LITHOS



Preliminary Geoenvironmental Investigation

Land at Dewsbury Riverside Gateway

For Kirklees Metropolitan Borough Council & Barton Willmore

Report no: 3901/1A

Date: September 2021

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DEWSBURY RIVERSIDE GATEWAY SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	3901	**Site area/ha**	29.5 hectares
Client:	Kirklees Metropolitan Borough Council & Barton Willmore	**NGR:**	SE 228 195
Site:	Dewsbury Riverside Gateway	**Nearest postcode:**	WF12 9EE

The site is located off Ravensthorpe Road, approximately 2.5km southwest of Dewsbury town centre, and currently comprises cropped farmland with areas of woodland (west), a school (northeast) and allotment gardens (east).

Lithos were commissioned by Kirklees Metropolitan Borough Council to provide a preliminary geoenvironmental appraisal of the site which it is understood is intended for residential development (along with surrounding land to the west, south & east).

Lithos' investigation included an inspection of historical and geological maps and information provided by the British Geological Survey, and the Landmark Information Group, the Coal Authority, the (former) NCB, QGIS, and the Environment Agency. In addition, a site inspection has been carried out.

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

Issue	Remarks
Former uses	Predominantly greenfield, but Lady Wood (west) has been historically worked for coal. Ravensthorpe School (east) developed in c. 1983.
Anticipated ground conditions	Veneer of Topsoil & Residual Soils over Coal Measures bedrock (sandstone & mudstone) from between about 1.0m to 3.0m depth. Deeper made ground anticipated in area of former landfilling and areas of former opencast coal extraction (within Lady Wood Extension, beyond areas of proposed development).
Anticipated contamination	The majority of the site is expected to be essentially 'clean' however some contamination likely in area of former landfill & backfilled opencast.
Coal mining	The entire site is expected to be underlain by shallow coal in several seams (c. 9 no.). A total of 40 mine entries are located within, or within 25m of, the site's boundary. However, only 3 are located within the area proposed for development. It is apparent from the abandonment plans reviewed that underground workings should be anticipated in the Middleton Main, Middleton Little and 2nd Brown Metal coals. The abandonment plans also show areas of 'Old Workings'. Some opencast extraction of the Middleton Little and 2nd Brown Coals has taken place in the west, within the Lady Wood Extension, beyond areas of proposed development. Mitigation of the risks posed by the shallow mineworkings will be required, and this could be achieved in one of two ways: • Extraction of the remaining coal • Consolidation, via drilling & grouting
Quarrying	There is a small former sandstone quarry in centre.
Hazardous gas	Potential sources of gas include: shallow mineworkings, opencast backfill and landfill (Lady Wood Extension) and quarry backfill. Gas monitoring & risk assessment will be undertaken following the proposed ground investigation. Between 1% & 3% of homes are estimated to lie above the radon action level.
Flooding & drainage	Given topography, soakaways are considered unlikely to provide a viable solution for the disposal of surface water across much of the site. The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low Based on topography soakaways may not provide a suitable means of surface water disposal.
Preparatory works	Consolidation of underground mineworkings & treatment/capping of mine entries. Topsoil strip & stockpile. Site regrade to provide relatively level development platforms.
Anticipated foundation solutions	The majority of new dwellings are likely to be built on reinforced strip footings founded in residual soils or bedrock. Plots in areas of opencast/former quarries may require alternative foundation solutions, e.g. piles.

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

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Job No.	3901	**Site area/ha**	29.5 hectares
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Site:	Dewsbury Riverside Gateway	**Nearest postcode:**	WF12 9EE

Issue	Remarks
Recommendations for ground investigation	Ground investigation has already been completed in the north. With respect to remaining areas, investigation will comprise: • c. 40 trial pits. • c. 20 dynamic sample boreholes (areas of restricted access – allotments and Lady Wood extension). • c. 35 rotary open probeholes.

At this stage, anticipated significant abnormals relating to geoenvironmental issues at the site are:

- Shallow underground mineworkings, mine entries & areas of opencast requiring treatment & consolidation.
- Underground & overhead utilities crossing the site which may require easements if they cannot be re-routed.
- Topography across much of the site necessitating regrade.

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

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3901/3	Site features
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3901/5	Preliminary conceptual site model
3901/8	Geology & mining features
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Appendix C - Commission

Appendix D – Historical OS plans

Appendix E – Search responses

From	Date	Content
Landmark	26/11/2020	Envirocheck report
Coal Authority	26/11/2020	Consultants coal mining report & correspondence
NCB	April 1973	Report - opencast viability at Ravensthorpe

FOREWORD (preliminary geoenvironmental investigation report)

This report has been prepared for the sole use and reliance of the Client named on page 1 and cannot be relied upon by any other parties without the express written authorisation of Lithos Consulting Limited (Lithos). Any unauthorized third party relies on this report at their own risk and the authors owe them no duty of care.

This report has been reviewed by a Competent Person, as defined in the National Planning Policy Framework. We ensure that all projects are managed by individuals with necessary experience, relevant qualifications, and current membership of a relevant professional organisation. Records of engineers, project managers and reviewers involved in this project are maintained by us. Lithos QA/QC procedures for all our work forms an integral part of our ISO9001 accreditation and as such is regularly audited.

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 Lithos prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Lithos cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context. However, it should be noted that in order to keep the number of sheets of paper in the hard copy to a minimum, some information (e.g. full copy of the Landmark/Groundsure Report) is only included within the "electronic", PDF Report on the accompanying CD.

