 BGS Stage 2 Report	Basic measures required.
Hydrogeology	Environment Agency Groundwater Vulnerability map (Sheet 11 South Pennines)	Site is not located within a groundwater source protection zone (GSPZ). No licensed groundwater abstractions within 500m of the site. Underlying Coal Measures strata classified as a minor aquifer. No licensed groundwater discharge consents within 250m of the site.
Hydrology	Environment Agency Landmark Report	A drain exists along the northern boundary of the site, which also crosses through the central region of Area A in a northwest-southeast direction. There have been four pollution incidents to controlled waters (2 significant and 2 minor) within 250m of the site, involving the discharge of oils and paints and dyes into an unnamed watercourse. The closest (minor) is located c.139m southeast of the site boundary. There are no licensed surface water abstractions within 500m of the site. There has been one discharge consent to controlled waters within 250m of the site, operated by British Coal Corporation c.31m southwest of the site involving trade effluent discharging into an unnamed watercourse. The authorisation has since been revoked.
Flood Risk	Environment Agency	Site falls outside of extent of extreme flood. However the site area is in excess of 1 hectare, therefore in accordance with PPG25 a Flood Risk Assessment will be required. A drainage ditch exists at the site. The prior consent of the EA is required for any proposal to divert, culvert or otherwise obstruct the flow of water in any watercourse.

4.2 Landfills

- 4.2.1 The Environment agency and Barnsley Metropolitan Borough Council indicate that no landfills are present within 250m of the site.
- 4.2.2 Known or suspected areas of landfill in the vicinity of the proposed development site are summarised below:

Landfill Sites

Location	NGR (proximity to site)	Remarks	Source of data
Cliff Lane Quarry	SE 314 055 (200m south)	Old sandstone quarry shown on 1855 & 1891 historical plans	Landmark
Jermyn Croft Refuse tip	SE 316 055 (220m south east)	No details	Landmark

- 4.2.3 Cliff Lane Quarry could have been backfilled with material which may produce landfill gas. However the quarry backfill dates back to 1894, over one hundred years and if backfilled with waste this will have comprised mainly ashy material, any putrescible waste will have certainly decomposed. It is considered very unlikely to present a gas risk to the site.
- 4.2.4 Jermyn Croft refuse tip is shown by Landmark to be located approximately 220m south east of the site. Historical plans show a landfill located 280m south east of the site. It is likely that the position of the landfill is recorded incorrectly by Landmark.

5 GROUND INVESTIGATION DESIGN

5.1 Anticipated Ground Conditions & Potential Issues

- 5.1.1 Based on the data reviewed in Sections 4 (Environmental Setting) anticipated ground conditions are expected to comprise:-

	Anticipated Condition
Made Ground	No made ground anticipated
Natural Soils	Thin veneer of topsoil across majority of site underlain by Firm/stiff Gravelly Clay and/or medium dense/dense clayey gravel (Weathered Coal Measures)
Bedrock	Mudstone/Sandstone (Coal Measures) at depths of between 1 and 3m bgl.
Mine workings	Not anticipated
Groundwater	No shallow groundwater anticipated

- 5.1.2 Historical OS Plans dating back to 1855 show the site to have always comprised undeveloped fields/allotment gardens. These areas of the site have not been subject to industrial use, and no made ground is anticipated to be encountered during the investigation.
- 5.1.3 Based on the data above and that in Sections 2 (Site Description) and 3 (History), no significant potential ground-related issues have been identified with this site.
- 5.2 Preliminary Conceptual Site Model
- 5.2.1 A preliminary conceptual site model, presented as Drawing No 9374/3 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 6.1 inclusive, of this report.
- 5.2.2 No potential pollutant linkages are considered to exist at this site as shown on the preliminary conceptual site model.

5.3 Investigation Strategy

- 5.3.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

Initial Ground Investigation Strategy

Exploratory holes	Purpose
TPs 1 to 11	To determine the general nature of soils underlying the site, including: • Prove absence of made ground across site • Prove absence of contamination • Determine suitability of the ground for founding structures and highways • undertake a visual inspection of underlying soils to determine suitability for soakaways as a suitable drainage solution for new dwellings.

- 5.3.2 Proposed exploratory hole locations have been selected to provide a representative view of the strata beneath the site and to target potential areas of interest identified in Section 6.1 above. A nominal 25m grid spacing is proposed. Additional exploratory locations will probably be scheduled by the site engineer in light of the ground conditions actually encountered.
- 5.3.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about 3 samples will be taken from most trial pits.

6 FIELDWORK

6.1 Objectives

- 6.1.1 The original investigation strategy is outlined in Section 5.2 above.

6.2 Exploratory Hole Location Constraints

- 6.2.1 No access was available to Area B (occupied dwelling and garden areas).

6.3 Scope of Works

- 6.3.1 Fieldwork was supervised by Encia on 9th March 2007 and comprised the exploratory holes listed below. Exploratory hole locations are shown on Drawing 9374/4 in Appendix B to this report.

Scope of Ground Investigation Works

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 1 to 11.	Between 2.6 m and 2.9m bgl.	Vane tests in cohesive soils.

- 6.3.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix A to this report.
- 6.3.3 Exploratory hole logs are presented in Appendix F to this Report. These logs include details of the:
- Samples taken
 - Descriptions of the solid strata, and any groundwater encountered.
 - Results of the in-situ testing

7 GROUND CONDITIONS

7.1 General

7.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendix F. However, a summary of the ground conditions is provided below.

7.2 Made Ground

7.2.1 Made ground was not encountered in any of the trial pits excavated at the site.

7.3 Natural Ground

7.3.1 Natural ground was encountered in each of the exploratory holes, and typically comprised topsoil (typically 300m thick) over firm becoming stiff gravelly clay (Weathered Coal Measures) to between 2.3m and 2.6 m bgl over weak mudstone (Coal Measures).

7.4 Visual & Olfactory Evidence of Organic Contamination

7.4.1 No visual or olfactory evidence of any organic contamination was encountered at the site.

7.4.2 The site has not been subjected to any industrial use or any potentially contaminating activity.

7.5 Groundwater

7.5.1 No significant inflows of groundwater were encountered during the investigation.

7.6 Stability

7.6.1 Stability of excavations was generally good.

7.7 Revised Conceptual Ground Model (Ground Conditions)

7.7.1 The Preliminary Conceptual Site Model has been revised in light of data obtained during the ground investigation, most notably with respect to:

- the strength, nature and depth of underlying natural strata

7.7.2 The revised Conceptual Site Model is presented in Appendix B, as Drawing 9374/5.

7.7.3 Further refinement of the Conceptual Site Model is presented in Sections 10.1, where the results of laboratory testing for contaminants have been considered.

8 CONTAMINATION (ANALYSIS)

8.1 General

8.1.1 Notes outlining current guidance with respect to the interpretation of analytical data are included in Appendix A to this report.

8.1.2 The historical plans indicate that site has always existed as undeveloped fields/allotment gardens and have not been subject to industrial use.

8.1.3 Made ground was not encountered in any of the exploratory holes excavated at the site.

8.1.4 No visual or olfactory evidence of contamination was encountered in any of the exploratory holes at the site.

8.2 Testing Scheduled

8.2.1 Based on the above assessment, an Encla Engineer submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory.

Type of Sample	No. of Samples	Determinands
Topsoli	11	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc)

8.3 Soil Contamination Results

8.3.1 The soil contamination test results are summarised in the table on page 9.

8.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix H to this report.

Inorganic Determinands

8.3.3 Of the 11 samples of natural and made ground analysed for inorganic parameters, 3 of the samples can be classified as uncontaminated and 11 could be classified as contaminated.

8.3.4 These samples are classified by comparison of parameters concentrations with the relevant current UK guidance threshold value for an end use including domestic gardens and any area where plants are to be grown (the most sensitive of the proposed end-uses).

8.3.5 The only contaminant is arsenic.

8.3.6 Statistical analysis of arsenic results has been carried out in general accordance with the methods outlined in CLR7 (see comments in Appendix A, Contamination Testing) and the results are summarised below, the statistical spreadsheet is included in Appendix H. The arsenic did not fail the outlier test.

Results of Statistical Analysis of Soil Contamination Data

Stratum	US ₉₅ Values for Contaminants that have yielded one or more Tier 1 exceedances for a given fill type	
	Arsenic (20)	
TOPSOIL	38	

Notes: Values are bolded where the US₉₅ value exceeds the relevant Tier 1 value.

8.3.7 This statistical analysis indicates that the upper 95th percentile bound values (US₉₅) for arsenic in made ground is slightly elevated in comparison with the relevant current UK guidance threshold value for residential with gardens end use.

9 CONTAMINATION (QUALITATIVE RISK ASSESSMENT & REMEDIATION)

9.1 Assessment of Contamination Test Results

9.1.1 Notes outlining current guidance with respect to the interpretation of analytical data are included in Appendix A to this report.

9.1.2 Topsoil, typically 300mm thick is present across the site. Testing suggests this material has elevated concentrations of arsenic and may not be suitable for re-use.

9.1.3 Additional bioavailability testing should be undertaken to assess the actual risk from the arsenic within the topsoil, the results of which could prove that arsenic actually poses no risk and the soil could be used within garden and landscaped areas without the need for any cover.

9.1.4 In the unlikely event that the bioavailability testing proves that the topsoil is unsuitable given the compressible nature and gas-generating potential of this material if buried at depth, it is recommended that it is placed in garden areas and/or POS, immediately beneath the proposed 300mm cover, and that it is overlain by no more than 1m of soil.

9.2 Revised Conceptual Ground Model (Contamination)

9.2.1 The Preliminary Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably with respect to the distribution of made ground and contaminants.

9.2.2 A revised Conceptual Site Model is presented as Drawing No. 9374/5 in Appendix B.

9.3 Potential Remedial Options

General

9.3.1 Approval of the recommendations given below should be sought from the appropriate regulatory authorities prior to commencement of site redevelopment.

Inorganic contamination

9.3.2 Topsoil across the site contains arsenic contamination.

Summary of Degree of Ground Contamination (Inorganics) at Higham Lane, Dodworth													
Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are Shown in Brackets and assume a residential with gardens end-use.													
Sample Location	depth (m)	Material	pH*	As (20) [†]	Cd *5	Cr (130) [†]	Pb (450) [†]	Hg (8) [†]	Se (35) [†]	B (3) [†]	Cu *x	Ni (50) [†]	Zn *x
TP1	0.2	TOPSOIL	5.9	-	-	-	-	-	-	-	-	-	-
TP2	0.2	TOPSOIL	7.6	32	-	-	-	-	-	-	-	-	-
TP3	0.2	TOPSOIL	6.1	-	-	-	-	-	-	-	-	-	-
TP4	0.2	TOPSOIL	6.5	-	-	-	-	-	-	-	-	-	-
TP5	0.2	TOPSOIL	6.3	39	-	-	-	-	-	-	-	-	-
TP6	0.2	TOPSOIL	6.1	38	-	-	-	-	-	-	-	-	-
TP7	0.1	TOPSOIL	6.1	34	-	-	-	-	-	-	-	-	-
TP8	0.2	TOPSOIL	5.7	40	-	-	-	-	-	-	-	-	-
TP9	0.2	TOPSOIL	4.9	40	-	-	-	-	-	-	-	-	-
TP10	0.2	TOPSOIL	6.6	44	-	-	-	-	-	-	-	-	-
TP11	0.1	TOPSOIL	7.5	28	-	-	-	-	-	-	-	-	-
Key													
-	Parameter tested for but not found to be in excess of trigger concentration												
	Parameter not tested for												
#	All pH results listed to confirm which soil guideline values are to be used in CLEA assessment												
♦	Tier 1 Value is pH dependent												
*	ICRCL Guidance Note 59/83, Second Edition (1987) – (Boron Phytotoxic only)												
o	Dutch Intervention Levels												
o	BRE Special Digest 1, Concrete in aggressive ground (2005)												
x	MAFF – The Soil Code (Rev. 1998)												
\$	DEFRA and the EA Contaminated Land Exposure Assessment (CLEA) – March '02												
Source of Guidance Trigger Level													

9.3.3 As stated in 9.1.3 additional testing should be undertaken to assess the bioavailability of the arsenic contamination. The results could be used in a risk assessment to show that the arsenic contamination does not actually pose a risk.

9.3.4 If proved to be unsuitable for re-use where residual topsoil remains beneath garden and landscaped areas it is recommended that a 300mm thick surface cover of "clean" soil comprising 200mm subsoil and 100mm topsoil be placed over the topsoil (i.e. not beneath hardstanding) and that it is overlain by no more than 1m of soil. This cover will break potential pollutant linkages between the contaminated made ground and future end-users.

Waste Classification

9.3.5 All soil arisings generated by excavations at this site are likely to be classified as non-hazardous waste.

10 HAZARDOUS GAS

10.1.1 Information from historical OS plans, the Environment Agency and Local Authority indicates that there are no known former landfill sites at or within 250m of the site. Though an old backfilled quarry is located 200m south of the site. However, it is unlikely that the site will be affected by landfill gas.

10.1.2 The site is neither underlain by shallow mineworkings nor located in an area considered susceptible to mines gas emissions.

10.1.3 However, the site is located in an area, which does require basic radon protection measures. These should comprise:

- use of 1200 gauge polyethylene DPM or DPC, with suspended concrete floors or ground bearing floor slabs.
- continuous membrane across cavity walls
- cavity tray in external walls
- fully sealed service entries/exits

11 GEOTECHNICAL TESTING

11.1 General

11.1.1 15 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Encia.

11.1.2 The geotechnical laboratory test results are presented in Appendix G to this report.

11.2 Atterberg Limits

11.2.1 Results are summarised below.

Soil type	Range of Plasticity Indices* (Average)	Shrinkability
Weathered Coal Measures	14-39 (26)	Medium

* Modified where appropriate in accordance with revised Chapter 4.2 of the NHBC Standards (April 2003).

Note. The term Shrinkability is equivalent to the term Volume Change Potential used in Chapter 4.2.

11.2.2 For the purposes of foundation design, it is recommended that all cohesive soils be regarded as being of medium shrinkability.

11.3 Soluble Sulphate and pH

11.3.1 In accordance with BRE Special Digest 1:2005, this site has been classified as natural ground with a mobile groundwater regime.

11.3.2 It is envisaged foundations will extend to depths of about 1m through and natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).

11.3.3 The highest groundwater sulphate concentration is 0.26g/l and the lowest pH value is 5.5.

11.3.4 Therefore, in accordance with Tables C1 of SD1, sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1.

12 GEOTECHNICAL ISSUES

12.1 Foundation Recommendations

General

12.1.1 It is understood that consideration is being given to redevelopment of the site with two storey domestic dwellings, associated gardens, POS and adoptable roads and sewers. No site layout has been provided to Encia at this stage.

12.1.2 Foundation recommendations assume that development will be two storey and that line loads will not exceed 60kN/m run). If this is not the case significant alteration to these recommendations will be required.

12.1.3 Made ground if encountered is not considered a suitable foundation material and foundations should therefore be taken through these materials into underlying strata of adequate bearing capacity.

12.1.4 The weathered coal measures strata are considered to have an allowable bearing capacity of 120kN/m².

12.1.5 Redrow Homes or their groundworker should seek further advice from Encia if unexpected ground conditions are encountered in foundation or sewer excavations, including any conflict between soft ground associated with a backfilled trial pit excavation and the line of a proposed footing.

12.1.6 Sub-surface concrete in contact with the natural ground should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1.

12.1.7 No significant groundwater flows were encountered within any trial pit excavations.

12.1.8 Trial pits were generally stable, though trench supports may be required if excavations are left open over a long period of time.

12.1.9 Where existing buildings are to be demolished, it is considered that all concrete slabs and service ducts will require breaking out prior to re-development. However, relict foundations could probably be left in-situ and an allowance made for local breaking out where these conflict with new foundations.

12.1.10 Foundations of plots placed over relict foundations should be taken to greater depth than the relict foundations and into natural ground of adequate bearing capacity.

12.1.1.11 Overdeepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.4.

12.1.1.12 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation.

Strip Footings

12.1.1.13 It is considered that strip footings will be the most suitable foundation solution for two storey houses constructed at the site.

12.1.1.14 Clay classification tests suggest that natural cohesive soils at the site should be regarded as being of medium shrinkability. A minimum founding depth of 900mm is recommended for all cohesive soils on the site where strip footings are proposed.

12.1.1.15 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 25% of the site may be affected by trees. It is recommended that a tree survey is undertaken.

12.1.1.16 Founding depths are from original or finished ground level, whichever is the lower, to the underside of the footing.

12.1.1.17 In order to minimise softening and swelling of cohesive soils or loosening of granular soils, it is recommended that as soon as formation level is reached, it should be blinded. The blinding should consist of concrete with as low a water:cement ratio as possible.

12.2 Designated Concrete Mixes

12.2.1 The following designated mixes in accordance with BRE Special Digest SD1 and BS 8500: Part1: 2006 will be suitable for use on this site.

Application	DS-1 conditions (natural ground) ACEC Class AC-1
Unreinforced strip/trench fill footings	GEN1
Unreinforced concrete floor slabs	GEN2
In situ reinforced concrete floor slabs	RC28/35

12.3 Excavations

12.3.1 Based on the results of the investigation it is unlikely that major groundwater flows will be encountered in shallow excavations.

12.3.2 Excavations in natural ground should remain stable in the short term but if left open for any significant period of time, may require shoring most notably in granular soils and made ground.

12.4 Drainage

12.4.1 Given that the majority of the site is open fields, it is considered likely that stormwater storage will be required, however, this should be confirmed with Yorkshire Water.

12.4.2 Due to the cohesive nature of the natural ground, it is likely that soakaways will not provide an effective means of surface water disposal.

12.4.3 Any damage to the existing land drainage system caused by foundation or sewer excavations should be made good; this may require diversion and re-connection.

12.4.4 It is recommended that the developer contact Yorkshire Water Services with respect to capacity in existing foul and surface water sewers in the vicinity of the development area.

12.5 Highways

12.5.1 Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published tables (Design Manual for Roads and Bridges - Volume 7, Section 2 - January 1999) indicate that the weathered coal measures will have a CBR value of 5%. These values should be verified prior to or during construction.

13 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

13.1 General

13.1.1 It is understood that consideration is being given to redevelopment of the site with two storey domestic dwellings, associated gardens, POS and adoptable roads and sewers. No site layout has been provided to Encia at this stage.

13.2 Hazardous Gas

13.2.1 Basic radon protection measures are required at this site.

13.3 Mining

13.3.1 No mining issues.

13.4 Contamination & Remediation

13.4.1 Inorganic contamination is present in the topsoil.

13.4.2 Bioavailability testing should be undertaken to assess the risk from arsenic. This may result in the topsoil being suitable for re-use without the need for a cover layer.

13.5 Foundations

13.5.1 Strip/trench fill footings are considered to be the most appropriate foundation solution, where firm clay is the founding material.

13.5.2 The firm clay is considered to have an allowable bearing capacity of approximately 120kN/m².

13.5.3 Sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1.

13.6 Flooding

13.6.1 The EA indicate that the site is/is not located within an indicative floodplain.

13.6.2 The site area is in excess of 1 hectare, therefore in accordance with PPG25 a Flood Risk Assessment will be required.

13.7 Drainage & Highways

13.7.1 It is not likely that soakaways will be an effective means of surface water disposal.

13.7.2 Natural ground it is considered to have a CBR value of 5%.

13.8 Further Works

- 13.8.1 Bioavailability testing on topsoil samples to assess the risk from arsenic and the suitability for re-use.
- 13.8.2 Post vacation site investigation in Area A (within footprint of existing dwelling).
- 13.8.3 A tree survey is required to assess the impact trees could have on foundation depths.
- 13.8.4 Flood Risk Assessment in accordance with PPG25.

APPENDIX A GENERAL NOTES

Environmental Setting

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the Correspondence Appendix of this Geoenvironmental Report.

Geology, Mining & Quarrying

In order to establish the geological setting of a site, Encia refer to BGS maps for the area, and the relevant geological memoir.

A coal mining report is obtained from the Coal Authority. Further information is sourced from the Local Authority and by reference to current and historical OS plans.

Landfills

Encia obtain data from the Landmark Information Group, the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move through fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Encia refer to BRE Report BR211, 2007: "Radon: guidance on protective measures for new buildings".

The level of protection needed is site-specific and is determined by reference to the maps contained in Annex A of BR211. These maps are derived from the Radon Atlas of England and Wales (2007), and indicate the highest radon potential within each 1km grid square.

If the site falls within a light grey square on the relevant map in Annex A then basic radon radon protection should be installed in new buildings; if the site falls within a dark grey square then full radon protection should be installed. **If the site is in an un-shaded square then no radon protection is needed.**

BR211 provides a preliminary indication of the measures required for a particular site, but it is also often beneficial to request a BR211 Radon Report from the BGS. The Annex A maps indicate the highest geological radon potential within each 1km grid square, but in many cases the radon potential varies considerably within the grid square. The BR211 Radon Report gives definitive guidance on the requirement for radon protective measures, and therefore may allow the adoption of a lower level of protection than that indicated in the Annex A maps.

Encia typically obtain a BR211 Radon Report for all sites that fall within a shaded square on the relevant Annex A map.

When requesting a BR211 Radon Report from the BGS Encia select the search radius carefully, since too large a search radius may result in the inclusion of areas of higher geological radon potential, and therefore in the recommendation of too high a level of protection.

Further details of the protective measures required, if appropriate, are provided in the Hazardous Gas section of this Geoenvironmental Report.

Hydrogeology

Encia obtain information from the Environment Agency (EA) and the Landmark Information Group with respect to:

- groundwater quality
- recorded pollution incidents
- licensed groundwater abstractions

Reference is also made to the EA document "Policy and Practice for the Protection of Groundwater" (1998) and the relevant Groundwater Vulnerability Map.