The findings and opinions conveyed in any Desk Study section of the report (including review of any third party reports) are based on information obtained from the sources listed, which Lithos understands are reliable. Reasonable skill, care and diligence has been applied in examining the information obtained. However, Lithos accept no responsibility for inaccuracies in the data supplied or for opinions based on any such inaccurate data.

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.

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

PRELIMINARY GEOENVIRONMENTAL INVESTIGATION OF LAND AT DEWSBURY RIVERSIDE GATEWAY

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting were commissioned by Kirklees Metropolitan Borough Council & Barton Willmore to carry out a preliminary investigation of land to the south of Ravensthorpe Road.

1.1.2 The current area of interest (c. 29.5 ha) is referred to as the Dewsbury Riverside Gateway Development. The Gateway Development falls within a much larger area (c. 156 hectares) which has been allocated for the construction of about 4,000 residential dwellings as well as three schools.

1.1.3 This document is a revision of the Preliminary Geoenvironmental Appraisal (Report 3901/1) issued by Lithos in December 2020; Report 3901/1 is now superseded. The only significant revisions to 3901/1 have been made in Section1.2.

1.1.4 Lithos have previously issued 6 reports relating to Dewsbury Riverside. Of these reports, two include the current area of interest:

- 'Preliminary Geoenvironmental Appraisal – Land at Dewsbury Riverside'. Report ref. 2336/1A, dated April 2016, issued to Miller Homes.
- 'Geoenvironmental Appraisal - Land at Dewsbury Riverside Phase 2'. Report ref. 2336/3, dated January 2018, issued to Miller Homes.

1.1.5 The findings of Report 2336/3 are reviewed and summarised in Section 8.

1.1.6 Following issue of the original version of this Report in December 2020, Lithos have issued the following reports to Kirklees Metropolitan Borough Council & Barton Willmore relating to the current area of interest:

- 'Geoenvironmental Appraisal - Land at Dewsbury Riverside Gateway'. Report ref. 3901/2A, dated July 2021.
- 'Remediation Strategy - Land at Dewsbury Riverside Gateway'. Report ref. 3901/3, dated August 2021.

1.1.7 Correspondence regarding Lithos' appointment, including the brief for this investigation, is included in Appendix C. 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
- A mining risk assessment in accordance with Coal Authority guidance.
- Assessment of anticipated ground conditions, including potential contaminants
- Assessment of anticipated foundation and engineering issues associated with redevelopment for a residential end-use
- Provision of recommendations for an appropriate ground investigation

1.1.8 This Preliminary Investigation comprised an inspection of historical and geological maps and information provided by the British Geological Survey, and the Landmark Information Group, the Coal Authority, QGIS[1], and the Environment Agency. In addition, a site inspection has been carried out by Lithos.

[1] *An Open Source Geographic Information System used by Lithos to access publicly available Government held digital data.*

1.1.9 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to inform potential developers when the Gateway Development is marketed.

1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with 'traditional' two and/or three storey domestic dwellings, associated gardens, POS and adoptable roads and sewers.

1.2.2 Barton Willmore have been commissioned by Kirklees MBC to prepare an indicative site layout and submit a Hybrid Planning Application comprising:

a) Application for full planning permission for engineering works, drainage and utilities connection for the provision of site access from Forge Lane and Ravensthorpe Road and associated works; and,

b) Application for outline planning permission for the erection of up to 350 dwellings and mixed use development (including community facilities) with associated works including the provision of internal estate roads and parking, landscape works (including provision of public open space, tree clearance/replacement/woodland management and ecological management) and sustainable urban drainage works drainage principles.

1.3 Report format and limitations

1.3.1 Standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on assessment of the site's environmental setting.

1.3.2 General notes and limitations relevant to all Lithos preliminary 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.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 3901/1 presented in Appendix B to this report. Site details are summarised in the table below:

Detail	Remarks
Location	2.5km southwest of Dewsbury town centre.
NGR	SE 228 195.
Approximate area	29.5 hectares (74 acres).
Known services	Overhead electricity. Underground gas (mains pressure).

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on the 24th November 2020. A selection of site photographs are included on Drawing 3901/4.

2.2.2 There are at least 6 sub-areas (see Drawing 3901/2) of significance for various reasons:-

- Area previously investigated by Lithos for Miller Homes (c. 7.2 ha). Lithos issued a comprehensive SI Report to Miller Homes (Ref. 2336/3, dated January 2018) and Millers have granted permission to KMBC allowing Lithos to "re-use" the data obtained.
- Mosque play school and car park (0.15 ha). A new spine road is expected to be routed through here.
- Existing allotments (c. 1.1 ha). Allotments are to be relocated (likely immediately west of the school) and a new spine road is expected to be routed through here.
- Primary school (c. 2.0 ha). To be retained; no development and no intrusive ground investigation is proposed within this sub-area.
- Lady Wood (c. 3.1 ha). To be retained; no development and no intrusive ground investigation is proposed within this sub-area.
- Lady Wood Extension (c. 4.0 ha), adjacent to, and east of, Lady Wood. No development is proposed in this sub-area, but it may be underlain by landfill and some ground investigation (mini-boreholes, with well installations) is anticipated.

2.2.3 The site's borders are defined by:

- North: (east) semi-detached residential dwellings with attached gardens, Ravensthorpe Road runs east to west immediately beyond.
- South: a bridleway that runs east to west along the southern boundary between Ouzlewell Lane (east) and Sands Lane (west).
- East: an un-named track with Ouzlewell Lane beyond.
- West: low dry stone walls which open out onto farmland.

2.2.4 Access can be gained:

- From Ouzlewell Lane which runs along the southern boundary via gaps in walls and hedgerows;
- via a track which runs through the east of the site and opens onto Ravensthorpe Road; or
- via one of two gaps in the terraced housing along the northern boundary which open out onto Ravensthorpe Road.

2.2.5 Topography across the site, and the wider area, generally slopes down to the north and northeast. The steepest slopes reach gradients of about 1v:6h in the centre-north, although the 'typical' gradient is c. 1v:12h.

2.2.6 The north, south and centre comprise three **fields** which were covered by rough grasses and stubble at the time of walkover. The fields are separated by low dry-stone walls and hedgerows.

2.2.7 An area of c. 32,000m^2 in the southeast is a relatively level field which was planted with an immature winter crop at the time of walkover. The field was noted to be very wet underfoot.

2.2.8 Ravensthorpe **School**, buildings with associated playing fields and macadam/block paved outdoor play areas, is located in the northeast. The school is secured from the wider site by steel palisade fencing and is accessed by a gated entrance which opens onto Ravensthorpe Road.

2.2.9 An area of 11,000m^2 in the north-easternmost corner is occupied by **allotment** gardens; most allotments have an associated wooden shed and/or glass greenhouse and allotments are accessed by grassed paths.

2.2.10 An unsurfaced access track runs north to south across the west from Ravensthorpe Road (to the north) between Ravensthorpe School and the allotments to Ouzlewell Lane (to the south). The track is secured by a metal gate.

2.2.11 An area of about 30,000m^2 in the far-west is occupied by mature woodland which is bounded by low dry-stone walls and post & wire fencing. This mature woodland is named **Lady Wood** on OS maps. Several unsurfaced public footpaths pass through the woodland; these are accessed off a track on the northern boundary and via a footbridge to the northwest of the site. A small watercourse issues in the west of the woodland and flows north for about 30m before draining away into the ground.

2.2.12 Topography in Lady Wood is variable with some steep slopes. Several hummocky areas are present and these likely represent former mine entries, mining features and/or settlement of deep made ground (spoil heaps).

2.2.13 A roughly C shaped area (c. 42,000m^2) known as '**Lady Wood Extension**' is located immediately east of Lady Wood. This woodland comprises immature trees which have been planted in straight rows. This woodland is bounded by low dry-stone walls and post & wire fencing. Erosion of footpaths and animal burrows suggest that shallow soils comprise ashy gravel of mudstone, burnt shale and clinker.

2.2.14 Three **electricity** utilities run north to south across the site; one in the east (on wooden poles along the western edge of Ravensthorpe School and over the cropped field); and, two in the west (steel pylons, over the immature woodland).

2.2.15 A regional **high pressure gas** pipeline runs north to south across the centre of the site. The line of the gas main is shown by marker posts in field boundaries.

2.2.16 There is a **culverted** stormwater drain (not shown on YW plans) running east-west along the northern boundary.

2.2.17 Drainage **ditches** cross the centre-north and run along the eastern boundary. The drainage ditch in the centre-north terminates in a storm sewer.

2.2.18 Lithos lifted the manhole cover for the storm sewer during a previous investigation in 2017 (see Section 8), close to its junction with the drainage ditch and could see a 0.5m diameter pipe at 2.3m depth running east-west.

2.2.19 At the time of an earlier walkover in 2017, 3 shallow excavations in the eastern field had been left open by the farmer. It is understood that these pits were excavated in order to locate, and unblock, a **land drain**. A terracotta land drain could still be seen in the base of one of the excavations, running across from the south east to the drainage ditch in the centre of the site, the water within the land drain was ochreous.

2.2.20 During a site visit in December 2017, the farmer described a 6" land drain that ran from the south-east, and had been exposed (and unblocked) in the centre-north. The farmer believes this land drain ultimately discharges into the storm sewer than runs along and parallel with the northern boundary.

2.2.21 The farmer also mentioned the presence of a **redundant 12" gas pipeline** which runs roughly north-west to south-east across the centre of the site. This pipeline is shown on a British Coal drawing and runs from a former coke works at Ingham's Pit to Ravensthorpe power station; see Drawing 3901/3. Lithos were able to locate the pipeline using a CAT.

2.2.22 Existing salient features, at the time of the walkover are presented on Drawing 3901/3 in Appendix B to this report and summarised in the table below:

Feature	Remarks
Current Access	Off Ravensthorpe Rad (north) & Ouzlewell Lane (South).
Topography	Slopes down to the north & northeast; ave. gradient c. 1:12, max gradient c. 1:6.
Approximate areas	3,000m^2 buildings (school). 3,500m^2 Macadam/block paving/track. 11,000m^2 allotment gardens. 20,000m^2 cut & maintained grass. 32,000m^2 cropped field. 159,500m^2 rough grasses & stubble. 71,000m^2 woodland.
Surrounding land uses	North – commercial/industrial buildings, railway lines & River Calder beyond. South – farmyard & farmland. East – residential dwellings. West – farmland & farmyard.

3 SITE HISTORY

3.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1855 have been examined. Some of these plans are presented in Appendix C to this report.