Bedrock and any overlying granular Drift deposits are classified by the EA:-

- **Major aquifers:** "Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public water supply and other purposes".
- **Minor aquifers:** "Fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Although these aquifers will seldom produce large quantities of water for abstractions, they are important both for local supplies and in supplying base flow to rivers".
- **Non-aquifers:** "Formations which are generally regarded as containing insignificant quantities of groundwater. However groundwater flow through such rocks, although imperceptible, does take place and needs to be considered in assessing the risk associated with persistent pollutants. Some non-aquifers can yield water in sufficient quantities for domestic use".

Groundwater vulnerability is determined by 4 variables:

1. The presence and nature of overlying soil (the weathered zone affected by living organisms; soil in the UK can extend up to 2m in depth). Physical properties of the soil affect the downward passage of water and it's ability to attenuate pollutants. The EA make reference to a three-fold classification of soil types:-
 - Soils of **low** leaching potential are defined as "soils in which the pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants".
 - Soils of **intermediate** leaching potential are defined as "soils which have a moderate ability to attenuate diffuse source pollutants or in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer".
 - Soils of **high** leaching potential are defined as "soils with little ability to attenuate diffuse source pollutants and in which non-adsorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater".

In urban areas and restored mineral workings the soil information is based on fewer observations than elsewhere. A worst-case vulnerability (H) is therefore assumed for these areas and for current mineral workings by the EA. All are given a designation of **HU** unless proved otherwise.

2. The presence and nature of Drift, which often overlies bedrock. Where Drift is of substantial thickness and low permeability, it can provide an effective barrier to surface pollutant migration. Permeable Drift is classified as a Minor Aquifer except where it is in probable hydraulic continuity with a Major Aquifer, where it is regarded as part of the Major Aquifer unless proven otherwise by site investigation.
3. The nature of the geological strata (bedrock). Rocks that contain groundwater in exploitable quantities are called aquifers.
4. The depth of the unsaturated zone; ie that part of the aquifer which lies above the water table

The EA have also designated Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

Hydrology

Endia obtain information from the Environment Agency and the Landmark Information Group with respect to:

- surface water quality
- recorded pollution incidents
- licensed abstractions (groundwater & surface waters)
- licensed discharge consents
- site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are six GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps provide show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.

There are two different kinds of area shown on the Flood Map:

1. Dark blue areas could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year

2. Light blue areas show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year (or 1 in 200 year as appropriate), areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist consultant who can advise on appropriate mitigating measures; ie raising slab levels, provision of storage etc.

COMAH & Explosive Sites

Endia obtain information from the Landmark Information Group with respect to COMAH or explosive sites within 1km of the proposed development site. Endia's report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

Preliminary Conceptual Ground Model

The site's environmental setting (and proposed end use) is used by Endia to assess the significance of any contamination encountered during the subsequent ground investigation

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential targets.

Potential pollutant linkages are shown on a preliminary conceptual site model, presented as a Drawing in an Appendix to this Geoenvironmental Report. The preliminary model is revised in light of data arising from the subsequent ground investigation.

Generic Notes – Encia Geoenvironmental Investigations

2. Ground Investigation Fieldwork

General

Encia Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:1999 "Code of practice for site investigation"
- BS10175:2001 "Code of practice for the identification of potentially contaminated sites".
- "Technical Aspects of Site Investigation" – EA R&D Technical Report P5-065/TR (2000)
- "Development of appropriate soil sampling strategies for land contamination" – EA R&D Technical Report P5-066/TR (2001)
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 "Sampling strategies for contaminated land"
- "Guidance on the protection of housing on contaminated land" – NHBC & EA R&D Publication 66 (2000)
- AGS: 1996 "Guide to the selection of Geotechnical Soil Laboratory Testing"

Exploratory hole logs are presented in Appendices to this Geoenvironmental Report. These logs include details of the:

- Investigation technique adopted
- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of any in-situ testing
- Any gas/groundwater monitoring well installed

Exploratory Hole Locations

Exploratory hole locations are selected by Encia, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

Investigation Techniques

Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 1999 and BS1377: 1990. Techniques most commonly used by Encia include:

- Machine excavated trial pits, usually equipped with a backactor and a 0.6m wide bucket.
- Cable percussive (Shell & Auger) boreholes, typically using 150mm diameter tools and casing.
- Window or Windowless Sampling boreholes. Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often

the most appropriate technique. A window sampling drilling rig can be manoeuvred in areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).

- Rotary percussive open-hole probeholes are typically drilled using a tricone rock roller bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse.

Where installed, gas/groundwater monitoring wells typically comprise a lower slotted section, surrounded by a filter pack of 10 mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete.

Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

In-situ Testing

Where relative densities of granular materials given on the trial pit and window sample logs are based on visual inspection only, they do not relate to any specific bearing capacities. However, wherever possible Encia employ a Mackintosh probe to assess relative density. Mackintosh probe results can be related to approximate allowable bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as $N^* = x$.

The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

Sampling

Representative soil/fill samples are taken at regular intervals from the exploratory holes to assist in description of the ground and to allow selected laboratory testing to be performed. The type of sample taken is dependent on the nature of the stratum and the purpose of the analysis.

Where the soils encountered contain a significant proportion of coarse grained material, truly representative samples are not typically obtained - only the finer fraction is placed in sample containers. However, a visual estimate of the amount of coarse material is made on site.

NB: Coarse constituents not sampled are defined as: coarse gravel, cobble and boulder. (i.e. any 'particles' with an average diameter greater than 20mm).

Occasionally, unrepresentative 'spot' samples are also taken from some exploratory locations for contaminant analysis, typically where unusual, localised pockets of materials are encountered.

Samples of soil for chemical testing are placed into 1 litre plastic tubs prior to delivery to the selected laboratory. Samples of water are taken in one litre, brown glass bottles and stored in cool boxes, at a temperature of approximately 40C, until delivery to the selected laboratory. Soil/fill samples for organic analysis are also stored in cool boxes.

Groundwater

Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Long-term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

Description of Strata

The soils encountered during an Encia ground investigation are described (logged) in general accordance with BS 5930. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text.

The materials encountered in the trial pits are logged, samples taken, and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

Key to Exploratory Hole Logs

Keys to logs are presented in the Appendix(ces) containing the logs. There are two Keys – Symbols & Legends and Terms & Definitions.

Generic Notes – Encia GeoEnvironmental Investigations

3. Geotechnical Laboratory Tests

General

Soil samples are delivered to the laboratory for testing along with a schedule of testing drawn up by Encia. All tests are carried out in accordance with BS 1377:1990.

The test results are presented as received in an Appendix to this GeoEnvironmental Report.

The following laboratory testing are routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

The additional tests are typically only scheduled where significant earthworks regrade is anticipated:

- Grading.
- Compaction tests
- Particle density.

Atterberg Limits & Moisture Content

The Liquid and Plastic Limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average Plasticity Index (PI) for each "type" of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth. Encia typically only consider a soil to be shrinkable if the proportion finer than 63µm is >35%.

PI results are compared against guidance given in the NHBC Standards, Chapter 4.2 (revised April 2003), which advocates the use of modified Plasticity Index (I'p), defined as:

$$I'p = Ip * (\% < 425\mu m / 100)$$

ie if PI is 30%, but the soil contains 80% < 425µm, then: $I'p = 30 * 80/100 = 24\%$.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425µm sieve is routinely reported by testing labs.

Encia apply engineering judgment where PI results are spread over a range of classifications. Consideration is given to:

- the average values for each particular soil type (ie differentiate between residual soil and alluvium),
- the number of results in each class and
- the actual values.

Unless the judgment strongly indicates otherwise, Encia typically adopt a conservative approach and recommend assumption of the higher classification.

Soluble Sulphate and pH

Sulphates in soil and groundwater are the chemical agents most likely to attack sub-surface concrete, resulting in expansion and softening of the concrete to a mush. Another common cause of concrete deterioration is groundwater acidity.

The rate of chemical attack depends on the concentration of aggressive ions and their replenishment at the reaction surface. The rate of replenishment is related to the presence and mobility of groundwater.

Encia refer to BRE Special Digest 1 (SD1) "Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment" (2001). SD 1 provides definitions of:

- the nature of the site (greenfield, brownfield or pyritic)
- the groundwater regime (static, mobile or highly mobile)
- the Design Sulphate Class (DC Class) and
- the Aggressive Chemical Environment for Concrete (ACEC Class)

Encia reports clearly state each of the above for the site being considered.

The concentrations of sulphate in aqueous soil/fill extracts are determined in the laboratory using the gravimetric method. The results are expressed in terms of SO_4 for direct comparison with BS 5328:1997. The pH value of each sample was determined by the electrometric method.

SD1 also discusses determination of "representative" sulphate concentration from a number of tests. Essentially if <10 samples of a given soil-type have been tested, the highest measured sulphate concentration should be taken. If >10 samples have been tested, the mean of the highest 20% of the sulphate test results can be taken. With respect to groundwater, the highest sulphate concentration should always be taken.

With respect to pH (soil & groundwater) the value used is the lowest value if <10 samples have been tested and the mean of the lowest 20% if >10 samples have been tested.

Generic Notes – Encia Geoenvironmental Investigations

4B. Contamination Laboratory Analysis & Interpretation (including WAC)

Waste Classification & WAC

In the context of waste soils generated by remediation and/or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics).
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds).
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds).

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

From 16th July 2005, landfill operators will require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**, and such waste must have been subjected to pre-treatment. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Encia typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc.

If off-site disposal of soils classified as hazardous waste were undertaken during redevelopment, then WAC analysis should be scheduled at an early stage in the remediation programme.

However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous. These contaminants can often be dealt with by alternative technologies (eg by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (eg WAC) is required.

Contamination Laboratory Analysis & Interpretation

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "Potential contaminants for the assessment of land" and the relevant DETR Industry Profile(s).

Common Inorganic Contaminants

These include:

- metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc.
- semi-metals, most notably arsenic, selenium, and (water soluble) boron
- non-metals, most notably sulphur
- inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates.

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction.

Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to uv digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO₄), sulphides etc

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common Organic Contaminants

Petroleum hydrocarbons are a mixture of hydrocarbons produced from the distillation of crude oil. They include aliphatics (alkanes, alkenes and cycloalkanes), aromatics (single or multi benzene ringed compounds) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen.

Petroleum hydrocarbons can be grouped based on the carbon number range:-

GRO - Gasoline Range Organics (typically C₆ to C₁₀). Also referred to as PRO - Petroleum Range Organics

DRO - Diesel Range Organics (typically C₁₀ to C₂₈)

LRO - Lubricating Oil Range Organics (typically C₂₈ to C₄₀)

MRO - Mineral Oil Range Organics (typically C₁₈ to C₄₄)

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies.

Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C₅-C₄₀, whereas other define TPH as C₁₀-C₃₀.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (eg petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons (especially within the C₄ to C₅ range) that will rapidly evaporate. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTX. Small amounts of polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present.

Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar nitrogen, sulphur and oxygen-containing compounds (NSO) compounds are also present.

Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have more than two fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (Benzo(a)pyrene) and/or mobile in the environment (naphthalene).

Semi-Volatile Organic Compounds (SVOCs) include a variety of compounds, which as the names suggest have relatively low boiling points; however, VOC's are much more volatile than SVOC's. Examples of VOC's include benzene, chloroform and toluene; SVOC's include phenol, florene. Both groups of chemicals are readily absorbed through skin and some, such as benzene, are believed to be linked to tumour growth.

Phenols are compounds that have a hydroxyl group attached to an aromatic ring (ie include a benzene ring and an -OH group). Most are colourless solids. A solution of phenol in water is known as carbolic acid, and is a powerful antiseptic. However, phenol vapour is toxic, and skin contact can result in burns.

Polychlorinated Biphenyls (PCBs) were used in pre-1974 transformers as dielectric fluids. PCB's are of increasing toxicity relative to the degree of chlorination. Acute symptoms of PCB poisoning are irritation of the respiratory tract leading to coughing and shortness of breath. Nausea, vomiting and abdominal pain are caused by ingestion of PCB's.

Dioxins and furans (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are some of the most toxic chemicals known; in the environment, they tend to bio-accumulate in the food chain. Dioxin is a general term that describes a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD.

Dioxin is formed by burning chlorine-based chemical compounds with hydrocarbons. The major source of dioxin in the environment comes from waste-burning incinerators and also from backyard burn-barrels. Dioxin pollution is also affiliated with paper mills which use chlorine bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals (like many pesticides).

Methods of Analysis (Organic Compounds)

TPH by GC-FID is a more refined analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C₁₀ to C₄₀ (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a breakdown of the TPH results into diesel range organics (DRO) and heavier lubricating oil range organics (LRO).

GRO (PRO) by GC-FID analysis detects the more volatile C₆-C₉ hydrocarbons (aliphatic and aromatic), including those organic compounds present in petrol.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethylbenzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH by GC-FID. Naphthalene (the lightest PAH) is also one of the 58 US EPA VOCs.

Speciated TPH by GC-FID provides a "banded" TPH, initially split into aromatic and aliphatic fractions and then further divided into fraction specific carbon bandings based upon behavioural characteristics.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.

Current UK Guidance

The UK approach to contaminated land is set out in Contaminated Land Report No. 11 (2004) "Model Procedures for the Management of Land Contamination". The approach is based upon risk assessment, where risk is defined as the combination of the probability of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

In the context of land contamination, there are three essential elements to any risk: (1) a contaminant source, (2) a receptor (eg controlled water or people) and (3) a pathway linking the (1) and (2). Risk can only exist where all three elements combine to create a pollutant linkage. Risk assessment requires the formulation of a conceptual model which supports the identification and assessment of pollutant linkages.

Encia adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate UK guidance levels, Encia risk-derived screening values, or remedial targets.

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate or groundwater concentrations with the appropriate water quality standard. Depending upon the specific characteristics and environmental setting of the site the appropriate standard is likely to be one of the following:

- Water Supply (Water Quality) Regulations 1989
- Environmental Quality Standards (for Freshwater)
- The Surface Waters (Abstraction for Drinking Water) Regulations

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents:

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2006) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2007 – Code of Practice for the characterisation & remediation from ground gas in affected developments

Further information is presented in Generic Note No. 5 – Hazardous Gas.

In March 2002 DEFRA and the Environment Agency published a series of technical research papers (R & D Publications CLR 7, 8, 9 and 10) introducing the UK approach to the assessment of risk to **human health** from land contamination. This methodology and approach represents current scientific knowledge and thinking. The overall methodology also included the Contaminated Land Exposure Model (CLEA) and some Soil Guideline Values (SGVs).

At the time of writing this report, SGVs were only available for a limited number of contaminants, the development of both the CLEA model and additional SGVs is ongoing. Where published, SGVs have been utilised as intervention values for the purpose of an initial Tier 1 assessment.

It should be noted that exceedance of Tier 1 does not necessarily mean that remedial action will be required.

With respect to the assessment of potential **phytotoxic effects** of contaminants, Encia refer to "The Soil Code" (MAFF, 1998) for copper and zinc. The CLEA SGV is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that:

"In general.....it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn."

Current Guidance derived by Encia

In the absence of UK SGVs for a number of "common" organic compounds, Encia have derived generic screening values for use as "Tier 1" values. These values have been derived using the RISC model, and taking account of UK policy decisions, Health Criteria Values and CLEA defaults.

PAH cannot be assessed as a single "total" value, as each individual PAH compound has different toxicity and mobility in the environment. Speciated analysis is required to determine the concentrations of the various compounds, most notably the key PAHs: Benzo(a)pyrene (considered the most toxic of the PAHs); and Naphthalene (the most mobile and volatile of the PAHs).

Similarly, TPH cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG).

The TPHCWG have broken down "TPH" into thirteen representative constituent fractions or "EC Bandings". EC Bandings are based around Equivalent Carbon numbers and the TPHCWG have derived a series of physicochemical and toxicological parameters for each of the thirteen EC bandings. The methodology for the derivation of these banding-specific properties is outlined in the TPHCWG series volumes 1-4.

Encia have calculated a screening value for each of the thirteen constituent fractions. These fractions have then been considered in terms of GRO, DRO and LRO to provide simpler, conservative initial Tier 1 screening values.

Encia's derivation of Tier 1 values is based on a number of assumptions, most notably:

- The site's environmental setting, in terms of proximity to **Controlled Waters**, is not sensitive. It is not possible to derive generic Tier 1 values for waters, because distance and ground permeability are key factors, and both are extremely site-specific. Consequently, detailed quantitative risk assessment is required.
- Ground encountered during the site investigation will be isolated beneath a cover of "clean" soil. **Soil cover** in garden areas is "standard" remediation practice during the residential redevelopment of brownfield sites, where the contaminants of concern are inorganic and/or non-volatile organic. The majority of brownfield sites require a minimum 600mm soil cover. The CLEA model assumes that all pathways, other than inhalation of vapours, occur within 0.5m of ground level, consequently after placement of a 600mm thick soil cover, the only pathway of significance is vapour migration.

It should be noted that where the underlying ground is "clean", but includes undesirable elements (eg a significant proportion of demolition rubble, colliery spoil etc), a minimum 300mm thickness of soil cover is acceptable, in accordance with NHBC Standards, Chapter 9.2. However, before advocating a 300mm soil cover, consideration must be given to other potential pathways, most notably inhalation of dust, ingestion and dermal contact.

- The ingestion and dermal contact pathways have a significant effect on the Tier 1 values for benzo(a)pyrene, and petroleum hydrocarbons (TPH) in the Diesel (C_{10} to C_{20}) and Lubricating Oil (TPH C_{21} to C_{40}) ranges.
A conservative **Soil Organic Matter** of 1%.
(Note: $\text{TOC} = \text{SOM} \times 0.58$; and $\text{FOC} = \text{TOC}/100$).
Hydrocarbons tend to be "bind" with SOM, and therefore become less mobile. Consequently, Tier 1 values can be revised if the amount of organic matter within the soil exceeds 1%.

- Some determinands reach **residual saturation** before a vapour risk is predicted to occur. Prior to residual saturation, as the concentration of a contaminant in soil increases, so does the concentration of the same contaminant in the associated vapour phase. However, once saturation is reached, the concentration of contaminant in the vapour phase remains constant (for any given atmospheric conditions - temperature and pressure). Consequently, even if free product were encountered at depths >600mm, it would not pose a significant risk via the inhalation exposure pathway.

However, Encia recognise that it is unacceptable to leave free product in the ground and therefore arbitrary Tier 1 values have been ascribed to such contaminants. These values have been selected on the basis that they are below the limit of olfactory detection (ie at concentrations below Tier 1, odours are not readily identified).

Table 1 - Encia Tier 1 values

Contaminant	Tier 1 Value (mg/kg)	Comments/Notes
PCB's	1.4	Based on PCB EC seven. Driven by soil ingestion (very conservative assumption).
Benzene	0.33	
Xylene	230	
Benzo(a)pyrene	39	Residual saturation reached at 39mg/kg. 39mg/kg selected as Tier 1 value although no inhalation risk identified at 600mm depth.
Naphthalene	23	
total PAH	23	The higher volatility of Naphthalene makes it the most problematic PAH in ground overlain by a soil cover. Consequently, Encia have adopted the Tier 1 value for Naphthalene (23mg/kg) as an initial Tier 1 screening value for total PAH, on the conservative assumption that all the PAH is Naphthalene.
TPH < C_{10} Gasoline range organics (GRO)	0.3	Based on conservative assumption that all TPH < C_{10} is benzene. If concentrations >0.3 mg/kg are recorded, but no benzene is present, a Tier 1 value of 10 mg/kg could be adopted for the gasoline range or reference can be made to refined Tier 1 Values for specified TPH (see below).
TPH C_{10} ~ C_{20} Diesel range organics (DRO)	330	If DRO above tier 1 value and specified fraction banding for all sources on site are available, refer to Refined Tier 1 Values for specified TPH (see below).
TPH C_{21} ~ C_{40} Lubricating range organics (LRO)	5,000	Residual saturation reached for all fractions; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 5,000 mg/kg is well below the limit of olfactory detection.

If site concentrations of any of the three broad TPH bandings (GRO, DRO or LRO) exceed the Tier 1 values quoted in Table 1 above, further assessment, with reference to specified TPH results, will be required:

Table 2 - Refined Tier 1 values (TPH Bands)

Contaminant	Refined Tier 1 values (mg/kg)	Comments/notes
Aliphatic C5-C6	92	
Aliphatic C6-C8	500	Residual saturation reached due to lower toxicity of aliphatic compounds (cf aromatics), therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 500 mg/kg is well below the limit of olfactory detection.
Aliphatic C8-C10	40	
Aliphatic C10-C12	1,000	Residual saturation reached; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 1,000 mg/kg is well below the limit of olfactory detection.
Aliphatic C12-C16	1,000	
Aliphatic C16-C21	1,000	
Aliphatic C21-C34	5,000	Residual saturation reached at 16mg/kg; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 5,000 mg/kg is well below the limit of olfactory detection.
Aromatic C5-C7	16	
Aromatic C7-C8	36	
Aromatic C8-C10	63	
Aromatic C10-C12	330	
Aromatic C12-16	1,000	Residual saturation reached; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 1,000 mg/kg is well below the limit of olfactory detection.
Aromatic C16-C21	1,000	
Aromatic C21-35	5,000	Residual saturation reached at 16mg/kg; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 5,000 mg/kg is well below the limit of olfactory detection.

The significance of speciated TPH results can be assessed by following the 3 steps outlined in Table 3 below.

Note: This 3-step assessment is **not** required if concentrations of GRO, DRO & LRO are all above their respective Tier 1 values (see Table 1).