3.2 The table below provides a summary of the salient points relating to the history of the site. 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	Site	Surrounding land
1855	c. 30,000m² in the west occupied by Lady Wood – woodland. Small sandstone **quarry** in centre-east. Majority of site occupied by fields separated by walls, hedgerows & trees. Road runs north to south through eastern edge & along southern boundary. **Buildings** in north-easternmost corner.	**Railway** line immediately beyond northwestern boundary. Old **coal pits** from 280m south. Surrounding land predominantly comprises fields & areas of woodland. Thornhill Leeds village immediately to the northeast. Colliery/mineral railway runs north to south immediately beyond eastern boundary. Glassworks from 50m northeast.
1893	Small **buildings** & old **shaft** in westernmost corner, in Lady Wood. Quarry no longer shown. Layout of buildings in northeastern corner changed; several buildings no longer shown & new buildings constructed. Several footpaths cross the site.	Further buildings & **old shafts** immediately beyond western boundaries. Development of **ironworks** & residential dwellings to the northeast & east. Ravensthorpe Road runs east to west along northern boundary. Several mounds from 50m to the west; likely spoil heaps associated with mine entries.
1907	Second old **shaft** shown in Lady Wood in the west. Well shown in Lady Wood in the west (possible shaft associated with coal mining). Buildings in the northeast include glasshouses.	Residential dwellings constructed immediately beyond northeastern boundary. **Gravel pit** shown adjacent to glassworks from 200m east. Mineral railway expanded with sidings & some **earthworks** (regrade or spoil heaps) from 50m north. Majority of shafts to the west no longer shown. **Calder New Pit** (colliery) with associated earthworks from 50m northwest.
1922	No significant changes.	Residential dwellings built immediately beyond northwestern boundary. Spoil heaps/earthworks associated with rail sidings significantly expanded to the north.
1930	Buildings in northwest no longer shown. Area now shown as **allotment gardens**. Electricity **pylons** cross the centre-east. Area of **earthworks/spoil/tipping** shown in west.	Ouzlewell Lane runs north to south immediately beyond western boundary. Gravel pit & glassworks no longer shown. Area of **earthworks** with crane from 30m north.
1938	No significant changes.	Residential dwellings constructed immediately beyond northern boundary.
1948	Spring shown in centre.	No significant changes.
1955	Allotment gardens include several small glasshouses. Electrical **sub-station** in northeast. Electricity pylons cross the west. Possible earthworks (raised levels) in the centre. Rectangular feature (possible **building**) in centre-west. Extensive **earthworks** around building & to the west. Earthworks do not extend into Lady Wood, but underlie all of the Lady Wood Extension.	Further residential dwellings & concrete works developed to the north.

Date	Site	Surrounding land
1972	Annotation in west shows earthworks as comprising **slag heaps & refuse tip**. Outline of refuse tip corresponds to area of Lady Wood Extension. Rectangular area in west shown as 'scrub'. Buildings in Lady Wood no longer shown.	Earthworks to the north annotated as refuse tips & spoil heaps. Mineral railway disused where adjacent to eastern boundary.
1983	**School** (single building with associated areas of hardstand) shown in northeast. Footprint of immature woodland shown as refuse tip/slag heap.	Area of **refuse tip/slag heap** from 130m southeast. Residential dwellings developed to the east.
1993	Buildings in Lady Wood to the west no longer shown. School developed with further areas of hardstanding.	
2000	School building expanded.	Area of refuse tip/slag heap from 20m north. Earthworks & mineral railway to the north no longer shown.
2003	No significant changes.	No significant changes.
2009	School building expanded further.	
2020	School expanded further with ancillary buildings & areas of external hardstand.	

3.3 The approximate footprint of the sandstone quarry (mid-1800s) is shown on Drawing 3901/8.

3.4 The area of immature woodland in the west of the site, but east of Lady Wood, is understood to be known as 'Lady Wood Extension' and was planted post 2000 to improve the amenity of the wider area following restoration of former refuse tips/spoil heaps.

3.5 The Northern Mines Research Society records two collieries named Ladywood, operated by Mr Charles Wheatley, both located in Thornhill, Dewsbury. The sites operated from 1877 to 1881 and 1921 to 1928.

3.6 Coal Authority abandonment plans (see Section 5.4) suggest Ladywood Colliery was in operation during the 1920s with 3 primary adits and 4 pits (shafts) located immediately east of Lady Wood. Oddly, no colliery buildings are shown on OS plans (although associated shafts are).

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. Reference has been made to publicly available Government held digital data via QGIS (an Open Source Geographic Information System). Extracts from the response received from Landmark, and responses from the Coal Authority are presented in Appendix E. These responses are summarised below, together with the findings of our own "desk study" investigation.