Table 3 – Assessment of TPH

Step	Result	Action
1 – Consider indicator compounds: Are BTEX and Naphthalene above their respective screening values (refer to Table 1 above)?	Yes	Detailed Quantitative Risk Assessment (DQRA) required
	No	Proceed to Step 2
2 – Consider individual TPH fractions: Are they above respective screening values (refer to Table 2 above)?	Yes	DQRA required
	No	Proceed to Step 3
3 – Assess Cumulative effects (use the equation below): Is the calculated Hazard Index for each source > 1	Yes	DQRA required
	No	TPH compounds pose no significant risk.

Equation used to determine Hazard Index (Step 3).

$$HI = \sum_{i=1}^{16} HQ_i = \frac{\text{Measured concentration } F_i \text{ (mg kg}^{-1}\text{)}}{SGV_i F_i \text{ (mg kg}^{-1}\text{)}}$$

$$\begin{aligned} \text{where } HI &= \text{Hazard Index} \\ HQ_i &= \text{Hazard Quotient} \\ F_i &= \text{Fraction}_i \\ SGV_i &= \text{Soil Guideline Value} \end{aligned}$$

UK physiochemical properties, environmental properties, receptor and pathway parameters assumed within the assessment are detailed in the table below.

Table 4 – RISC input parameters to reflect UK position and data source.

Parameter	Data Source
Chemicals of concern	- Individual chemical SGV and Tier reports - Environment Agency Publication - Review of the Fate and Transport of Selected Contaminants in the Soil Environment, Technical Report PH-079/TR1 - TPH Criteria Working Group Vol 1-4
Surface soil and pathways selection	As 600mm cover assumed no direct ingestion of soil or dust, dermal contact or vegetable uptake and consumption. Inhalation pathway only.
Vapour Inhalation and pathways selection	Johansen and Ettlinger model used as default in RISC model considering vapours from a contaminated soil. Default model acceptable as it also UK adopted model for inhalation
Determine receptor point concentration	
Indoor Air – Building parameters (residential house)	Environment Agency and Defra Publication CLR 10 "Technical basis and algorithms", CLR briefing notes CLEA Briefing note 3
Cross-sect. area of basement = 40m ²	CLEA Briefing note 3
Volume of building = 194.6m ³	CLEA Briefing note 3
No. air changes per day = 12	CLEA Briefing note 3
Foundation thickness = 0.15m	CLEA Briefing note 3
Fraction of cracks = 0.001	CLEA Briefing note 3
Porosity of cracks = 0.25	CLEA Briefing note 3
Water content in cracks = 0	Assume 0 – no moisture restriction to vapour migration
Flow rate of soil gas into building = 0	CLEA Briefing note 3
Length of foundation perimeter = 34.4m	CLEA Briefing note 3
Depth of foundation = 0.15m	CLEA Briefing note 3
Pressure difference = 35g/cm ²	CLEA Briefing note 3
Permeability of soils = 1x10 ⁻⁹ m ²	Representative of current UK house building practice
Leak – material above source	Scenario specific
Thickness: "leak" cover in garden area assumed = 600mm (cover depth)	
Porosity = 0.46	CLEA Briefing note 2 and CLR 10
Water content = 0.15	CLEA Briefing note 2 and CLR 10
Source data – data regarding material contamination located in	
Porosity of source material = 0.46	CLEA Briefing note 2 and CLR 10
Water content of source material = 0.15	CLEA Briefing note 2 and CLR 10
Fraction organic carbon = 0.006	CLR 10
Bulk density = 1.6	CLEA Briefing note 2 and CLR 10
Unsaturation zone – data regarding material surrounding source	
Distance to building from source or groundwater = 0.15	Scenario specific
Total porosity = 0.46	CLEA Briefing note 2 and CLR 10
Water content = 0.15	CLEA Briefing note 2 and CLR 10
Source concentration – maximum recorded site concentrations	Site Specific (assumed 100 for all single compounds and 10,000 for all TPH fractions)
Describe receptor	
Receptor and analysis type	CLR 10 default parameter for a residential development
Dietary analysis, one receptor of a child resident (RME)	
Exposure Data	
Based on a female child of 0-6 years.	
Averaging time/deliver = 6yrs	CLR 10
Body weight = 14.5kg	CLR 10 Table 5.6
Exposure Frequency = 365days/yr	CLR 10
Exposure duration = 6yrs	CLR 10
Soil ingestion rate = 100mg/day	CLR 10 Table 6.1
Total skin surface area = 6186cm ²	CLR 10 Table 5.8
Fraction skin exposed = 0.265	CLEA Briefing Note 1
Soil/skin adhesion factor = 1	CLEA Briefing Note 1 and SGV reports
Exposure frequency for veg uptake = 365days	CLR 10

Parameter	Data Source
Exposure duration for veg uptake = 6yrs	CLR 10
Root Veg ingestion rate = 102.6g/day	CLR 10 Table 6.3
Above ground veg ingestion rate = 38.5g/day	CLR 10 Table 6.3
Fraction of home grown veg = 0.28	CLR 10 Table 6.4
Fraction organic carbon in soil = 0.006	Site Specific
Exp. Frequency indoor air = 385 days	CLR 10
Exp. Duration = 6yrs	CLR 10
Lung retention factor = 1	Assumed
Inhalation rate = 0.43m ³ /hr	CLR 10 Table 5.9
Time indoors = 20.8hr/day	Sniffler Framework Table 10.3

Note: The information contained within the table above reflects all parameters within the RISC model that were amended to reflect current UK guidance and scenarios. The model summary is not included with this text but is available upon request.

Possible Action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

- Undertake further statistical analysis following the approach set out in Appendix A of CLR 7 in order to determine whether contaminant concentrations of inorganic contaminants within soil/fill actually present a risk (only applicable to assessing the risk to human health).
- Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
- Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis (as set out in Appendix A of CLR 7) the issue of the **averaging area** requires further consideration. CLR 7 suggests the averaging area should be representative of the receptors behaviour, such as a single garden or an open area used by the local community as a play area. This approach to averaging areas is considered applicable within the context of Part IIA of the Environmental Protection Act (EPA) 1990, in terms of an existing residential development.

However, Encia consider the concept of a single garden as an averaging area to be inappropriate with respect to brownfield redevelopment, which is regulated by the planning regime. In this context, contamination across the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Encia gather and analyse sample results by fill type, and/or by former use in a given sub-area of the site, before undertaking statistical analysis; ie the averaging area is associated with the extent of a particular fill type, or an area affected by spillage/leakage.

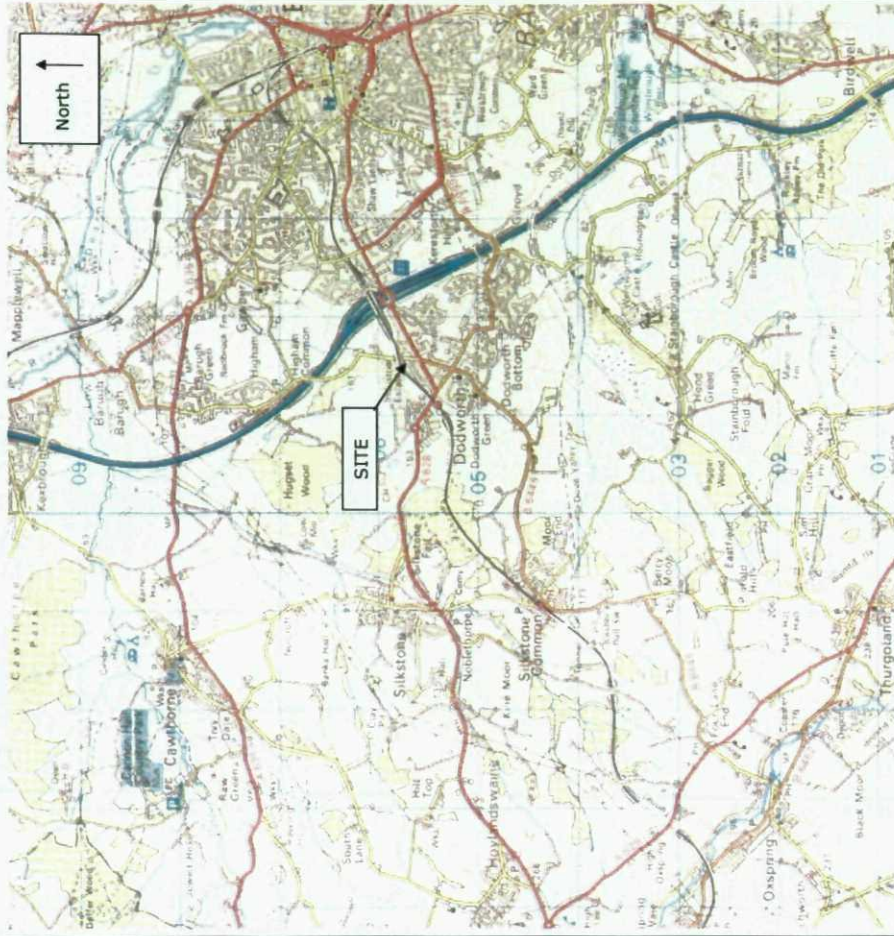
In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil/fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants

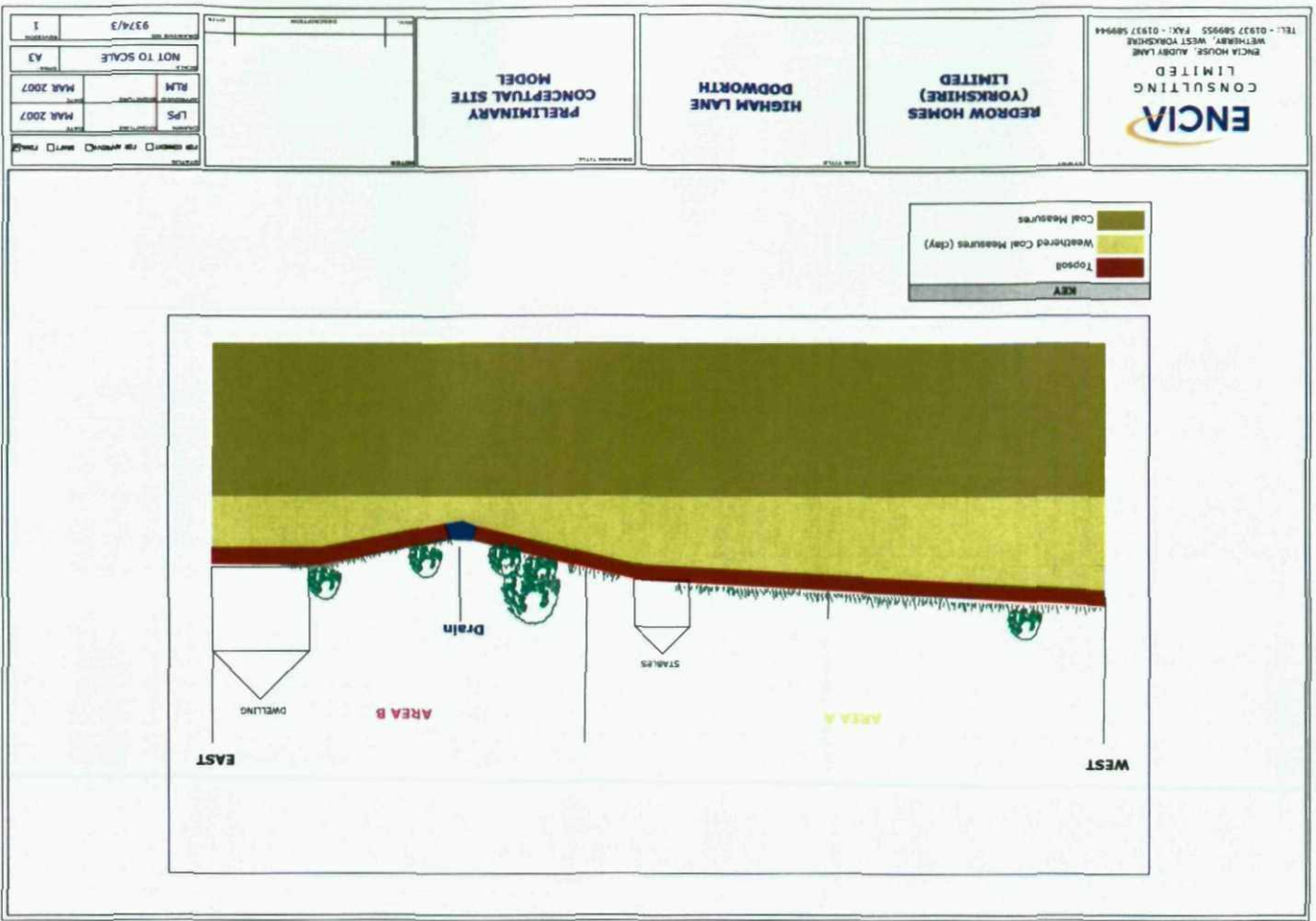
present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil/fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass; ie contamination would normally be more pervasive and significant in granular soils than cohesive soils.

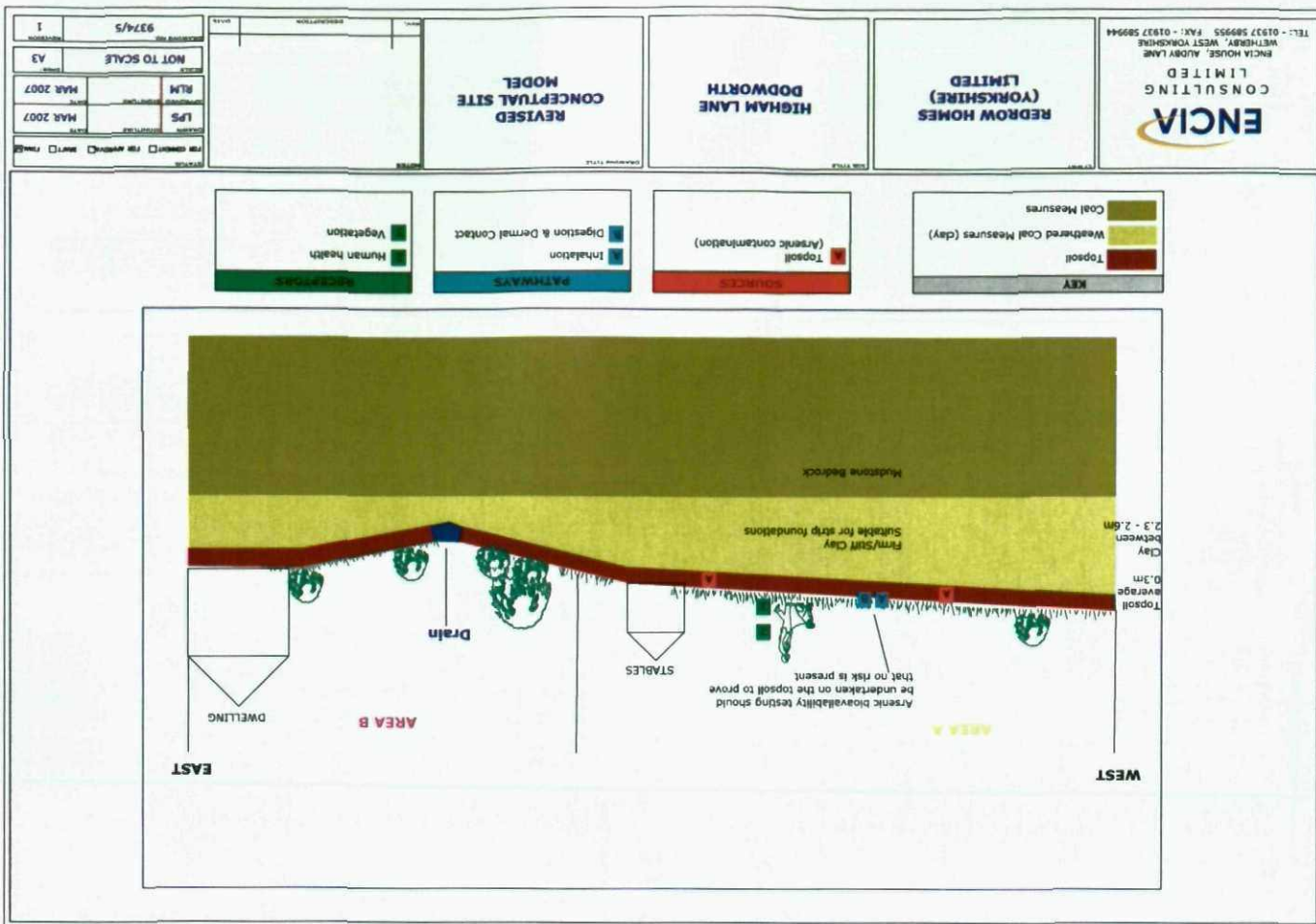
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APPENDIX B
DRAWINGS

CLIENT		Redrow Homes (Yorkshire) Limited			
JOB TITLE		Higham Lane, Dodworth			
DRAWING TITLE		Site Location Plan			
DRAWN BY	SIGNATURE	DATE	STATUS		
	JM	23/02/07	Final		
APPROVED	SIGNATURE	DATE	SCALE		
	JWH	23/02/07	1:50,000	DRG NO. 9374/1	





Regulatory Services

Assistant Director: Ken Eastwood, BSc (Hons), MCIEH
PO Box 602, Barnsley S70 9FB

My Ref:	JSC/152623	Your Ref:	9374	Date:	19 March 2007
Enquiries To:	Mr J Scott PollutionControl@barnsley.gov.uk	Dial Direct:	(01226) 772456	Fax:	(01226) 775699

Dear Madam

Re Higham Lane, Dodworth Road, Barnsley, NCR SE 315 057

Further to your letter requesting information in respect of the above site, I can now supply you with the information we hold regarding this site.

Closed Landfill Sites

We have no records of any former closed landfills on, or within 250m of, the above site.

Contaminated Land

Under the provisions of the Environmental Protection Act 1990, we have a duty to inspect the borough for contaminated land. As part of this work, records of potential sources of contamination have been compiled through the use of historical Ordnance Survey maps and local knowledge. With regards the above site, we have no current information of any previous uses of the above site that may have caused contamination to occur.

LAPPC Authorised Processes

We have no LAPPC Authorised Processes operating within 250m of the above site.

Nuisance Complaints

We have no records on our system of any complaints regarding the above site over the last three year period.

Pollution Incidents

We have no records of any pollution incidents relating to this site. However, I recommend you contact the Environment Agency in respect of this matter, as they receive more reports on this matter.

I must inform you that the Council make a charge for supplying this information and you will be invoiced accordingly in due course. This charge will be £50 as agreed.

Emma Hayes
ENCIA Consulting Ltd
Encia House
Audby Lane
Wetherby
LS22 7RD

This information is submitted as being the position to-date and other information may be available in records not held by this Authority at the present time. The Borough Council cannot, therefore accept liability or be prejudiced by the views expressed.

Should you wish to discuss this correspondence further, please don't hesitate to contact me.

Yours faithfully



John Scott
Contaminated Land Officer

creating a better place



Emma Hayes
Encia Consulting Limited
Encia House
Audby Lane
Wetherby
LS22 7RD

Our Ref : RFI/2007/972
Your Ref :

RECEIVED	12 MAR 2007	Date :	9 March 2007
JOB No.	F.A.O.		
9374	ELH		
26067			

Dear Emma

Higham Lane, Dodworth

Thank you for your enquiry, which was received on 15 February 2007, and subsequent payment of 26 February 2007.

Planning

We have no constraints in place regarding the proposed development.

Development Control

The Environment Agency "Flood Zone Maps" show the identified site to be in Planning Policy Statement 25 Development and Flood Risk (PPS25) zone 1, outside the 1 in 1000 year flood plain.

We have no record of this site having suffered flooding.

Our records show a drainage ditch running along the base of the railway embankment. It is not known what the capacity of this watercourse is or whether the site would drain to it naturally. The applicant would have to provide further information on this before the Agency could comment on whether or not this watercourse would be suitable for discharging of surface water from the site.

Any culverting of a watercourse requires the prior written approval of the Agency under the terms of the Land Drainage Act 1991 or Water Resources Act 1991. The Agency resists culverting on conservation and other grounds, and consent for such works will not normally be granted except for access crossings.

Under the terms of the Land Drainage Act 1991, the prior written consent of this Agency is required for any proposal to divert, culvert or otherwise obstruct the flow in any watercourse (including the provision of a connection to a culvert).

Phoenix House, Global Avenue, Leeds, LS11 8PG
Customer services line: 08708 508 508
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Notice for the supply of Environment Agency information (Standard Notice)

There are no active/non-active landfill sites within 250m's of the proposed development.

There are two consented discharges within 500m's of the property, please see the enclosed information.

Water Resources

There are no abstraction licences within 0.5km of the said grid reference.

Groundwater and Contaminated Land

The site is not within a currently defined Groundwater Source Protection Zone.

The site is located on undifferentiated Coal Measures. The Coal Measures, although composed of a variety of rock types, are designated as a Minor Aquifer (Policy and Practice for the Protection of Groundwater, EA, 1998).

The soil has a low leaching potential according to sheet 11 of the EA Groundwater Vulnerability Maps. Therefore the groundwater has a relatively low vulnerability to potentially polluting activities.

Biodiversity

We hold no records of protected species within 1km of this site.

There is a drain, which runs along the left edge of the proposed development site. The Agency's goal is to protect an enhance the environment and as a result of this Agency policy opposes the culverting of open watercourses. We like to see features like this watercourse incorporated into the development with ecological enhancements where possible.

Fisheries

We have no concerns/comments in relation to the proposed development

The information provided is based on that currently available to the Agency. The Agency and its officers accept no liability whatsoever for any loss or damage arising from the interpretation or use of the information.

I can advise that the interpretation of the information is your own responsibility however, should you have any queries regarding this letter, please contact this office at the address given below.

This information is provided subject to the enclosed notice, which you should read.