Issue	Data reviewed	Summary
Geology	1:10,000 BGS map (Sheet SE21NW) BGS Technical Report WA/98/6	Drift soils – Glaciofluvial Deposits (northeastern corner). None mapped across majority of site. Solid (bedrock) – Lower Coal Measures (interbedded mudstone, siltstone & sandstone), Lepton Edge Sandstone unit outcrops across the centre-south, Birstall Rock sandstone unit outcrops across the south. Strata dip – gentle to the north. Faults – A fault runs north to south across the west & downthrows to the to the east. Second fault runs north to south immediately beyond western boundary.
Mining	Coal Authority	About 70% of the site is located within a Coal Mining Development High Risk Area. The remaining 30% is located in a Low Risk Area. Further details in Section 5 below.
Quarrying	Historical OS plans	Sandstone quarry located in centre-east (very small). No further known areas of quarrying in, or within 250m of, site's boundary.
Radon	Envirocheck Landmark Report Public Health England Environment Agency electronic open data via QGIS	The site lies in an area where between 1% & 3% of homes are estimated to be above the action level. See Section 6.
Hydrogeology		Groundwater Source Protection Zone? None beneath site or surrounding area. Aquifer Secondary A (Drift in northeast only); Secondary A (Solid). Groundwater abstractions? None of significance. Soil leaching potential: Medium. Pollution incidents: none of significance. Discharge consents: Crowthroyd Farm, 10m south. Discharge of treated effluent to land/soakaway. Start December 1989, ongoing.
Hydrology		Nearest watercourses: unnamed tertiary river emerges from spring in west (Lady Wood) & flows north through site into R. Calder 170m northwest. Un-named tertiary river flows northeast along southeastern boundary into R. Calder 670m north. Catchment of R. Calder; R. Colne to R. Chad. Water quality moderate (ecological moderate, chemical fail). There is a culverted stormwater drain (not shown on YW plans). Pollution incidents: none of significance. Abstractions? Fortcrete Ltd. Abstraction of surface waters from R. Calder 150m northwest for general use preparing mineral products & dust suppression. 2008 – ongoing. Licence no. 2/27/13/229. Discharge Consents: Yorkshire Water Services Ltd, Foxroyd Service Reservoir, 650m south, discharge of processed effluent to surface water (tributary of R. Calder) which flows through site. Start April 1988, end March 2004
Flood risk		The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1

4.1.2 The approximate area underlain by the Glaciofluvial Deposits and the line of the geological fault are shown on Drawing 3901/8.

4.1.3 There are 3 recorded pollution incidents on site. Two of these incidents involved household waste and are classified as Category 3 (minor) towards water and land, Category 4 (no impact) towards air. One further incident involved asbestos pollutants and was assessed as Category 3 (minor) towards land, Category 4 (no impact) towards air and water.

4.1.4 The EA have provided 3 years of water quality results for the River Calder at the closest monitored upstream/downstream locations to the site. The immediate upstream point at Mitchell Cotts only carries more basic analyses. In order to offer more upstream/downstream comparison they have also included data (a more extensive suite) from the site further upstream at Battyeford. This EA data (Microsoft excel format) can be provided on request.

4.1.5 The EA have no concerns regarding surface/groundwater passing through the site.

4.2 Landfills

4.2.1 Known or suspected areas of landfill in the vicinity of the proposed development site are summarised below:

Location	NGR (proximity to site)	Remarks	Source of data
Off Ravensthorpe Road.	SE 226 196 Beneath west of site.	Thornhill Power Station. Provider ref. EAHLD31749. First input December 1923. Included inert & industrial waste.	QGIS*/ Environment Agency data/ BGS Mapping
North of Ravensthorpe Road.	SE 229198 20m north of site.	C R Longley Ltd. Provider ref. EAHLD35738. First input December 1900. Included inert, industrial & special waste.	
		C. R. Lomgley Ltd. First input April 1992, ongoing, waste limited to materials produced on-site: breeze blocks, sand, gravel, ceramic, slate, concrete & cement, earth brick & stone.	
Thornhill Quarry site, off Calder Road.	SE 232 201 210m north of site.	Thornhill Landfill. Demex Ltd. Waste excluding inert waste >10T/D. Start date 2016.	
Thornhill Steel Works, off Forge Lane.	SE 238 196 200m east of site.	James Austin & Sons Ltd. Provider ref. EAHLD04230. First input December 1947, last input June 1989 included inert, commercia (construction demolition, non-hazardous & non-toxic)l & industrial (non-hazardous, inert & non-flammable) waste.	

* QGIS is an Open Source Geographic Information System.

4.2.2 Areas of known landfill are shown on Drawing 3901/10.

4.2.3 The Envirocheck report and QGIS data shows that the footprint of the Thornhill Power Station landfill underlies Lady Wood Extension and land immediately east of the woodland (but off site). Historical mapping suggests that tipping is essentially limited to the footprint of Lady Wood Extension.

4.2.4 Lithos have undertaken some ground investigation on land east of Lady Wood Extension (but beyond the area of current interest). An overview of this investigation is included in Section 8, but, in summary, no evidence of landfilling/tipping was found.

4.2.5 Consequently, the area of tipping associated with Thornhill Power Station Landfill is unlikely to be as extensive as suggested in the Envirocheck Report.

4.2.6 It is likely that materials in the Thornhill Power Station Landfill are associated with combustion (ash, clinker & slag; see comments in Section 2.2.13). Such material is less prone to generate hazardous gas than household waste. However, this cannot be confirmed without ground investigation.

5 COAL & MINING

5.1 General

5.1.1 In July 2011 the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology relating to coal mining development areas. This Section provides the necessary preliminary mining risk assessment required by the proposed planning application.

5.1.2 About 70% of the site is located in a Coal Mining Development **High Risk Area**; an area with specific mining legacy risks to the surface, including mine entries, shallow underground workings etc. The remaining c. 30% lies in a Development **Low Risk Area**; within the Coalfield, but no defined risks have been identified to date but there might still be unrecorded issues. CA Development risk areas are shown on Drawing 3901/8.

5.1.3 Information examined later in this Section (BGS maps, a Coal Authority mining report, abandonment plans and an NCB opencast investigation report) has yielded some inconsistencies in terms of seam names and lines of outcrop. However, in essence 9 coal seams underlie the site at shallow depth, and these are:

Seam name(s)	Approximate thickness/m	Approximate depth below 2nd Brown Metal coal/m	Remarks
2nd Brown Metal aka Old Hards	0.3 – 0.7	-	Known workings associated with Ladywood Colliery in 1920s.
3rd Brown Metal aka Stone	0.2 – 0.6	10 - 20	Outcrops close to southern boundary in centre-south.
Green lane aka Middleton Little	0.3 - 0.7	30 - 40	Outcrops across centre of site. Known workings associated with Ladywood Colliery in 1920s.
Un-named	0 – 0.4	52	Outcrops across centre-north of site.
New Hards aka Middleton Main	0.2 – 0.4	75	Outcrops along western boundary. Known workings associated with Ladywood Colliery in 1920s and from Thornhill colliery until 1972.
Un-named		90	Outcrops in west, within Lady Wood (central).
Wheatley Lime	0.7 – 1.2	100	Outcrops in west, within Lady Wood (north).
Middleton Eleven Yard Coal	0 - 0.8	107	Does not outcrop within current area of interest.
Blocking Coal	0.4 – 0.6	134	

5.1.4 Approximate outcrops are shown on Drawing 3901/8.

5.1.5 The BGS Technical Report notes that all of the named seams have been worked in the area, with the 2nd Brown Metal, New Hards and Wheatley Lime described as extensively worked.

5.1.6 The 3rd Brown Metal seam is described as having been worked by opencast methods only.

5.1.7 Given dip (c. 2° to 3° to the east & south-east) and topography, the entire site is expected to be underlain by shallow coal in several seams.

5.2 BGS information

5.2.1 BGS mapping shows that solid geology beneath the site should be divided into two fault blocks; an area of c. 4 ha in the west and an area of c. 26 ha in the centre and east. The conjectured line of the **fault** is shown on Drawing 3901/8. The area of the western fault block broadly corresponds with the footprint of Lady Wood.

5.2.2 BGS mapped coal seams outcropping/at shallow depth beneath the **western fault block** are:

- A thin un-named coal seam outcropping in the centre.
- The Wheatley Lime Coal; outcropping along the northwestern boundary.
- The Middleton Eleven Yard Coal.
- The Blocking Coal.

5.2.3 BGS mapped coal seams outcropping/at shallow depth beneath the **central/eastern fault block** are:

- 3rd Brown Metal/Stone Coal outcropping in the centre south.
- Green Lane/Middleton Little Coal; outcropping across the centre.
- An un-named Coal; outcropping across the north.
- The New Hard/Middleton Main Coal outcropping along the northwestern boundary and to the north.
- A thin un-named coal seam.
- The Wheatley Lime Coal.

5.2.4 Approximate outcrops based on BGS information are shown on Drawing 3901/8. It should be noted that outcrops shown on BGS maps have been known to be inaccurate by distances in excess of 100m.

5.2.5 The BGS technical report notes that:

- The Wheatley Lime Coal is a single seam which has been extensively worked underground and at surface in the wider area.
- The New Hards/Middleton Main Coal varies between 0.2m and 1.8m in thickness (this contradicts the map sheet) but is generally c. 0.7m thick and has been extensively worked deep underground and at surface in the wider area.
- The Green Lane/Middleton Little Coal is only known to have been worked underground at the former Calder Colliery (c. 400m northwest of the site) and has been extensively worked by opencast in the area.
- The 3rd Brown Metal/Stone Coal is only known to have been worked in opencast.

5.3 Unrecorded mineworkings

5.3.1 Coal has been mined in Yorkshire for centuries, and there are also likely to be unrecorded mineworkings which pre-date the requirement for abandonment plans (Coal Mines Regulation Act of 1872). Early mining methods included drifts or adits from outcrop. Where mining extended further from the crop, bell pits were often sunk, and as the coal got deeper still, shafts were used to access gallery workings (pillar & stall).

5.3.2 The shafts associated with bell pits are typically only about 1.2m in diameter, and the bell pit itself was typically 5m to 10m in diameter (bell pit size would have been constrained by roof stability). Consequently, bell pits are often closely spaced; the most intensive concentration of shafts recorded to date (66 per acre) was at the Middleton Broom Opencast site.

5.3.3 As coal was removed during bell pitting, the unsupported strata above assumed an inverted slope of stability, generating a bee-hive shape around the base of the shaft which forms the characteristic vertical section. The depth limit of bell pit mining is almost certainly 15m, and this is considered a deep bell pit; the vast majority were probably less than half this depth.

5.3.4 At greater depths, pillar and stall workings appear to have been the preferred method, and such workings were often accessed via a single shaft. Consequently, shafts associated with such workings are more widely spaced; but rarely exceeded one quarter of a mile (400m) shaft to shaft, due to problems with ventilation and underground haulage. It was customary to view the life expectancy of an individual pit as about three to five years and at any one time several new pits would be sinking to replace those currently operating.