Yours sincerely

Cheryl Howe

**CHERYL HOWE
EXTERNAL RELATIONS OFFICER**

Encs

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Issued by:

The Coal Authority, Mining Reports Office, 200 Lichtfield Lane, Berry Hill, Mansfield, Nottinghamshire NG18 4RG
On-Line Service: www.coalminingreports.co.uk - Phone: 0845 762 6848 - DX 716176 MANSFIELD 5

EMMA HAYES,
ENCA CONSULTING LIMITED,
2 AUDBY LANE,
WETHERBY,
WEST YORKSHIRE,
LS22 4RD

Person dealing with this matter: **Darreea Moody**
Our reference: 00014917-07
Your reference: 9374-RM1-003745
Electronic Ref: EME_00006208760001_005
RRUID: 005.00006208760001
Date of your enquiry: 15 February 2007
Date we received your enquiry: 15 February 2007
Date of issue: 16 February 2007

This report is for the property described in the address below and the attached plan.

Coal and Brine Report
Land At, Higham Lane, Dodworth, Barnsley, South Yorkshire

This report is based on and limited to the records held by, the Coal Authority, and the Cheshire Brine Subsidence Compensation Board's records, at the time we answer the search.

Coal mining	Yes
Brine extraction	No

Information from the Coal Authority
Underground Coal Mining

Past

The property is in the likely zone of influence from workings in 6 seams of coal at 60m to 260m depth, and last worked in 1966.

Any ground movement from these coal workings should have stopped by now.

In addition the property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked at some time in the past.

Present

The property is not in the likely zone of influence of any present underground coal workings.

Future

The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods.

The property is not in an area for which a licence has been granted to remove coal using underground methods.

The property is not in an area that is likely to be affected at the surface from any planned future workings.

However reserves of coal exist in the local area which could be worked at some time in the future.

No notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

Mine entries

There are no known coal mine entries within, or within 20 metres of, the boundary of the property.

Records may be incomplete. Consequently, there may exist in the local area mine entries of which the Coal Authority has no knowledge.

Coal-mining geology

At the surface, there are no known faults or other lines of weakness due to coal mining that have made the property unstable.

Opencast Coal Mining

Past

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

Present

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

Future

The property is not within 800 metres of the boundary of an opencast site for which the Coal Authority is determining whether to grant a licence to remove coal by opencast methods.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

Coal-mining subsidence

The Coal Authority has not received a damage notice or claim for the property since 1 January 1984.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority has not received a request to carry out preventive work before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Authority, following the reporting of an alleged coal mining related hazard under its Emergency Surface Hazard Call Out procedures.

Withdrawal of Support

The property is not in an area for which a notice of entitlement to withdraw support has been published.

The property is not in an area for which a notice has been given under section 41 of the Coal Industry Act 1994, revoking the entitlement to withdraw support.

Working Facilities Orders

The property is not in an area for which an Order has been made under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

Payments to Owners of Former Copyhold Land

The property is not in an area for which a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Comments on Coal Authority Information

Where development proposals are being considered, technical advice should be obtained before beginning work on site. All proposals should apply good engineering practice developed for mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without the permission of the Coal Authority.

Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Additional remarks

This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions 2006. The report is compliant with Home Information Pack requirements.

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Location map



Approximate position of property

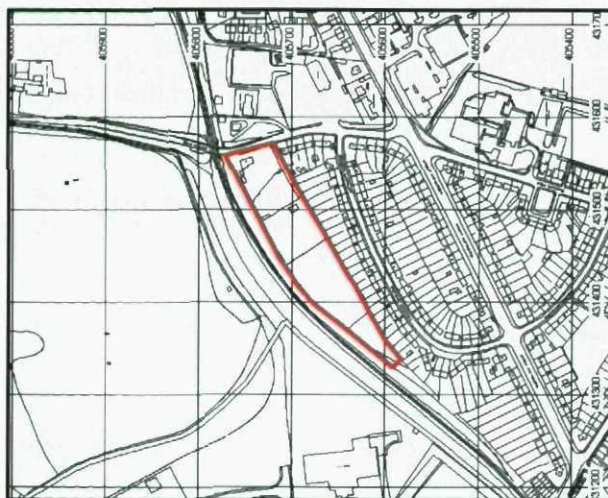


Enquiry boundary

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Key

Approximate position of enquiry boundary shown



Radon Protective Measures Site Report – Standard

Advisory report on the requirement for radon protective measures in new dwellings and extensions including a BR211 (1999) Stage 2 Geological Assessment

Client's Reference:

9373/1

Section 1: Location and extent of report area

Area centred at: 431500, 405700
Radius of site area: 200 metres



Scale: 1:25000 (1cm = 250m)
KEY:



INNER RECTANGLE or CIRCLE defines site area (details provided by client).

OUTER LINE shows extent of TOTAL SEARCH AREA comprising the site area and automatically generated buffer zone. The requirement for radon protective measures indicated in Section 2 is based on a geological assessment of the Total Search Area.

Please see Section 4 for details of how the search is carried out

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Section 2: Requirement for radon protective measures

The determination below follows the two stages described in *BR211 Radon: Guidance on protective measures for new dwellings (1999 edition)*, which also provides guidance on what to do if the result indicates that protective measures are required.

Stage 1

Stage 1 (Annex A) of the BR211 (1999) procedure indicates that the minimum level of protection for the report area is **NO** radon protective measures.

Stage 2

The Stage 2 geological assessment carried out for this report indicates **BASIC** radon protective measures are required for the report area. This assessment was derived automatically from the BGS Radon Protective Measures GIS (RPM-GIS) from 1:250,000 scale digital data. Results of the geological search are described in Section 3, and more detail on the assessment procedure is outlined in Section 4.

Result

The BR211 (1999) two-stage procedure indicates that **BASIC** protective measures are required for the site. This is the higher of the two levels of protection indicated by Stage 1 and Stage 2.

The BGS is not able to provide advice on the technical specifications of 'basic' and 'full' radon protective measures. This information is detailed in **BRE Report BR211 :Radon: Protective measures for new dwellings** which may be purchased from [brebookshop.com](http://www.bre.co.uk/radon/protect.html). BR211 offers guidance on the technical solutions that are required to satisfy Building Regulations requirements. Summary guidance is available on the web at:

<http://www.bre.co.uk/radon/protect.html>.

If you require further information or guidance, you should contact your local authority building control officer or approved inspector.

Contact 020 7944 5745 or Email: partscdgh.br@odpm.gsi.gov.uk for advice on the interpretation of guidance contained in BRE Report BR211.

Section 3: Geological units within the search area

Below is a listing, if available, of the possible combinations of Bedrock (Solid) Geology units and overlying Superficial (Drift) Geology units within the total search area derived automatically by the RPM-GIS.

These have been derived (as indicated) from searches of either:

- a) Combined 1:250,000 Bedrock (Solid) and 1:625,000 Superficial (Drift) geology maps
- b) 1:50,000 Bedrock (Solid), Superficial (Drift) and Artificial geology maps

1:250,000 data

- 1. MIDDLE COAL MEASURES (FORMATION)/(SANDSTONE 3D00); No drift
- 2. LOWER COAL MEASURES (FORMATION)/(ARGILLACEOUS ROCKS, UNDIFFERENTIATED); No drift
- 3. MIDDLE COAL MEASURES (FORMATION)/(ARGILLACEOUS ROCKS, UNDIFFERENTIATED); No drift

Section 4: Determining the level of radon protection.

BR 211 (1999) sets out a two-stage procedure to help determine the level of radon protection required in new dwellings and extensions.

In Stage 1 of the procedure, the 5 km grid square radon potential maps (Annex A, BR211, 1999) produced by the National Radiological Protection Board (NRPB) are used to make the primary determination of the level of radon protection needed. The NRPB maps are based on the average estimated proportion of homes exceeding the radon Action Level for each 5 km square of the Ordnance Survey National Grid.

In Stage 2, a second series of maps produced by the BGS (Annex B, BR211, 1999) is used to decide whether it is necessary to consider upgrading the requirement for protection indicated by Stage 1. This procedure has the objective of avoiding cases of underprotection that might occur had the guidance depended solely on the average radon level in the 5 km grid square indicated by the NRPB maps. The BGS maps in Annex B (BR211, 1999) show those 5 km grid squares that are uncertain, completely or in part, by geological units that require either basic or full protection to be installed in new dwellings.

A geological assessment may need to be carried out where the site falls within a shaded grid square on the BGS map in Annex B of BR211 (1999). The geological assessment checks whether a site is on or close to a geological unit which potentially exceeds the action levels for either basic or full radon protection. Consideration must be given to installing basic or full radon protection if the geological assessment shows that this is indicated. If a site falls within one of the shaded squares, it does not necessarily mean that it must have radon protection. This is because some of the grid squares contain bed rocks and unconsolidated (drift) deposits with lower radon potential than the maximum levels shown on the 5 km grid maps in Annex B (BR211, 1999).

In many cases the geological radon potential varies considerably within a grid square. In other cases, only a very small area (sometimes only a few hundred square metres) with a radon potential exceeding the thresholds for basic or full protection occurs within the shaded grid square. The level of protection that might be required is thus site specific, and can be determined by reference to the relevant radon potential map in BR211 (1999) followed by a geological assessment of the site.

(Please note, the NRPB is now the Radiation Protection Division of the Health Protection Agency)

The geological assessment in this report is produced by the BGS Radon Protective Measures Geographical Information System (RPM GIS), which has been developed to provide Stage 2 Geological Assessments (RPM Site Reports). The assessment is derived from a geologically based interpretation of radon measurements in dwellings which were provided to the BGS by the NRPB without prejudicing confidentiality undertakings to householders and the Department of the Environment, Food and Rural Affairs (DEFRA). The reliability of a geological radon potential assessment is approximately proportional to the number of radon measurements available and the scale of the geological maps.

The RPM GIS currently comprises 1:250,000 scale data with more detailed information for twenty 1:50,000 scale geological map sheets covering the most radon-prone parts of Derbyshire, Northamptonshire, Nottinghamshire, Leicestershire, Lincolnshire, Oxfordshire, Shropshire, Somerset and Yorkshire. The RPM-GIS is being upgraded to 1:50,000 scale as new digital maps become available through the BGS DigMapGB programme.

The search area (circle or rectangle) for a site is increased by a buffer zone of 50 m in areas with 1:50,000 scale data and 500m in areas with 1:250,000 scale data. This is to allow for potential inaccuracies in the position of the geological boundaries. In many cases a number of combinations of bed rock and drift with differing geological radon potentials will occur within the total search area. Following the precautionary principle, the requirement for protective measures is derived from the highest geological radon potential encountered within the total search area.

Section 5: Follow-up Detailed Radon Protective Measures site report

For most parts of the UK, a higher resolution assessment of radon protective measures requirements can also be provided by BGS. This will comprise:

- Assessment by a qualified geologist of the relevant 10,000, 1:10,560 or 1:50,000 scale geological map(s) covering the total search area from BGS archives.
- Identification of the level of radon protective measures indicated for all geological units encountered within the site and the immediately surrounding area.

The basic charge for a Detailed Radon Protective Measures Report is **£230 (incl. VAT & Delivery)**. Reports for very large or geologically complex sites may, however, have to be supplemented with additional charge – in such cases, enquiry staff will confirm the charge with the client before proceeding.

Before ordering either a Detailed Radon Protective Measures report, please refer to the clear descriptions of the BR211 process as described in Figure 3 of BR211 (1999) and the guidance on BR211 published in Environmental Radon Newsletter, Issue 23 (http://www.bgs.ac.uk/radiation/publications/newsletters/environmental_radon/2000/ern23.pdf). In particular, users should be aware that the Stage 2 geological assessment (even in a Detailed Radon Protective Measures report) cannot override the Stage 1 (Annex A BR211) assessment, which represents the minimum level of protection for a report area.

The Radon follow-up reports can be ordered from:-

Geological Enquiries, British Geological Survey, Keyworth, Nottingham NG12 5GG; Tel: 0115-936-3192;
Fax: 0115-936-3192; e-mail: geohelp@bgs.ac.uk. An on-line ordering facility is available on the BGS Website: www.bgs.ac.uk/georeports.

Section 6: What is radon ?

Radon is a naturally occurring radioactive gas, which is produced by the radioactive decay of radium which, in turn, is derived from the radioactive decay of uranium. Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. Radon that enters poorly ventilated enclosed spaces such as some basements, buildings, caves, mines, and tunnels may reach high concentrations in some circumstances. The construction method and degree of ventilation will influence radon levels in individual buildings. A person's exposure to radon will also vary

according to how particular buildings and spaces are used.

Inhalation of the radioactive decay products of radon gas increases the chance of developing lung cancer. If individuals are exposed to high concentrations for significant periods of time, there may be cause for concern. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). The Government advises householders that, where the radon level exceeds the Action Level, measures should be taken to reduce the concentration.

Section 7: Radon in workplaces

The Ionising Radiation Regulations, 1999, require employers to take action when radon is present above a defined level in the workplace. Advice may be obtained from your local Health and Safety Executive Area Office or the Environmental Health Department of your local authority. The BRE publishes a guide (BR293): **Radon in the workplace**.

BRE publications may be obtained from The BRE Bookshop, I H S Technical Indexes Ltd., Willoughby Road, Bracknell, Berkshire RG12 8DW. Tel: 01344 404407, Fax: 01344 714440, website: www.brebookshop.com

Section 8: Radon in existing dwellings

Useful information is given in the following free publications which can be obtained by writing to: Radon Studies, Radiation Protection Division, Health Protection Agency, Chilton, Didcot, Oxfordshire OX11 0RQ

Radon - A Householder's Guide

Radon - You Can Test for it

Radon - A Guide for Homebuyers and Sellers

Radon - A Guide to Reducing Levels in Your Home

Information in the booklets is also available on the DEFRA website at:

<http://www.defra.gov.uk/environment/radioactivity/background/radon.htm>

Householders are recommended to follow advice in **Radon - a householder's guide**. The guide outlines simple solutions for dealing with the radon problem depending on whether or not the home has been tested for radon. In radon affected homes, the problem of radon can usually be tackled with simple, effective and relatively inexpensive measures. These measures are comparable in cost to work such as damp-proofing and timber treatment. You can get practical advice about construction work to reduce radon levels from the Building Control Officer at your

local council.

Advice about radon, its health risks and details of how to order the radon test may be obtained from the **Radon Freephone** on 0800 614529 or Tel: 01235 822622, website: www.bgs.org.uk or by writing to Radon Studies at the Health Protection Agency, address above.

Section 9: Terms & Conditions

General

This report is supplied in accordance with the GeoReports Terms & Conditions available on the BGS website at www.bgs.ac.uk/georeports and also available from the BGS Central Enquiries Desk at the below address.

Important notes about this report

- The data, information and related records supplied in this report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
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- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.

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Report issued by: BGS Enquiries Service

For further information, please contact:

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Email: enquiries@bgs.ac.uk

Pro/002/RJH/rjh

12th February 2007

Mr D Adams
Redrow Homes Yorkshire Limited
Redrow House
Brunel Road
Wakefield 41
Wakefield
WF2 0XG

Dear Dave

25 Higham Lane, Dodworth

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We have assumed that at your proposed development will include traditional two storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; although no layout is available yet.

Review of topographic survey supplied with your correspondence dated 9th February 2007, suggests that the site consists of a single parcel of land of approximately 1.2 hectares off Higham Lane, Dodworth.

The site currently comprises a single storey dwelling and associated garden fronting Higham Lane. Paddocks currently used for equestrian grazing extend to the west and area accessed via a gate off Higham Lane. An operational rail-line runs on an embankment along the northern boundary.

Our records suggest that the site has remained undeveloped (with the exception of the dwelling) throughout its history. The site is understood to have been used as allotment gardens since the early 1960's.

The scope of works outlined in this letter should enable us to assess abnormal development issues, associated with ground. However, the nature of site investigation is such that it is not always possible to foresee all the potential issues. Consequently, it is sometimes necessary to recommend additional work, but where this occurs we will inform you immediately, provide costs, and seek your further instruction. We have visited the site and reviewed available geological maps in order to minimise the likelihood of further work.

Some uncertainties may remain in the area of the existing dwelling and a supplementary, post-demolition ground investigation may be required by the relevant regulatory authorities.

Brief examination of the relevant geological map suggests the site is underlain predominantly by sandstone with mudstone in the north-east. The Lidgett Coal outcrops in the extreme northern corner of the site. The next shallowest coal seams are the Joan Coal (0.36m to 0.61m thick, minimum depth approximately 16m) and the Flockton Thick (0.48m to 2.16m, minimum depth approximately 30m). The Tankersley Ironstone lies between the Joan and Flockton Thick seams. Given their depths and thicknesses none of these mineral seams are expected to be of concern at the site. This will be confirmed by during the preliminary desk based investigation.

Our site investigation proposal allows for the following works:

Desk Study: An examination of historical Ordnance Survey plans will be made to determine whether any past land uses have had any effect on the proposed development. Additionally, published geological plans of the area will be examined and enquiries will be made of the ***Environment Agency, Coal Authority and the Local Authority. Depending on the sensitivity of your interest in the site you may wish that we do not undertake some or all of these consultations and we will be guided by your letter of instruction.

Fieldwork: At this stage we have allowed for one day's trial pitting (no allowance has been made for soakaway testing). If required, or considered feasible based on ground conditions encountered, soakaway tests could be undertaken for an additional fee of about £1,200. All trial pits will be supervised and logged by an experienced geoenvironmental engineer.

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane. Mackintosh probing will be undertaken within and adjacent to pits in order to determine the in-situ density of any granular soils.

We will make every effort to compact arisings and 'sweep' them over each pit. However, you should be aware that on completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) unsuitable for trafficking, will be left at each trial pit location. At this stage, no allowance has been made for any further reinstatement.

If the pitting encounters significant thicknesses of made ground or very soft/loose deposits (neither considered likely), boreholes may be required to obtain geotechnical data from greater depth. We will advise you of any need for boreholes within 2 days of completion of the pitting.

The desk study may highlight other potential problems with the site such as landfill gas, quarrying, shallow mining or soil contamination. It may therefore be necessary to carry out additional works, but we will inform you prior to undertaking any such work and provide revised a cost estimate.

Soils Testing: This will comprise routine geotechnical soils analysis, typical of that normally required for greenfield sites. Although no allowance has been for in-situ or laboratory CBR testing, CBR values will be estimated from the extra descriptions and classification test results, where appropriate (i.e. if no significant regrading or reworking of made ground is proposed).

Testing of potentially contaminated samples should only be required if made ground is encountered in the exploratory holes. If made ground is encountered, we will inform you immediately and provide costs for the necessary chemical testing. Although given the site location allowance has been made to assess the suitability of topsoil for reuse.

Reporting & Timescales: In order to provide you with sufficient information to enable assessment of abnormal costs at the earliest opportunity we will issue a concise overview report within three days of fieldwork completion.

On completion of the desk study, fieldwork and laboratory testing a comprehensive bound, factual and interpretative report will be issued. This will contain detailed engineering records, laboratory test results, copies of all relevant correspondence and drawings of the site. The report will include qualitative risk assessment with respect to both controlled waters and human health.

The report will also provide technically feasible options for redevelopment of the site with housing, including consideration of foundation types and treatment/removal of contamination.

Allowing for receipt of statutory search information, the preliminary investigation will require up to four weeks and fieldwork would take one day. However, at this time fieldwork could be commenced prior to completion of the preliminary investigation, within approximately one week of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report (1 bound & 1 loose copy) will be issued within five weeks of fieldwork completion.

Given previous usage of this land, it is considered unlikely that significant contamination will be encountered, consequently at this stage we have not allowed for the production of either a Remedial Strategy and Quantitative Risk Assessment reports.

Copies of the final report will be issued to the relevant regulatory authorities on receipt of written instruction from yourselves.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of £**** plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent.

Our proposal allows for submission of the report to the Local Authority and N HBC, and for submission of a single piece of subsequent correspondence with each regulator to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

We will submit our invoice for this project with the final report.

Underground Services: Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption/repair costs. We will obtain the necessary plans (to include electricity, gas, water, drainage & telecom) direct from each of the utility companies and our proposal allows for this.