5.3.5 Up until the last decades of the eighteenth century, coal mining almost always represented a short-term interruption to ongoing use of land for agricultural. The right to sink shafts and extract coal was usually conditional upon restoration of the surface after coal extraction was complete. This not only involved filling the shaft, but also required that any subsequent settlement of shaft fill material did not result in depressions in the field surface. Consequently, it was usual to fill the shaft and heap excess arisings into a dome over the shaft eye. Over subsequent years, the dome supplied material to compensate for settlement of the shaft fill. In the normal course of events, at the conclusion of the recovery period, any remaining spoil accumulations above ground level would have been planed-off to leave a relatively stable, level surface where the shaft had been.

5.3.6 Bell pits may be present across the whole of the site near coal outcrops (see Drawing 3901/8). Given the absence of loose superficial deposits across the majority of the site, it is considered unlikely that any shallow mine entries at Dewsbury Riverside would have been lined.

5.3.7 A fault is present in the west. Faults are usually bordered by a shatter zone where the coal is degraded. The nature and extent of a shatter zone varies according to the intensity of the faulting. Early and modern mining practice was to leave the coal in the shatter zone untouched as it was of little economic value. Thus there is usually a margin between the workings and the fault, which based on observations elsewhere might be about 60m wide (30m either side of the fault). This is shown on abandonment plans for the Lady Wool Colliery.

5.4 Recorded mineworkings

Coal Authority information – Mining Report

5.4.1 A Consultants Mining report has been obtained from the Coal Authority which states that:

- Known workings have taken place in 5 seams beneath the site. These are the:
  - Middleton Main; at 4.0m to 31m depth with a maximum extraction thickness of 1.14m from 1833 to 1927.
  - Top Beeston; at 97m to 108m depth with a maximum extraction thickness of 1.08m from between 1903 and 1909.
  - Whinmoor; at 123m depth with an extraction thickness of 0.41m in 1915.
  - Black Bed; at 54m depth with an extraction thickness of 76cm in 1915.
  - Better Bed; at 237m depth with an extraction thickness of 0.60m in 1909.

  In fact, abandonment plans suggest there are also known workings in the Green Lane and 2nd Brown Metal coals.
- The site is underlain by probable shallow workings *(i.e. the CA is aware of shallow economic coal which is likely to have been worked historically, but no records exist)*.
- There are no known spine roadways at shallow depth.
- A total of 40 mine entries are present in, or within 25m of, the site's boundary.
- A total of 4 coal seams outcrop within the site boundary.
- A fault is recorded *(this refers to the fault in the west)*.
- CA recorded areas of opencast are recorded from
- Several areas of opencast coal extraction are present in the west and from c. 50m to the south.
- There are no CA managed tips within 500m.
- There is one claim within 50m of the site for subsidence damage claims. This comprises a single residential dwelling located 10m east off Ouzlewell Lane.
- There are no mines gas emissions recorded within 500m.
- The site is in an area where a notice to withdraw support was given in 1947; the property is not in an area where notice has been given… cancelling the right to withdraw support.

5.4.2 The Coal Authority suggest that the following seams outcrop within the current area of interest:

- Low Fenton (2nd Brown Metal).
- Middleton Little.
- Middleton Main.
- Wheatley Lime.

5.4.3 The above names do not tally with seam names on an NCB drawing (see Section 5.5) or the BGS map.

5.4.4 A total of 40 mine entries are located in, or within 25m of, the site's boundary. The locations of the mine entries are shown on Drawing 3901/8. A summary of mine entries is outlined below:

Type	Total no.	Location	CA Reference's
Adit	18	West, vicinity of Lady Wood & Lady Wood Extension	422419-012, 422419-013, 422419-014, 422419-016, 422419-017, 422419-018, 422419-019, 422419-020, 422419-021, 422419-022, 422419-023, 422419-024, 422419-028, 422419-029, 422419-030, 422419-031, 422419-032 & 422419-037.
Shaft	8		422419-003, 422419-005, 422419-006, 422419-007, 422419-009, 422419-010, 422419-011 & 422419-026.
Shaft	1	Centre	422419-027.
Shaft	3	East (adj. to School)	423419-006, 423419-005 & 423419-004.
Adit	1	Off-site; southwest	422419-025.
Shaft	3	Off-site; west	422419-004, 422419-015 & 422419-043.
Shaft	2	Off-site; north	423419-008 & 422419-002.
Shaft	4	Off-site; east	423419-011, 423419-002, 423419-001 & 423419-003.

5.4.5 Of the above 40 mine entries the CA only have treatment records for one; Shaft ref. 422419-002 which is positioned off-site to the north in the former Calder Colliery and which was located, found and subsequently capped with an 8.5m x 8.5m x 0.75m thick reinforced concrete cap at rockhead by IMC Ltd on behalf of the Coal Authority in 2003.

5.4.6 Given the absence of further records it is likely that the remaining mine entries, especially those located within the site's boundary, have not been formally treated.

5.4.7 The majority of these mine entries are located in the vicinity of Lady Wood, beyond areas of proposed development. Within the area proposed for development, there are only 3 known mine entries, CA Refs. 422419-027, 423419-004 & 423419-005.

5.4.8 It should be noted that there may be further mine entries located in the site's boundary which the Coal Authority have no record of.

Coal Authority information – Abandonment Plans

5.4.9 Abandonment plans have been obtained from the Coal Authority and are reproduced in Drawings 3901/9A & 3901/9B in Appendix B to this report. These plans show workings within the Middleton Main, Middleton little and 2nd Brown Metal coal seams. It should be noted that further abandonment plans have been examined for the wider Dewsbury Riverside area which show that coal has been extensively worked in the surrounding vicinity.