We will make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, ENCIA cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

Terms & Conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are printed on the back of the first page of this letter.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely



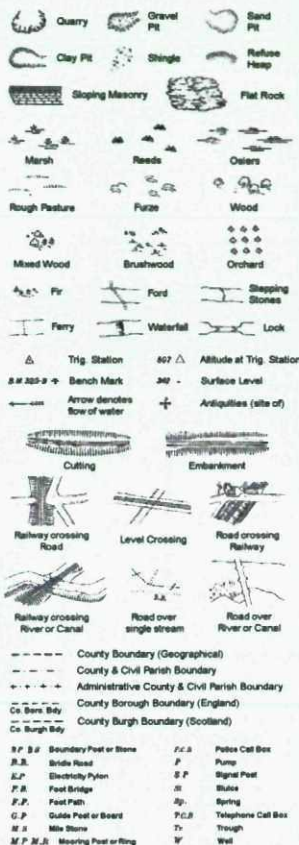
Richard Hey
Regional Director
for and on behalf of
ENCIA CONSULTING LIMITED

enc

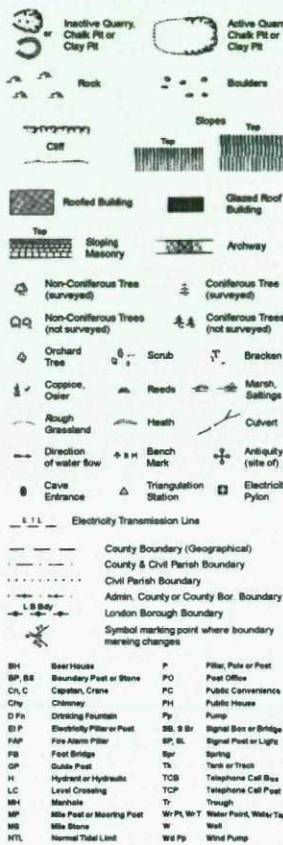
APPENDIX E HISTORICAL OS PLANS

Historical Mapping Legends

Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



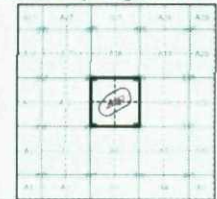
Large-Scale National Grid Data 1:2,500 and 1:1,250



Ordnance Survey mapping included:

Mapping Type	Scale	Date	Page
Yorkshire	1:2,500	1893	2
Yorkshire	1:2,500	1894	2
Yorkshire	1:2,500	1901	4
Ordnance Survey Plan	1:2,500	1892	5
Ordnance Survey Plan	1:2,500	1891	6
Ordnance Survey Plan	1:2,500	1892	7
Ordnance Survey Plan	1:2,500	1893	8
Ordnance Survey Plan	1:2,500	1894	9
Ordnance Survey Plan	1:2,500	1895	10
Ordnance Survey Plan	1:2,500	1896	11
Ordnance Survey Plan	1:2,500	1897	12
Ordnance Survey Plan	1:2,500	1898	13
Ordnance Survey Plan	1:2,500	1899	14
Ordnance Survey Plan	1:2,500	1900	15

Historical Map - Segment A13



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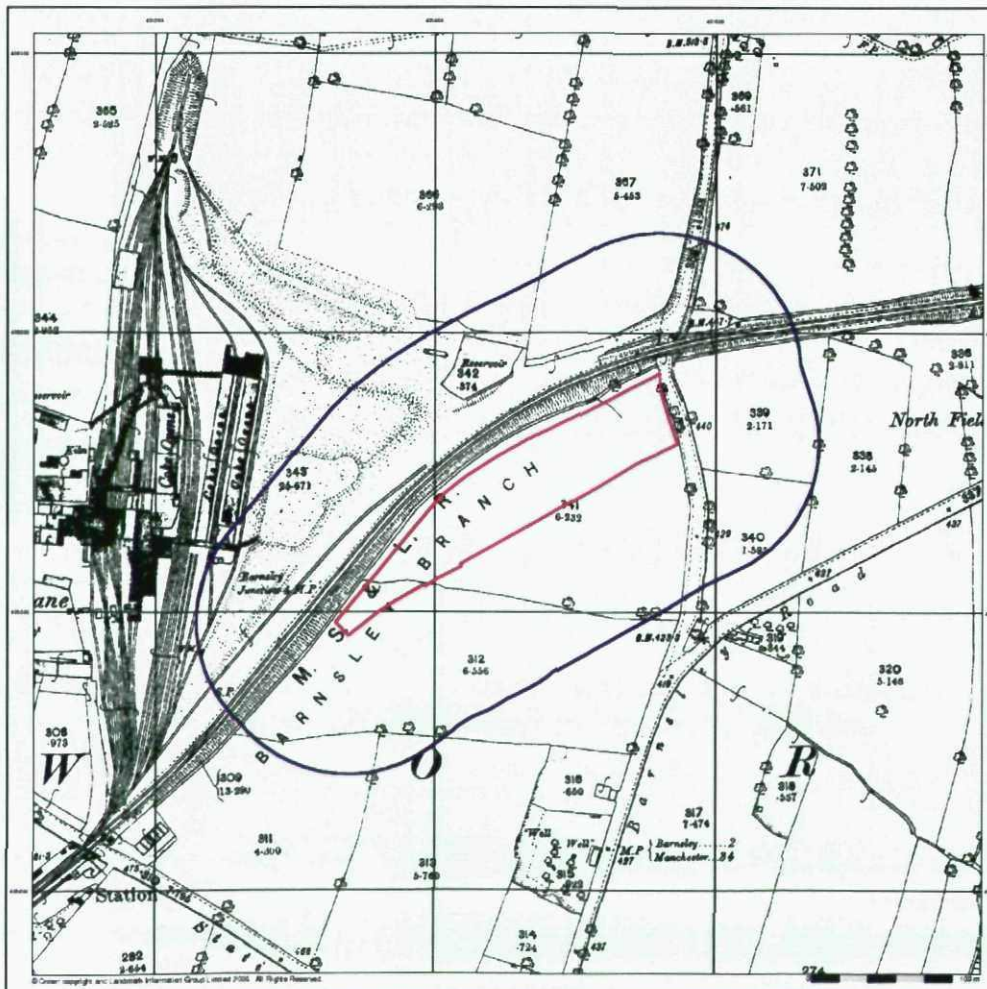
Site Details

Site at 431500, 405700



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Fax: 0870 880 8871
Web: www.envirocheck.co.uk

A Landmark Information Group Service v20.0 15-Feb-2007 Page 1 of 15



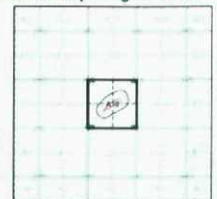
Yorkshire Published 1893 Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1890 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1858, 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 adjoining areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



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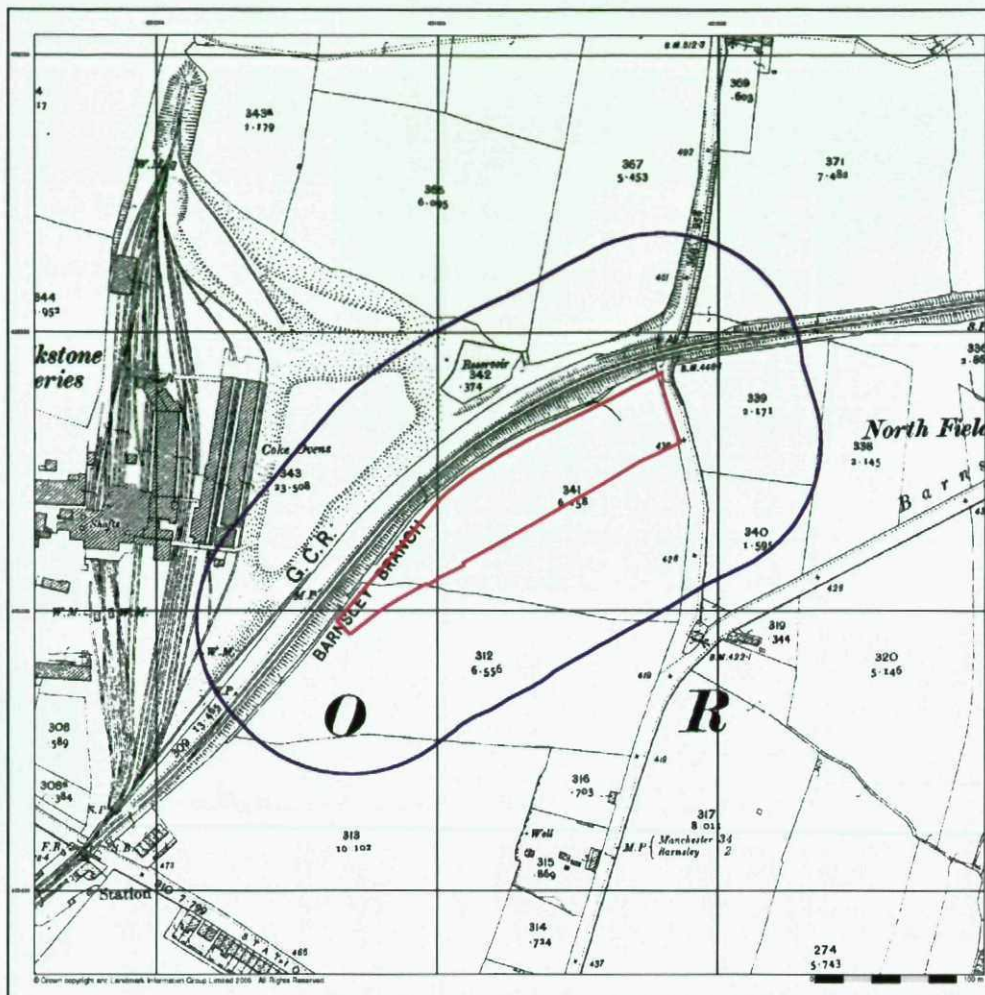
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Site at 431500, 405700



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A Landmark Information Group Service v20.0 15-Feb-2007 Page 2 of 15



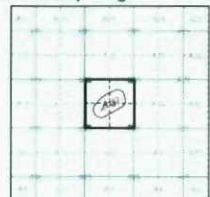
Yorkshire
Published 1906
Source map scale - 1:2,500

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Map Name(s) and Date(s)



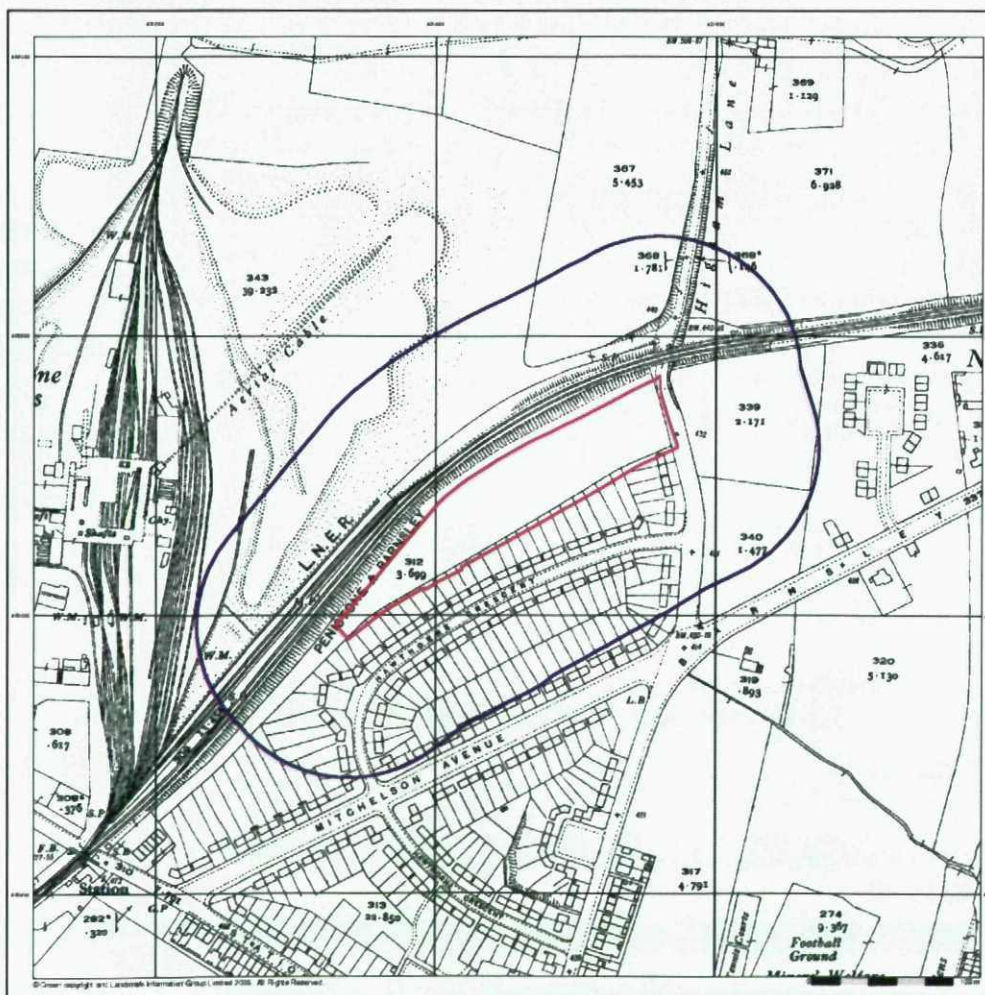
Historical Map - Segment A13



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Site Details
Site at 431500, 405700



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Yorkshire
Published 1931
Source map scale - 1:2,500

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Map Name(s) and Date(s)



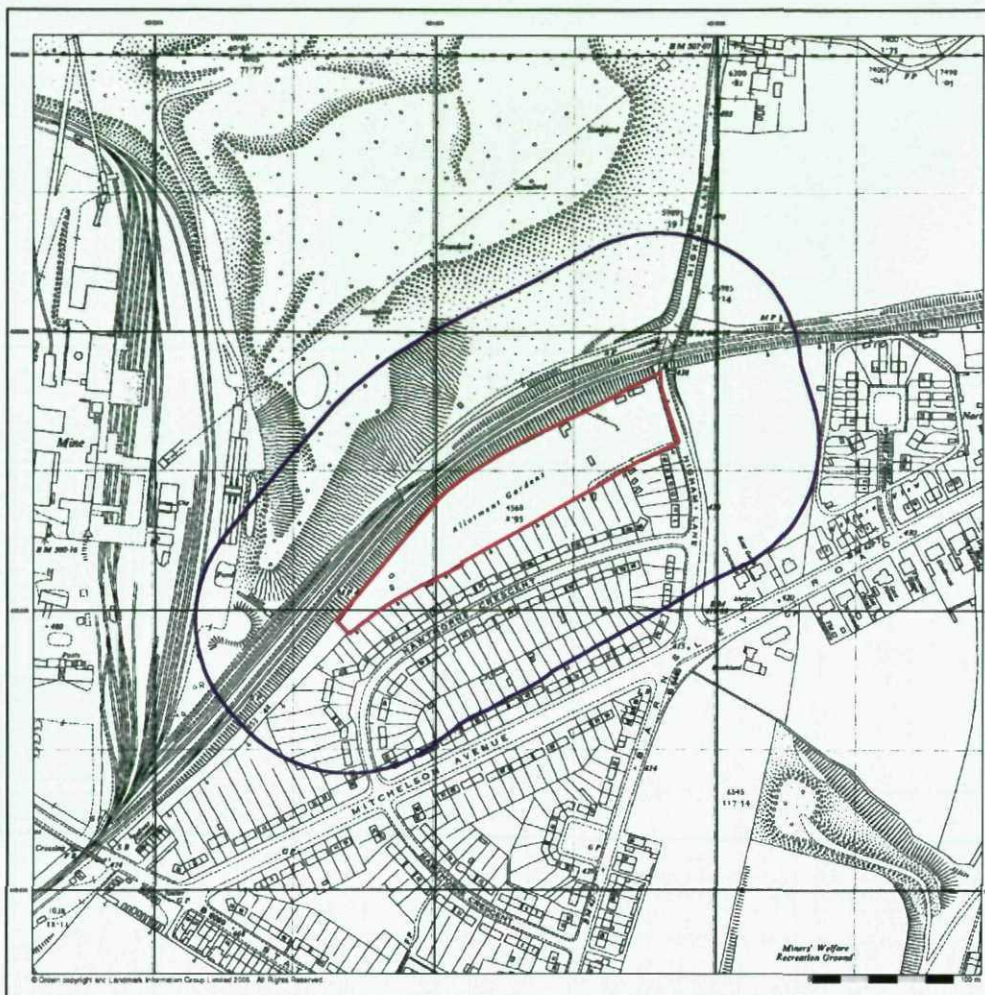
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Web: www.envirocheck.co.uk



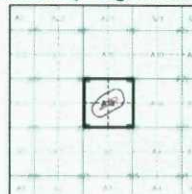
Ordnance Survey Plan
Published 1962
Source map scale - 1:2,500

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Map Name(s) and Date(s)



Historical Map - Segment A13

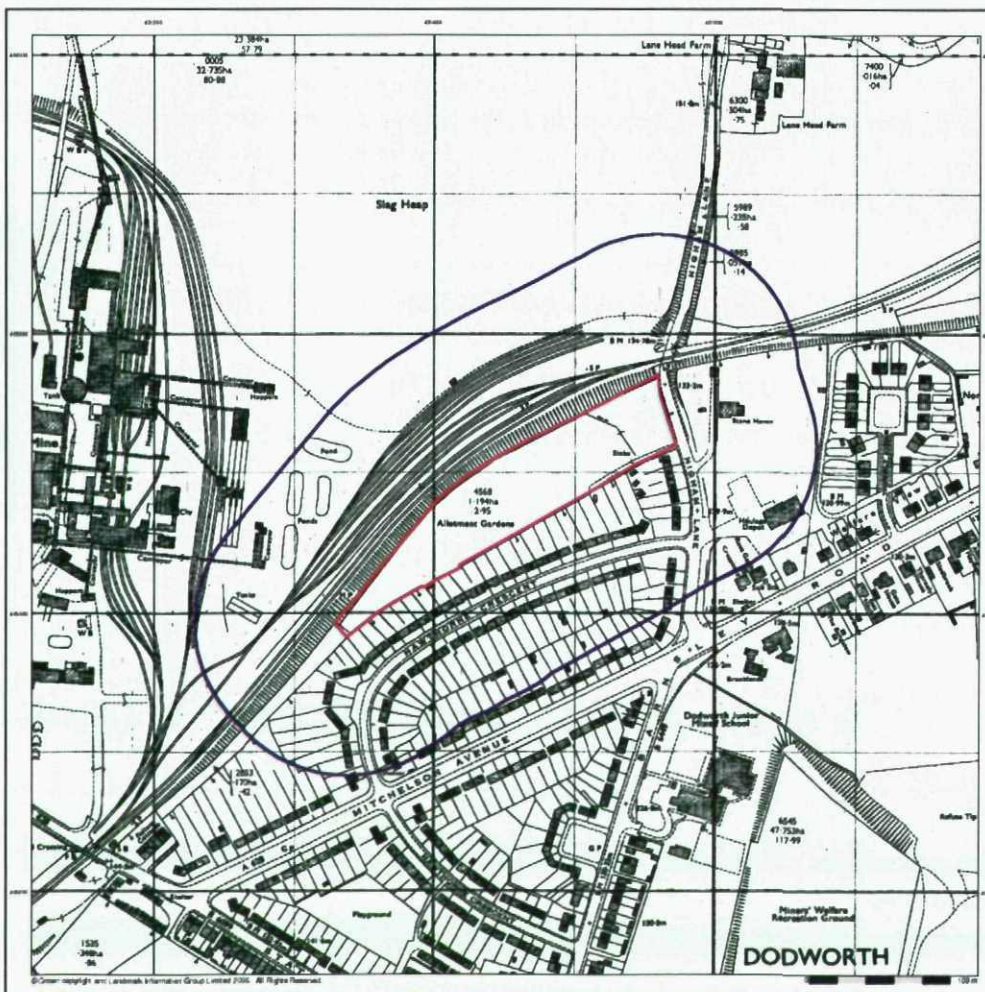


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Site at 431500, 405700



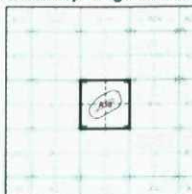
Ordnance Survey Plan
Published 1971
Source map scale - 1:2,500

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Map Name(s) and Date(s)



Historical Map - Segment A13

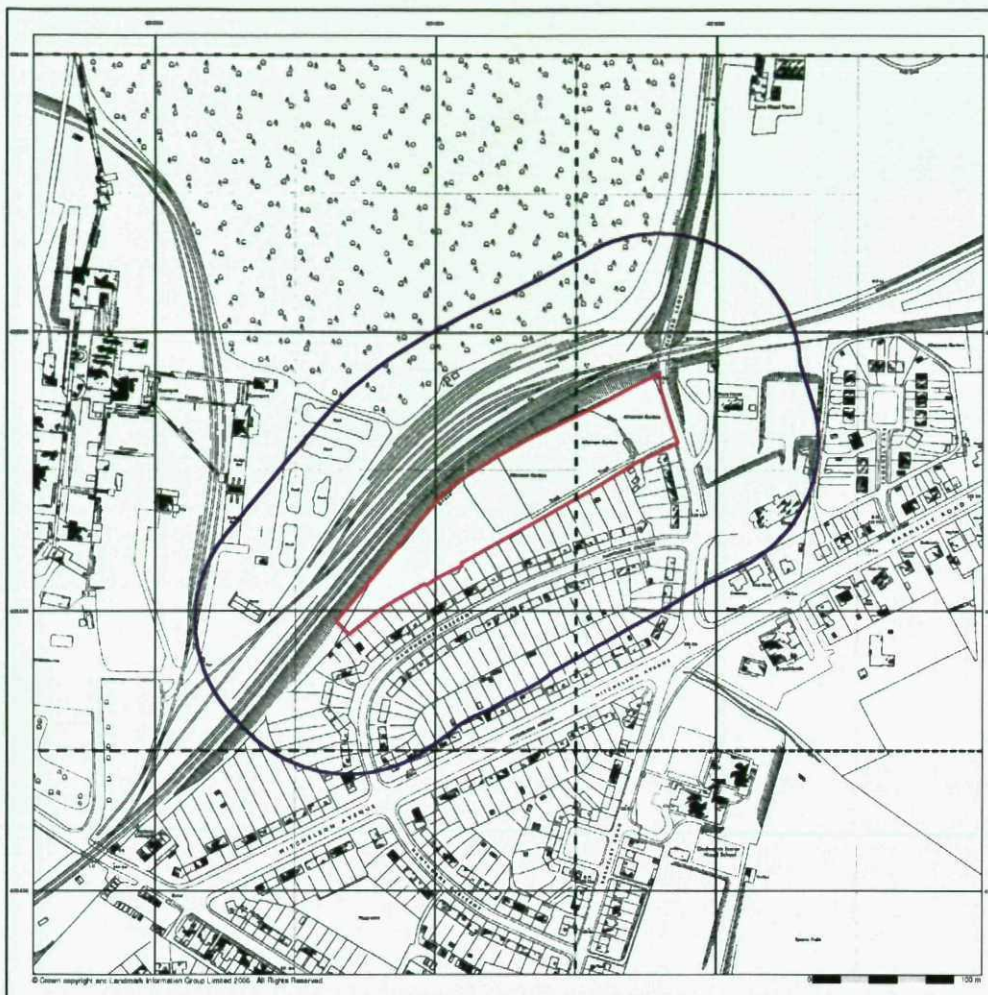


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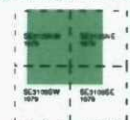
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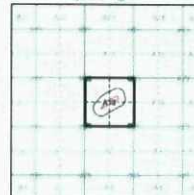
Ordnance Survey Plan
Published 1979
Source map scale - 1:1,250

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 2,500 scale was adopted for mapping urban areas and by 1890 it covered the whole of what was considered to be the subdivided parts of Great Britain. The published date given below 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.

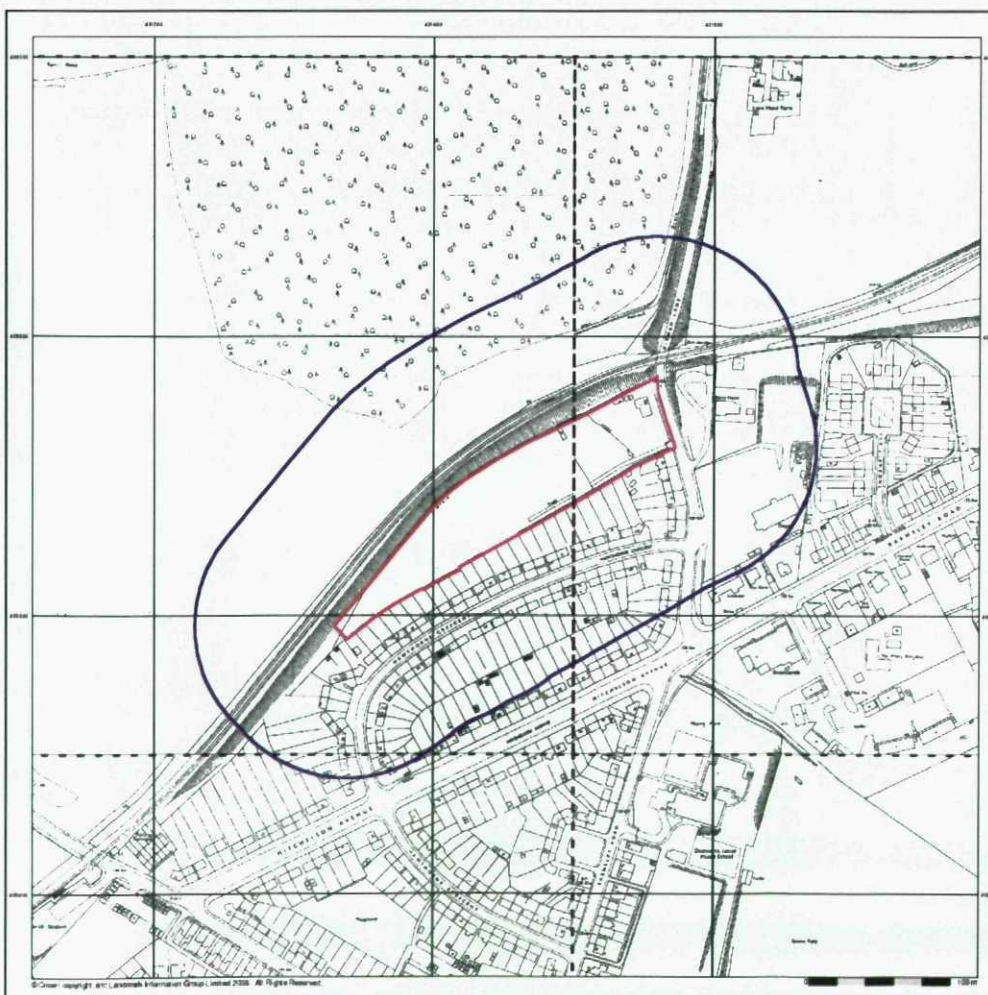
Map Name(s) and Date(s)



Historical Map - Segment A13



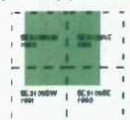
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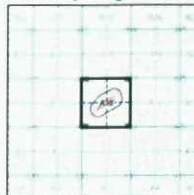
Additional SIMs
Published 1990 - 1991
Source map scale - 1:1,250

The SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in the main editions as an area was updated. They date from 1947 to 1991, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

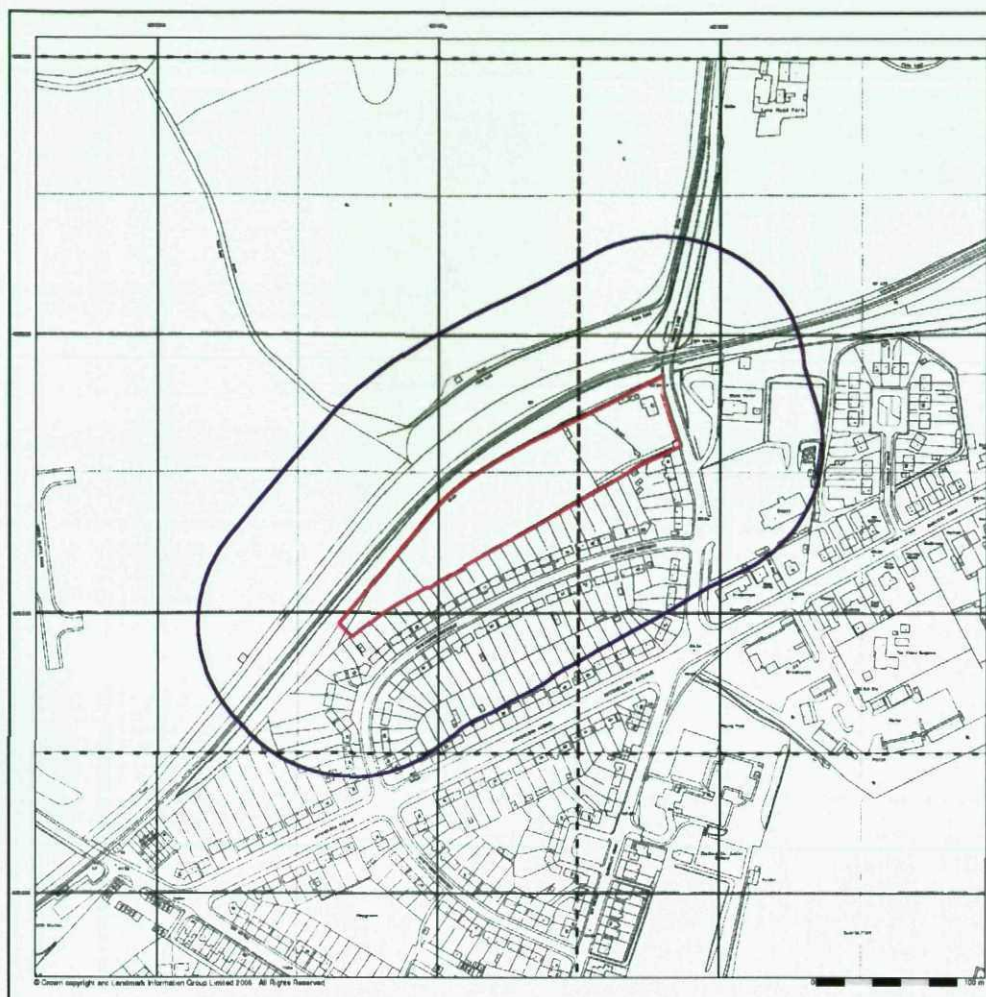
Map Name(s) and Date(s)



Historical Map - Segment A13



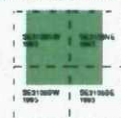
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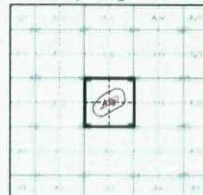
Large-Scale National Grid Data
Published 1993 - 1995
Source map scale - 1:1,250

Large Scale National Grid Data superseded BM data (Ordnance Survey's Survey of Information on Microfilm) in 1992, and continued to be produced until 1995. These maps were the forerunners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

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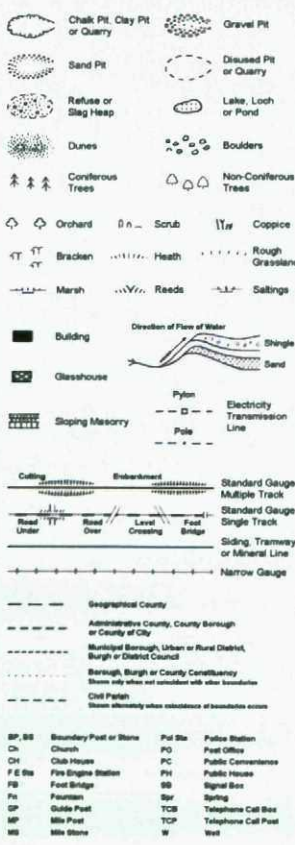
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Historical Mapping Legends

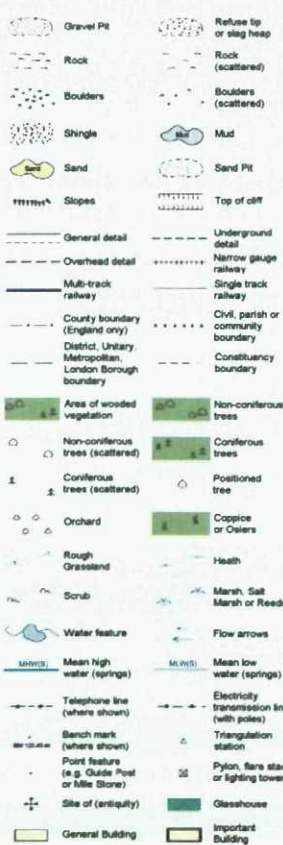
**Ordnance Survey County Series and
Ordnance Survey Plan 1:10,560**



Ordnance Survey Plan 1:10,000



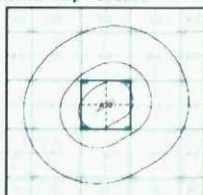
1:10,000 Raster Mapping



Ordnance Survey mapping included:

Mapping Type	Scale	Date	Py
Yorkshire	1:10,560	1885	7
Yorkshire	1:10,560	1891 - 1894	3
Yorkshire	1:10,560	1907	4
Yorkshire	1:10,560	1928	5
Ordnance Survey Plan	1:10,560	1958	6
Ordnance Survey Plan	1:10,560	1965 - 1966	7
Ordnance Survey Plan	1:10,560	1973 - 1978	8
Ordnance Survey Plan	1:10,560	1983	9
Ordnance Survey Plan	1:10,560	1978 - 1993	10
10K Raster Mapping	1:10,000	2000	11
10K Raster Mapping	1:10,000	2004	12

Historical Map - Slice A

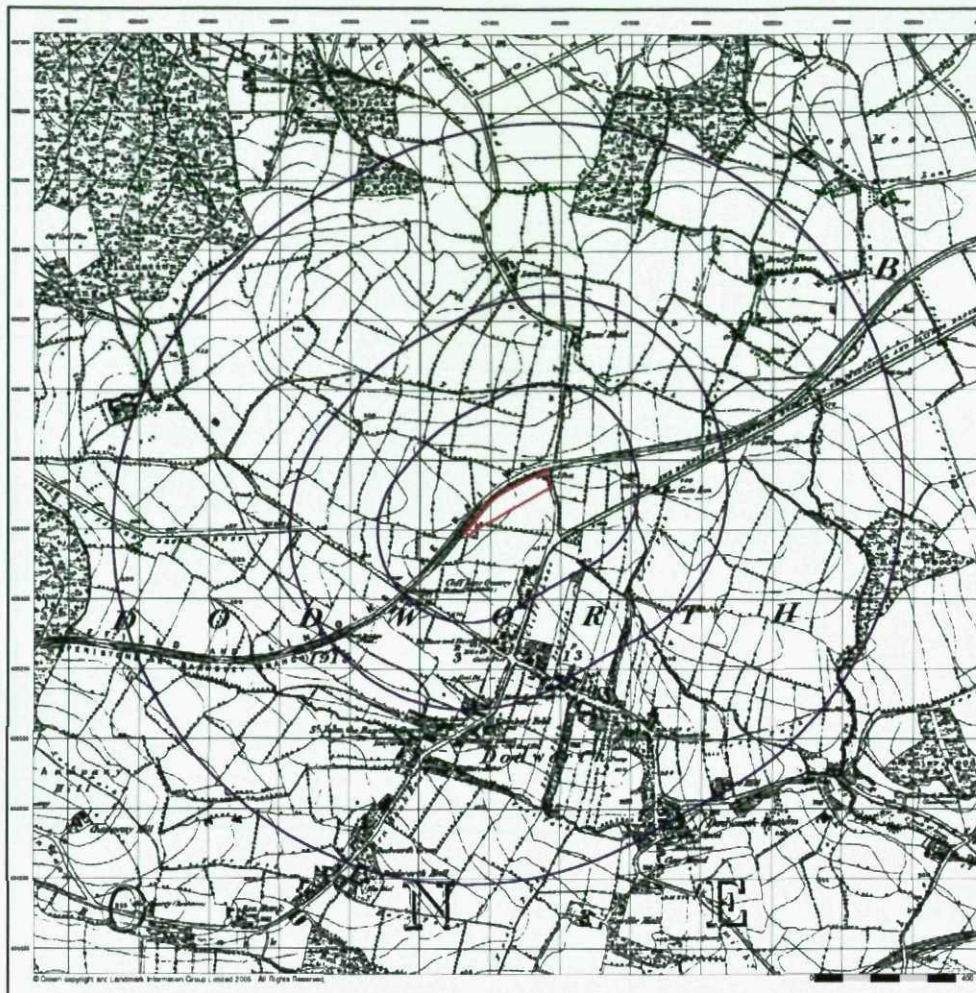


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Site Details

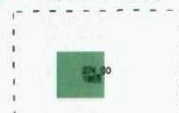
Site at 431500, 405700



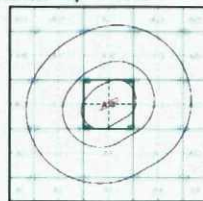
Yorkshire
Published 1855
Source map scale - 1:10,560

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 1:10,560 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published data 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 adjoining 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 overlaid 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

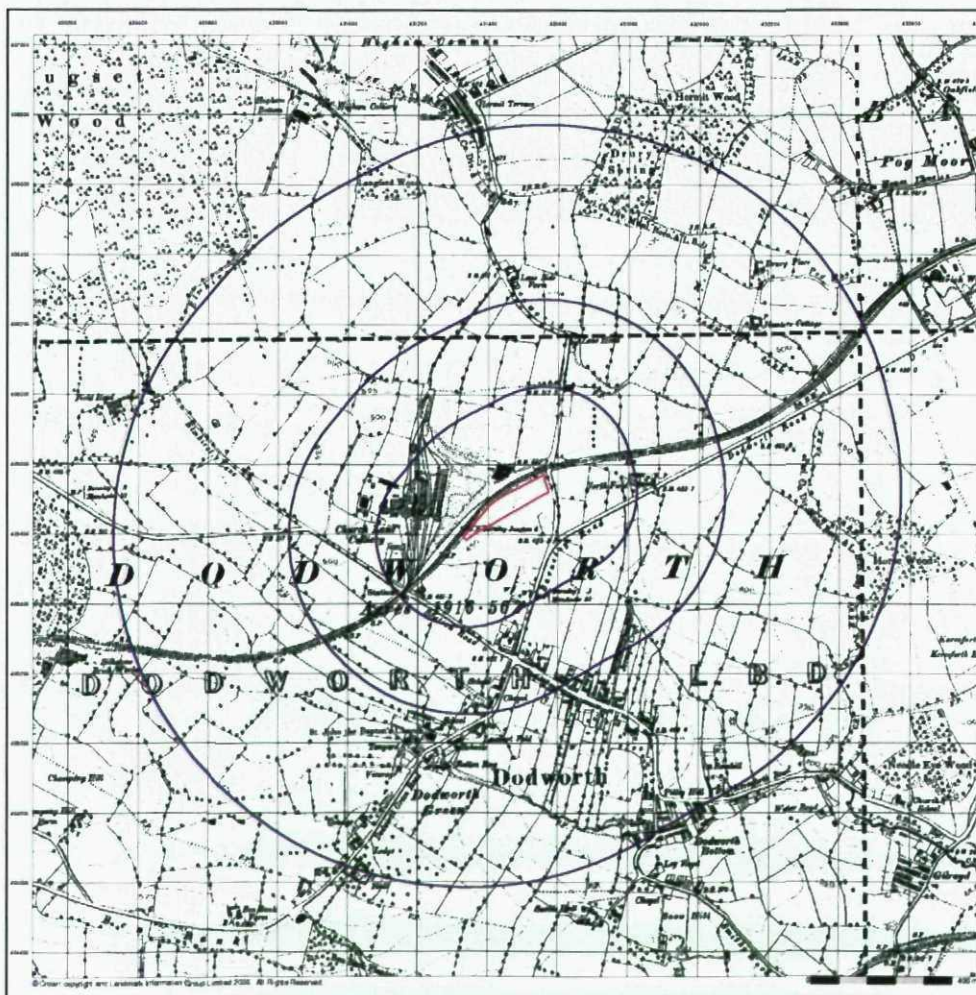


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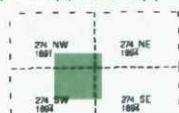
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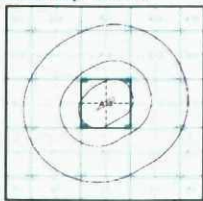
Yorkshire
Published 1891 - 1894
Source map scale - 1:10,560

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 1:10,560 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published data 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 adjoining 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 overlaid 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

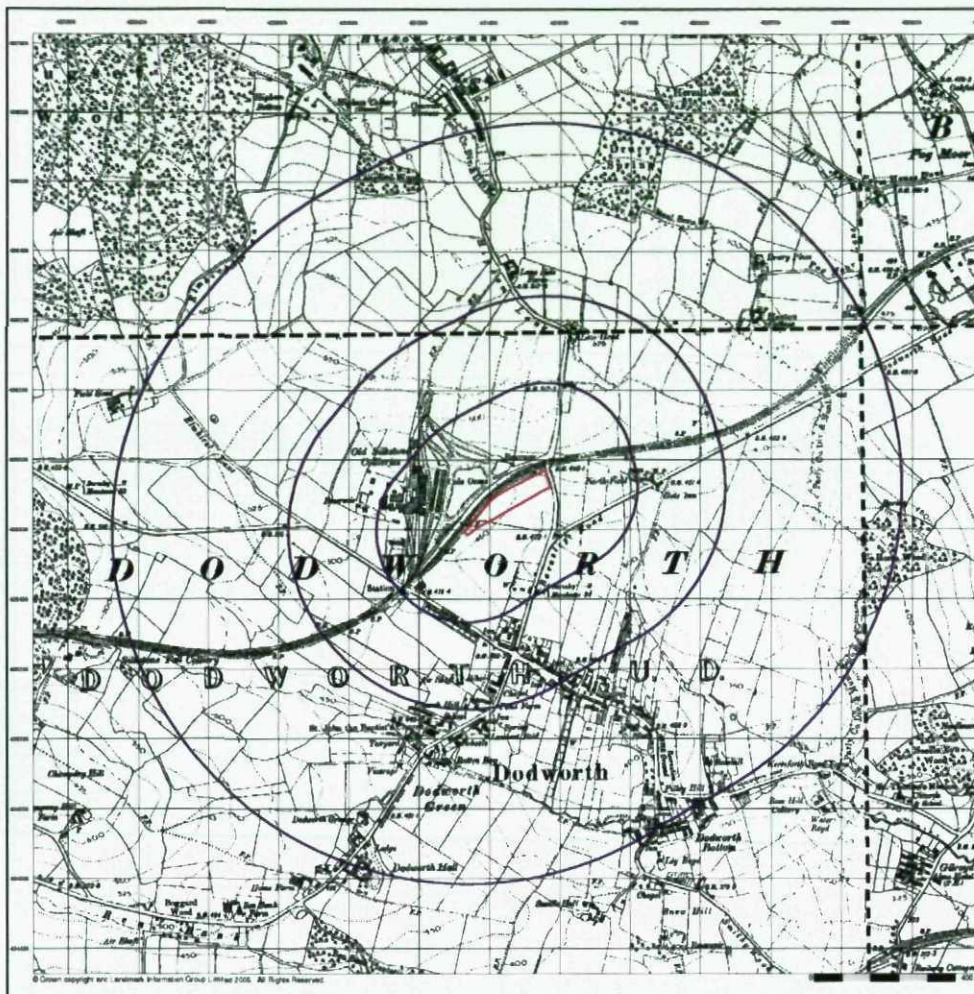


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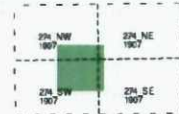
Site at 431500, 405700



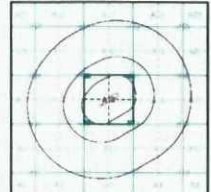
Yorkshire
Published 1907
Source map scale - 1:10,560

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 data given therefore is often some years later than the surveyed date. Before 1835, 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 surveying areas. In the late 1840'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

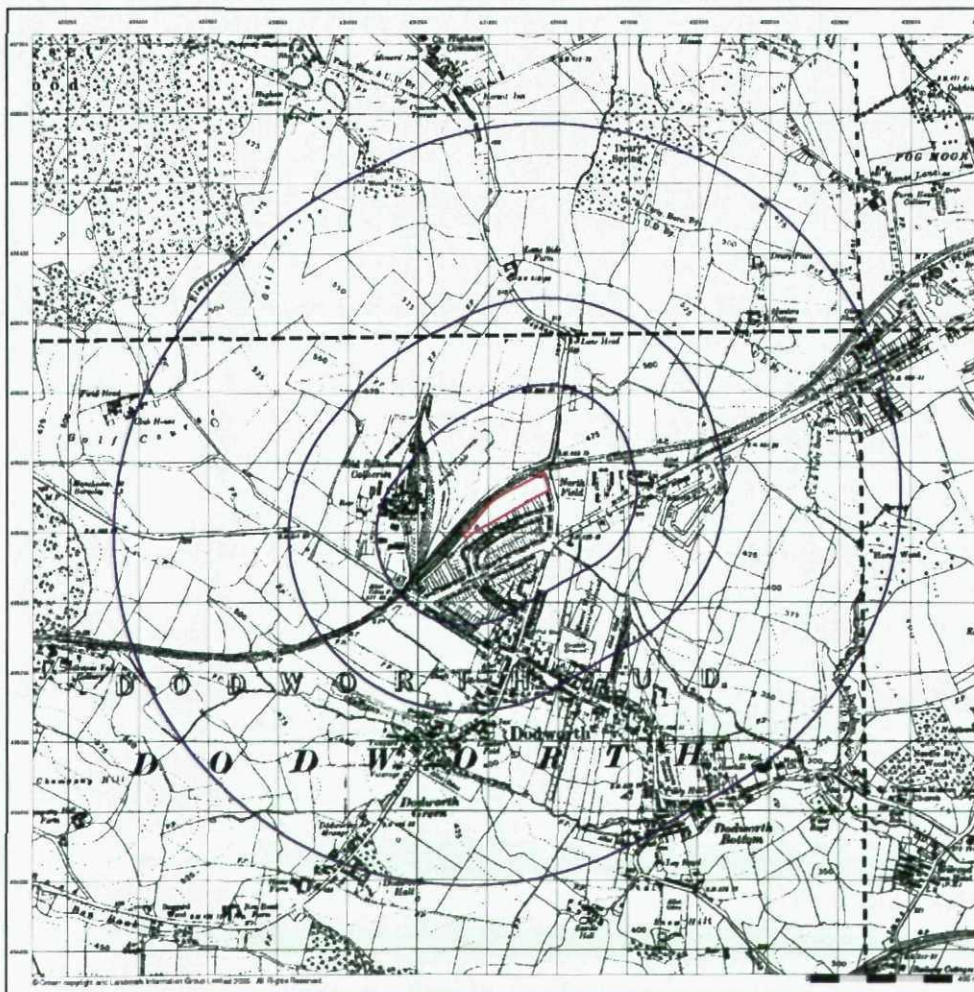


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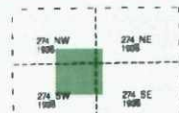
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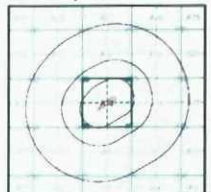
Yorkshire
Published 1938
Source map scale - 1:10,560

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Map Name(s) and Date(s)



Historical Map - Slice A

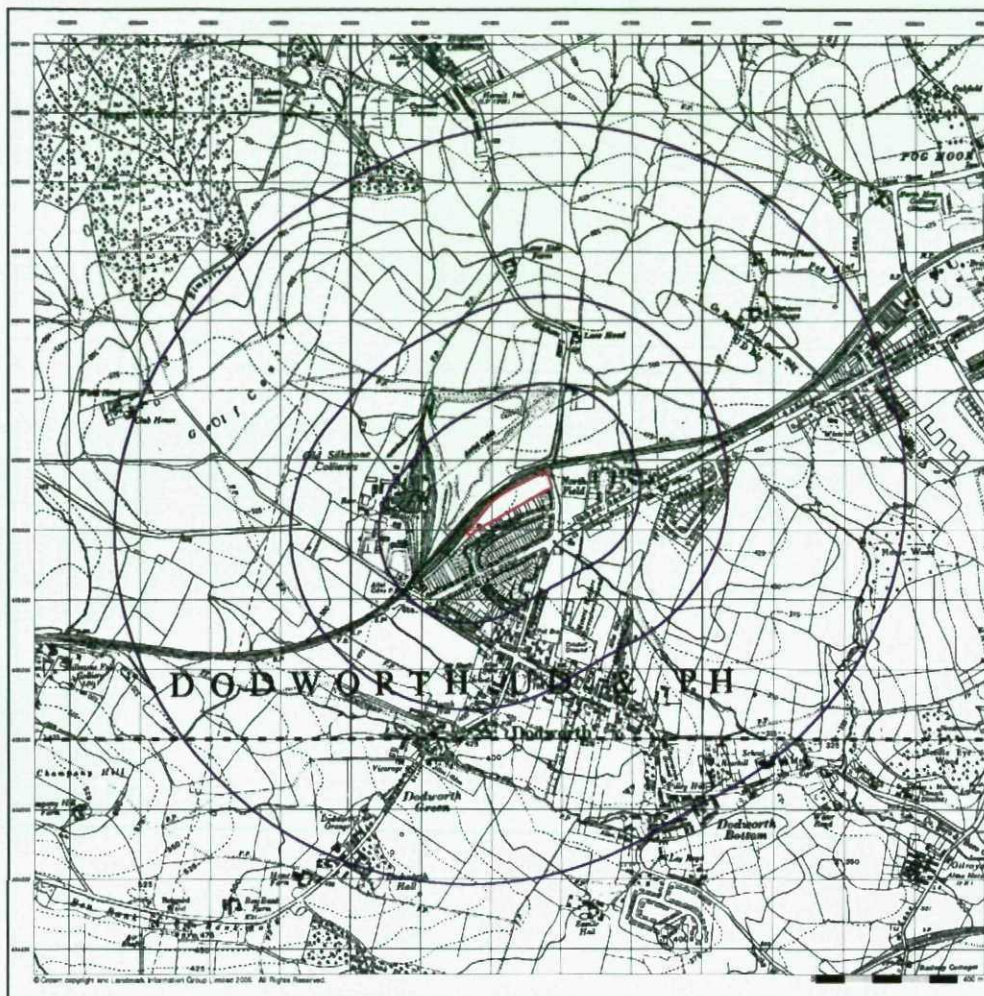


Order Details

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Site Details

Site at 431500, 405700



Ordnance Survey Plan

Published 1956

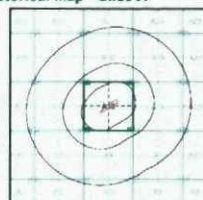
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The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. In 1854 the 1:2,500 scale was adopted for mapping urban areas. These maps were used to update the 1:10,560 maps. The published data 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 1940s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unaltered - with all military camps and other strategic sites removed. These maps were initially overlaid 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

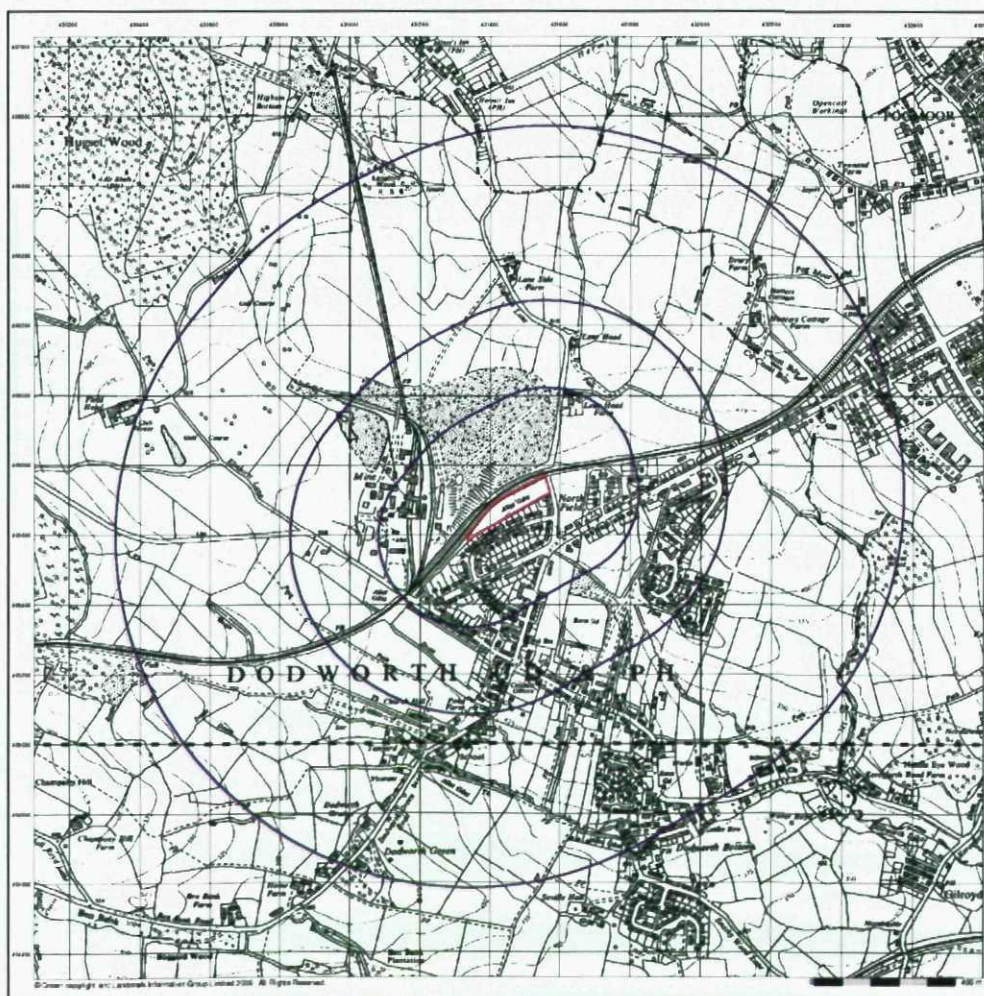


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Site Details

Site at 431500, 405700



Ordnance Survey Plan

Published 1965 - 1966

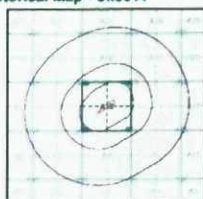
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840s. 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 data 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 1940s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unaltered - with all military camps and other strategic sites removed. These maps were initially overlaid 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

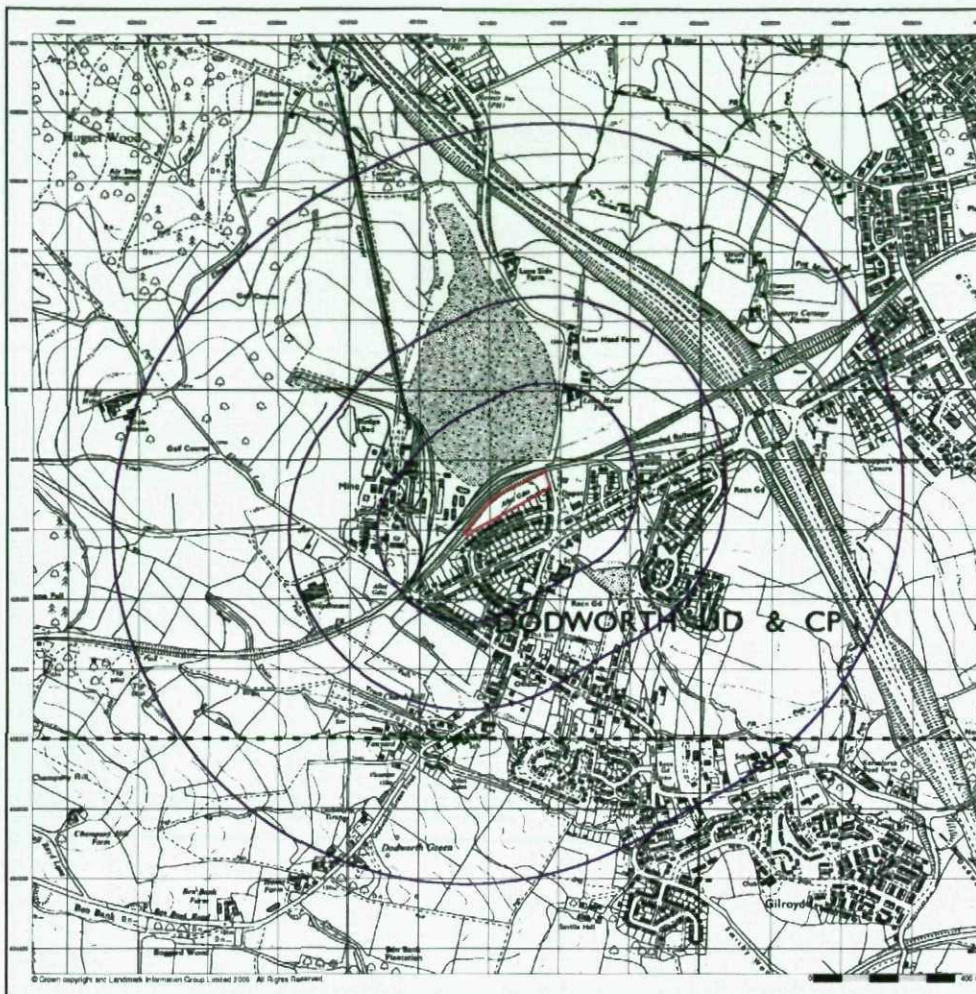


Order Details

Order Number: 21005127_1_1
Customer Ref: 9374/1
National Grid Reference: 431450, 405680
Sheet: A
Site Area (Ha): 1.22
Search Buffer (m): 1000

Site Details

Site at 431500, 405700



Ordnance Survey Plan
Published 1973 - 1978

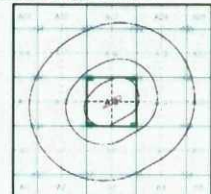
Source map scale - 1:10,000

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 1:25,000 scale was adopted for mapping urban areas, these maps were used to update the 1:10,000 maps. The published data given therefore is often some years later than the surveyed date. Before 1933, 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 surveying areas. In the late 1940's a Provisional Edition was produced, which updated the 1:10,000 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overlaid 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

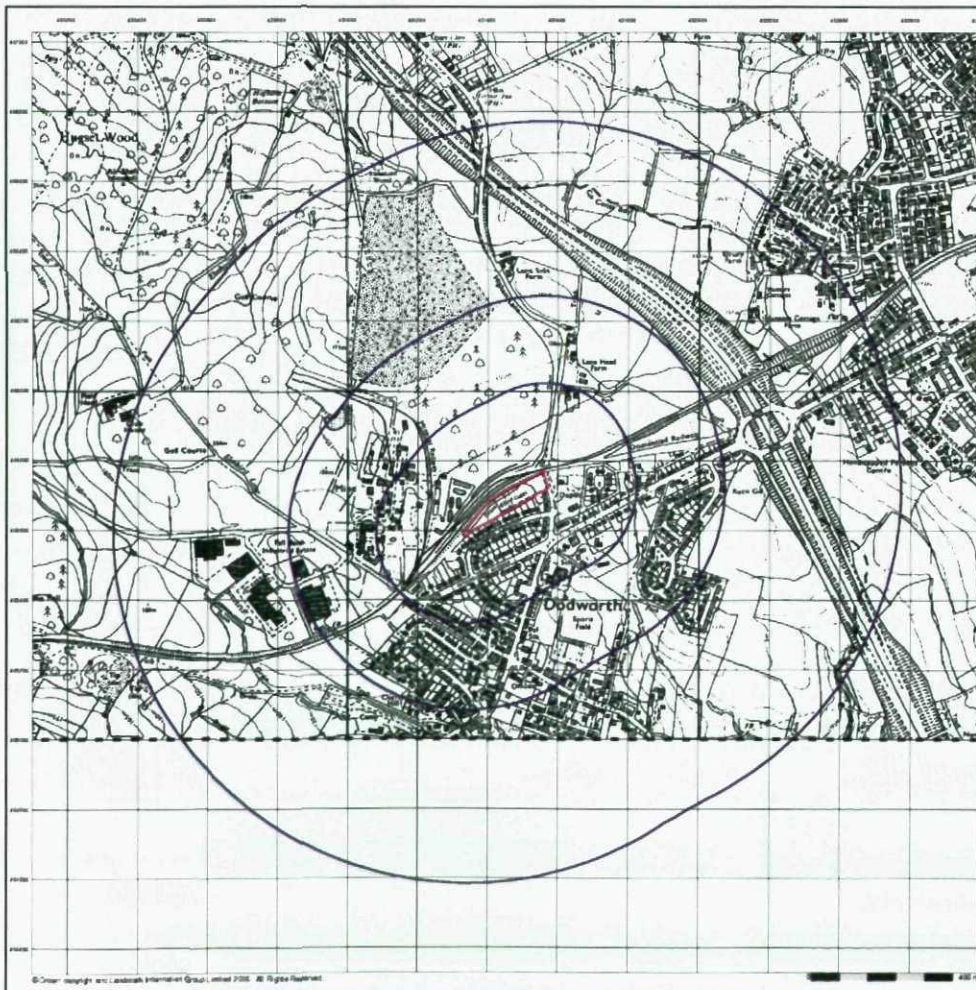


Order Details

Order Number: 21005127_1_1
Customer Ref: 9374/1
National Grid Reference: 431450, 405680
Sheet: A
Site Area (Ha): 1.22
Search Buffer (m): 1000

Site Details

Site at 431500, 405700



Ordnance Survey Plan
Published 1983

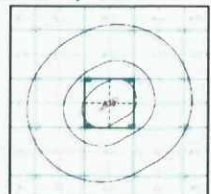
Source map scale - 1:10,000

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 1:25,000 scale was adopted for mapping urban areas, these maps were used to update the 1:10,000 maps. The published data given therefore is often some years later than the surveyed date. Before 1933, 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 surveying areas. In the late 1940's a Provisional Edition was produced, which updated the 1:10,000 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overlaid 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

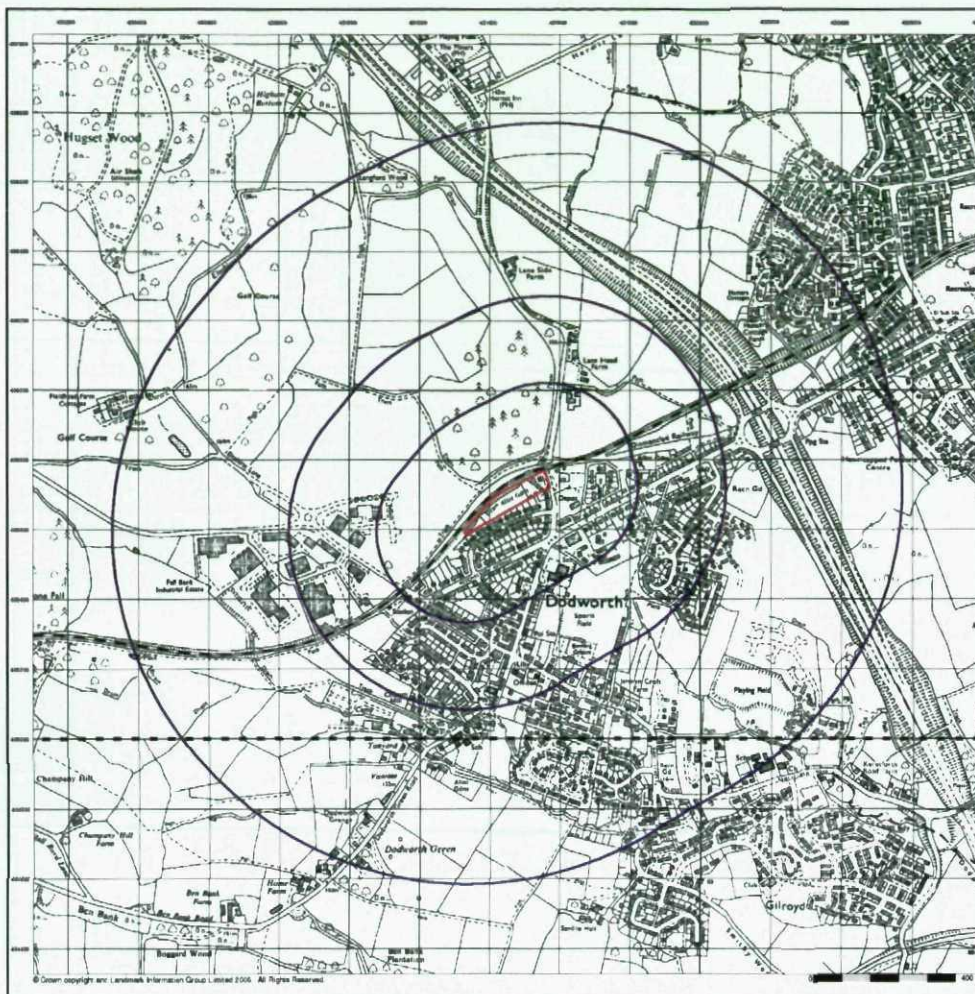


Order Details

Order Number: 21005127_1_1
Customer Ref: 9374/1
National Grid Reference: 431450, 405680
Sheet: A
Site Area (Ha): 1.22
Search Buffer (m): 1000

Site Details

Site at 431500, 405700



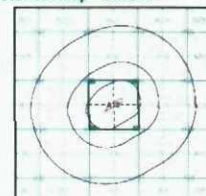
Ordnance Survey Plan
Published 1978 - 1993
Source map scale - 1:10,000

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 1:25,000 scale was adopted for mapping urban areas; these maps were used to update the 1:10,000 maps. The published data given therefore is often some years later than the surveyed date. Before 1838, 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 adjoining areas. In the late 1840's, a Provisional Edition was produced, which updated the 1:10,000 mapping from a number of sources. The maps appear unaltered - with all military camps and other strategic sites removed. These maps were initially oversupplied 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)



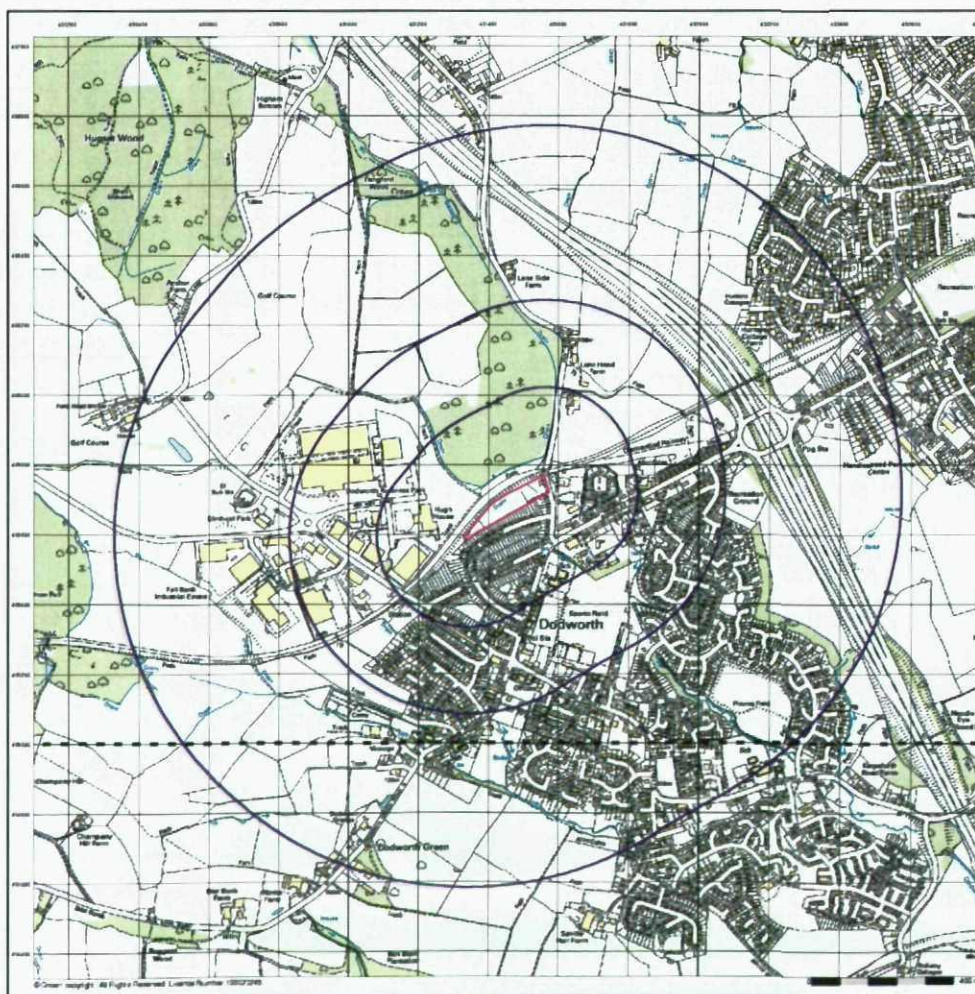
Historical Map - Slice A



Order Details

Order Number: 21005127_1_1
Customer Ref: 9374/1
National Grid Reference: 431450, 405680
Sheet: A
Site Area (Ha): 1.22
Search Buffer (m): 1000

Site Details
Site at 431500, 405700



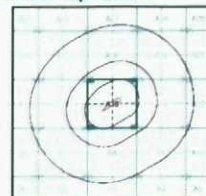
10K Raster Mapping
Published 2000
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 raster mapping. These maps are derived from Landmark which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, routes and paths. Road names are also included together with the relevant road number and classification. Boundary information includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)



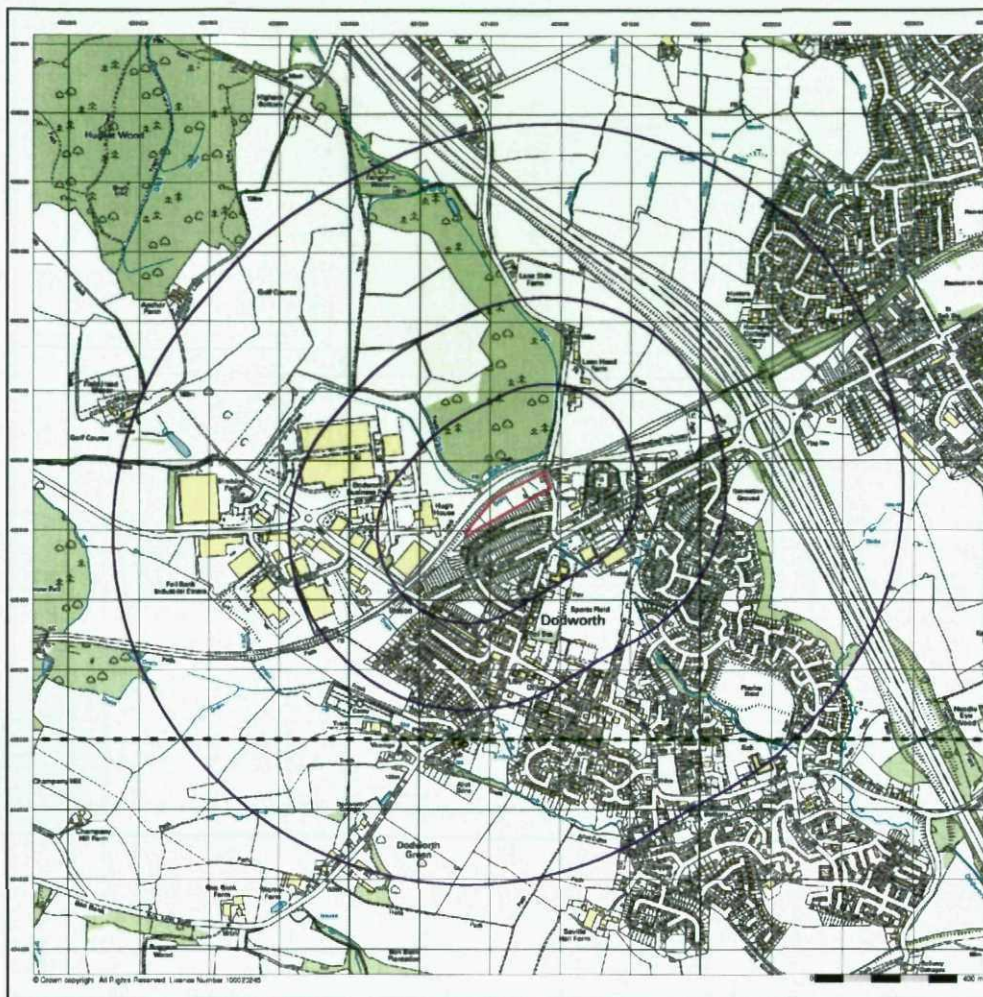
Historical Map - Slice A



Order Details

Order Number: 21005127_1_1
Customer Ref: 9374/1
National Grid Reference: 431450, 405680
Sheet: A
Site Area (Ha): 1.22
Search Buffer (m): 1000

Site Details
Site at 431500, 405700



10K Raster Mapping

Published 2004

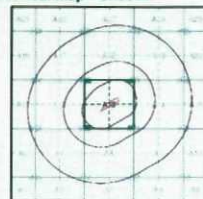
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and designation. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

SE300W
2004

Historical Map - Slice A



Order Details

Order Number: 21005127_1_1
Customer Ref: 8374/1
National Grid Reference: 431450, 405680
Sheet: A
Site Area (Ha): 1.22
Search Buffer (m): 1000

Site Details

Site at 431500, 405700

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007

Co-ords

TP1

Sheet 1 of 1

Scale 1:25

Ground Level

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.20		Dark brown very sandy CLAY with some roots. (TOPSOIL)	0.40			
2D	0.60		(Medium dense) orange-brown very clayey angular fine to coarse GRAVEL of mudstone. (WEATHERED COAL MEASURES)	0.80			
		V = 67 kPa	Firm orange-brown very gravelly CLAY. Gravel is tabular fine to coarse mudstone. (WEATHERED COAL MEASURES)	1.50			
		V = 70 kPa					
3D	1.40		Stiff grey and orange-brown very gravelly CLAY. Gravel is angular fine to coarse mudstone. (WEATHERED COAL MEASURES)	2.50			
		V = 83 kPa					
		V = 97 kPa	Weak light and dark brown fine grained MUDSTONE. Recovered as tabular fine to coarse gravel and cobbles. (COAL MEASURES)	2.80			
			End of trial pit at 2.80 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

JOB

9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007

Co-ords

TP2

Sheet 1 of 1

Scale 1:25

Ground Level

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.20		Dark brown very clayey fine SAND with some roots. (TOPSOIL)	0.30			
		V = 63 kPa	Firm becoming stiff orange-brown and grey slightly gravelly CLAY. Gravel is angular fine to coarse mudstone and occasional sandstone. (WEATHERED COAL MEASURES)				
2D	1.10						
		V = 87 kPa					
		V = 107 kPa					
		V = 103 kPa					
3D	2.30		Stiff thinly to thickly laminated light and dark brown slightly gravelly CLAY. Gravel is angular fine to coarse mudstone. (WEATHERED COAL MEASURES)	2.00			
		V = 103 kPa					
			Weak thinly to thickly laminated light and dark brown fine grained MUDSTONE. Recovered as tabular fine to coarse gravel size fragments. (COAL MEASURES)	2.50			
			End of trial pit at 2.70 m	2.70			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

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FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007 Co-ords
Ground Level

TP3

Sheet 1 of 1
Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.20		Dark brown slightly clayey fine SAND with some roots. (TOPSOIL)	0.30			
2D	0.80	V = 65 kPa V = 65 kPa V = 90 kPa	Firm orange-brown and grey slightly gravelly to gravelly CLAY. Gravel is angular fine to coarse mudstone. Rare tabular cobbles of mudstone. (WEATHERED COAL MEASURES) Below 1.2m bgl: becoming very gravelly clay. Stiff dark and light brown very gravelly CLAY. Gravel is angular fine to coarse mudstone and shale. (WEATHERED COAL MEASURES)	1.40			
3D	1.80	V = 122 kPa		2.50			
4D	2.60		Weak light and dark brown thinly to thickly laminated fine grained MUDSTONE. Recovered as slightly clayey angular fine (COAL MEASURES) End of trial pit at 2.80 m	2.80			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

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FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007 Co-ords
Ground Level

TP4

Sheet 1 of 1
Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.20		Dark brown very sandy CLAY with some roots. (TOPSOIL)	0.30			
2D	1.00	V = 55 kPa V = 63 kPa V = 77 kPa V = 103 kPa	Firm becoming stiff orange-brown and grey very gravelly CLAY. Gravel is tabular fine to coarse mudstone. (WEATHERED COAL MEASURES)	2.50			
3D	2.00	V = 103 kPa	Weak light and dark brown fine grained MUDSTONE. Recovered as tabular fine to coarse gravel with occasional cobbles of mudstone. (COAL MEASURES) End of trial pit at 2.70 m	2.70			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

JOB

9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007

Co-ords

TP5

Sheet 1 of 1

Scale 1:25

Ground Level

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	logged
1D	0.20		Firm dark brown very sandy CLAY with some roots. (TOPSOIL)	0.30			
		V = 58 kPa	Firm orange-brown and grey very gravelly CLAY. Gravel is angular to coarse sandstone and mudstone. (WEATHERED COAL MEASURES)				
2D	0.80	V = 63 kPa					
		V = 65 kPa					
3D	1.80	V = 93 kPa	Firm becoming stiff thinly to thickly laminated light and dark brown very gravelly CLAY. Gravel is tabular fine to coarse (WEATHERED COAL MEASURES)	1.60			
4D	2.70		Weak thinly to thickly laminated dark and light brown fine grained MUDSTONE. Recovered as slightly clayey angular fine to coarse gravel and cobbles. (COAL MEASURES)	2.60 2.80			
			End of trial pit at 2.80 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

JOB

9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007

Co-ords

TP6

Sheet 1 of 1

Scale 1:25

Ground Level

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	logged
1D	0.20		Dark brown slightly clayey fine SAND with some roots. (TOPSOIL)	0.30			
		V = 55 kPa	Firm orange-brown and grey slightly gravelly to gravelly mudstone. Recovered as tabular fine to coarse sandstone and (WEATHERED COAL MEASURES)				
2D	0.80	V = 62 kPa					
		V = 117 kPa					
3D	2.20	V = 83 kPa	Weak black COAL. Recovered as angular fine to coarse gravel. (COAL MEASURES)	1.80 1.90			
		V = 113 kPa	Stiff grey slightly gravelly CLAY. Gravel is tabular fine to coarse mudstone, shale and occasional coal. (WEATHERED COAL MEASURES)				
			Weak thinly to thickly laminated fine grained MUDSTONE. Recovered as angular fine to coarse gravel and cobbles. (COAL MEASURES)	2.60 2.80			
			End of trial pit at 2.80 m				

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

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9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007

Co-ords

Sheet 1 of 1

TP7

Ground Level

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.10		Dark brown very clayey fine SAND. (TOPSOIL)	0.20			
		V = 62 kPa	Firm becoming stiff orange-brown and grey slightly gravelly CLAY. Gravel is angular fine to coarse mudstone. (WEATHERED COAL MEASURES)				
		V = 77 kPa					
		V = 83 kPa					
2D	1.00						
		V = 90 kPa	At 1.6m bgl: 100mm thick band of black coal. Recovered as fine to coarse gravel.				
		V = 87 kPa	Stiff grey and dark brown very gravelly CLAY. Gravel is angular fine to coarse mudstone, shale and occasional coal. (WEATHERED COAL MEASURES)	1.80			
3D	2.00						
		V = 87 kPa					
		V = 87 kPa					
4D	2.70						
			Weak light and dark brown fine grained MUDSTONE. Recovered as angular fine to coarse gravel and cobbles. (COAL MEASURES)	2.60			
			End of trial pit at 2.80 m	2.80			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

JOB

9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007

Co-ords

Sheet 1 of 1

TP8

Ground Level

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.20		Dark brown very sandy CLAY with some roots. (TOPSOIL)	0.30			
		V = 63 kPa	Firm becoming stiff orange-brown and grey slightly gravelly CLAY. Gravel is angular fine to coarse mudstone. (WEATHERED COAL MEASURES)				
		V = 87 kPa					
2D	0.80						
		V = 103 kPa					
			Stiff grey very gravelly CLAY. Gravel is angular fine to coarse mudstone and shale. (WEATHERED COAL MEASURES)	1.40			
3D	1.80						
		V = 97 kPa					
		V = 103 kPa					
4D	2.60						
			Weak dark and light brown fine grained MUDSTONE. Recovered as tabular fine to coarse gravel and cobbles. (COAL MEASURES)	2.50			
			End of trial pit at 2.80 m	2.80			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

JOB

9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007 Co-ords

TP9

Sheet 1 of 1

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.20		Dark brown very sandy CLAY with some roots. (TOPSOIL)	0.30			
		V = 67 kPa	Firm becoming stiff orange-brown and grey slightly gravelly CLAY. Gravel is angular fine to coarse mudstone. (WEATHERED COAL MEASURES)				
2D	1.00	V = 90 kPa					
		V = 107 kPa	Stiff grey and dark brown very gravelly CLAY. Gravel is tabular fine to coarse mudstone, shale and occasional coal. (WEATHERED COAL MEASURES)	1.40			
3D	2.00	V = 103 kPa					
			Weak dark brown and grey fine grained MUDSTONE. Recovered as tabular fine to coarse gravel. (COAL MEASURES)	2.60			
			End of trial pit at 2.80 m	2.80			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

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9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire
SITE Higham Lane, Dodworth

DATE 09/03/2007 Co-ords

TP10

Sheet 1 of 1

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.20		Dark brown very sandy CLAY with some roots. (TOPSOIL)	0.30			
		V = 67 kPa	Firm becoming stiff orange-brown and grey slightly gravelly CLAY. Gravel is angular fine to coarse mudstone. (WEATHERED COAL MEASURES)				
2D	0.80	V = 80 kPa					
		V = 83 kPa	Stiff grey and dark brown very gravelly CLAY. Gravel is tabular fine to coarse mudstone. (WEATHERED COAL MEASURES)	1.20			
		V = 87 kPa					
		V = 100 kPa					
3D	2.60		Weak light and dark brown fine grained MUDSTONE. Recovered as slightly sandy tabular fine to coarse gravel. (COAL MEASURES)	2.50			
			End of trial pit at 2.80 m	2.80			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

JOB

9374

FIGURE

TRIAL PIT LOG

CLIENT Redrow Homes Yorkshire

SITE Higham Lane, Dodworth

DATE 09/03/2007

Co-ords

Ground Level

TP11

Sheet 1 of 1

Scale 1:25

sample no & type	depth (m)	in-situ test	description	depth (m)	level (m)	ground water	legend
1D	0.10		Dark brown very sandy CLAY with some roots. (TOPSOIL)	0.20			
		V = 65 kPa	Firm becoming stiff orange-brown and grey slightly gravelly CLAY. Gravel is angular fine to coarse mudstone. (WEATHERED COAL MEASURES)				
		V = 70 kPa					
2D	0.80	V = 70 kPa					
		V = 87 kPa					
3D	1.40	V = 107 kPa					
			Stiff light and dark brown very gravelly CLAY. Gravel is tabular fine to coarse mudstone. (WEATHERED COAL MEASURES)	1.80			
			Weak light brown and grey fine grained MUDSTONE. Recovered as tabular fine to coarse gravel. (COAL MEASURES)	2.20			
			End of trial pit at 2.60 m	2.60			

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

Equipment/Methods

JCB 3CX with 0.6m wide tooth bucket.

Logged by

LPS

JOB

9374

FIGURE

APPENDIX G GEOTECHNICAL TEST RESULTS

ALcontrol Geochem Analytical Services Table Of Results

Job Number: 07/04632/02/01
Client: Encia Consulting
Client Ref. No.: 9374

Matrix: SOLID
Location: HIGHAM LANE
Client Contact: Alex Hutchinson

* ISO 17025 accredited
 M MCERTS accredited
 • Subcontracted test
^b Shown on prev. report

Sample Identity	TP1 D1	TP2 D1	TP3 D1	TP4 D1	TP5 D1	TP6 D1	TP7 D1	TP8 D1	TP9 D1	Method Code	LoD/Units
Depth (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sample Date											
Sample Received Date	13.03.07	13.03.07	13.03.07	13.03.07	13.03.07	13.03.07	13.03.07	13.03.07	13.03.07		
Batch	1	2	3	4	5	6	7	8	9		
Sample Number(s)	1	2	3	4	5	6	7	8	9		
Boron Water Soluble	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	TM129 ^u _M	<3.5 mg/kg
Arsenic	19	32	18	18	39	38	34	40	40	TM129 ^u _M	<3.0 mg/kg
Cadmium	0.3	0.3	<0.3	0.3	0.4	0.3	<0.3	0.3	<0.3	TM129 ^u _M	<0.3 mg/kg
Chromium	20	21	21	14	23	23	21	22	22	TM129 ^u _M	<4.5 mg/kg
Copper	20	35	30	25	54	82	46	49	66	TM129 ^u _M	<6 mg/kg
Lead	59	76	45	81	110	80	72	86	76	TM129 ^u _M	<3 mg/kg
Mercury	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	TM129 ^u _M	<0.6 mg/kg
Nickel	19	22	40	17	24	25	20	24	22	TM129 ^u _M	<0.9 mg/kg
Selenium	<3	<3	<3	<3	<3	<3	<3	<3	<3	TM129 ^u _M	<3 mg/kg
Zinc	150	230	140	150	190	190	110	140	100	TM129 ^u _M	<2.5 mg/kg
pH Value	5.94	7.57	6.12	6.51	6.33	6.08	6.11	5.72	4.90	TM133 ^u _M	-1.00 pH / unit

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Date 20.03.2007

* ISO 17025 accredited
 M MCERTS accredited
 • Subcontracted test
 = Shown on prev report

Validated	Preliminary
☒	☐

Job Number: 07/04632/02/01
Client: Encia Consulting
Client Ref. No.: 9374
Matrix: SOLID
Location: HIGHAM LANE
Client Contact: Alex Hutchinson

Matrix: SOLID
Location: HIGHAM LANE
Client Contact: Alex Hutchinson

Client Contact: Alex Hutchinson

Sample Identity	TP10 DI	TP11 DI
Depth (m)	0.2	0.1
Sample Type	SOLID	SOLID
Sampled Date		
Sample Received Date	13.03.07	13.03.07
Batch	1	1
Sample Number(s)	10	11
Boron Water Soluble	<3.5	<3.5
Arsenic	44	28
Cadmium	0.4	0.7
Chromium	21	24
Copper	61	41
Lead	97	84
Mercury	<0.6	<0.6
Nickel	25	25
Selenium	<3	<3
Zinc	190	250
pH Value	6.61	7.54

All results expressed on a dry weight basis.

Date 20.03.2007

Material Type	Log Data
Topsoil	19.00
	22.00
	1.553
	18.00
	1.553
	39.00
	38.00
	1.5798
	34.00
	40.00
	1.6071
	40.00
	1.6115
	44.00
	1.5798
	38.00

[illegible][illegible]

Outlier Test

Mean Value Test

Analytical Data

Encia Job No.	9374
Site Name	Higham Lane, Dodworth
Engineer	JWH

95% det.	3.8
st dev (s)	9.76
mean (x)	33.73
t value	1.812
No. of samples	20
SCV	11
assess	

Is the Mean Value Test Higher or Lower than the SCV?

Higher

Y max	1.643
Y mean	1.493
Y st dev	0.152
t value	0.988
Comparator	2.088

Maximum Value Test Result:

Outlier Test?

Maximum is within a Normal Distribution

Outlier Values	Sample Number
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Outlier Values	Sample Number
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APPENDIX H
CHEMICAL TEST RESULTS