5.4.10 The abandonment plans also show areas of 'Old Workings' beyond the recorded mines which indicates that large portions of the site are also underlain by older, unrecorded mineworkings.

5.4.11 In addition, some opencast extraction of the Middleton Little and 2nd Brown Coals has taken place; shown on both on the abandonment plan and the Consultants Mining Report map. These areas are also shown on Drawing 3901/8 in Appendix B and lie in the west, within the Lady Wood Extension, beyond areas of proposed development.

5.4.12 Unfortunately, none of the abandonment plans include levels (mAoD) for the workings. However, they do often include sections which indicate thicknesses of coal and fireclay. These suggestions suggest:

- The New Hards / Middleton Main seam comprises 3'6" (1.0m) of coal, with a 3" dirt parting. It is underlain by Fireclay (thickness not stated, so likely not worked).
- The Green Lane / Middleton Little seam comprises 2'" (0.6m) of coal, underlain by 9" (0.2m) of Fireclay.
- The Old Hards / 2nd Brown Metal seam comprises 1'7" (0.5m) of coal.

5.4.13 The fault shown on BGS maps which runs through Lady Wood is shown on abandonment plans to have a downthrow to the east of 30 yards (27m).

5.4.14 Relevant abandonment plans are reproduced in Drawings 3901/9a and 3901/9b and summarised in the table below:

Abdn Plan Ref. (Lithos Drwng)	Coal Seam	Workings section?	General remarks	Mine entries
Ladywood Colliery 9482 (3901/9a)	Middleton Main.	Yes; coal in two leaves (0.69m & 0.38m) with dirt parting (8cm). Total thickness 1.14m). Fireclay at base (thickness not given).	Extensive underground workings beneath Lady Wood, Lady Wood Extension & the centre-west. Absence of workings where fault cuts across site.	Regularly spaced adits along coal outcrop in south of Lady Wood. Three pits (shafts) in centre & east of Lady Wood between 3.4m & ft &19.4m deep. Two adits in the north of Lady Wood Extension.
	Middleton Little.	Yes; single leaf of coal. Total thickness 60cm. Fireclay at base 0l22m thickness).	Worked from surface (opencast) in the southeast of Lady Wood & worked underground beneath the centre & south of Lady Wood Extension. Further opencast working of outcrop in northernmost tip of Lady Wood.	5 adits in the southwest of Lady Wood extension.
	2nd Brown Metal.	Yes; single leaf of coal. Total thickness 0.48m.	Worked from surface (opencast) in the south of Lady Wood Extension. Minimal underground workings in the south of Lady Wood Extension.	Single adit in centre-south of Lady Wood Extension.
Thornhill Colliery NE774 (3901/9b)	Middleton Main.	No.	Worked underground across the centre-east, southeast & south of the site. Old workings suggested across the centre.	Three shafts in the centre-northeast. Fault shown running east to west across the south downthrowing 8.2m to the north.

5.5 NCB information

5.5.1 In July 1973, the NCB Opencast Executive issued a Report (copy included in Appendix E) summarising the findings of an intensive borehole investigation within 4 sub-areas (A to D) of the wider site. The Report was issued to parties interested in tendering for anticipated opencast contract(s).

5.5.2 It is apparent from review of the 1:10,000 BGS map that coal was subsequently opencast (likely in the early 1980s) from land in the vicinity of the former Ingham's Pit, about 500m east of the current area of interest; broadly equating to Areas C & D.

5.5.3 **Areas A & B** lie within the centre-south of the current area of interest, but coal is not believed to have been extracted.

5.5.4 The NCB Report includes the findings of a large number of boreholes drilled within the current area of interest.

5.5.5 A drawing included with the NCB Report shows:

- The 4 sub-areas (A to D)
- Boreholes which encountered:
  - neither coal nor old workings
  - Solid coal only
  - Old workings
- The position of known or suspected shafts & adits
- Seam outcrops
- Direction & rate of seam dip

5.5.6 The seam expected to be worked within Area A was the 3rd Brown Metal, and that to be worked in Area B was the 2nd Brown Metal. Coal outcrops shown on the NCB Drawing do not tally with those shown on the British Geological Survey map (Sheet SE21NW); see Drawing 3901/8.

5.5.7 The NCB Report refers to "parting variation", which is the thickness of undifferentiated Coal Measures bedrock between each of the main coal seams. This suggests:

- the 3rd Brown Metal lies between 9.9m and 18.7m below the 2nd Brown Metal; and
- the Middleton Little lies 20.0m below the 3rd Brown Metal.

5.5.8 These partings tally reasonably well with those on the stratigraphic section on BGS mapping.

5.5.9 The NCB Report suggests:

- The predominant lithology is mudstone & Made ground was not encountered.
- Geological structure was interpreted by contouring the 2nd Brown Metal and the 3rd Brown Metal Coal Seams. The seams dip at about 1 in 60 to the east and up to 1 in 30 to the west. Some deformation of the coal seam seems apparent in the west, close to the line of the geological fault.
- No faulting was identified (boreholes were not drilled in the western fault block).
- No water was encountered during drilling.
- The only underground workings were encountered in the **3rd Brown Metal** Coal in the west of the site. Workings have been **packed** with 'waste'; colliery arisings likely comprising mudstone, clay etc.

5.6 Mining risks

5.6.1 Risks associated with shallow mineworkings include:

- Mines gas
- Combustion
- Collapse, with consequent subsidence affecting surface stability
- Recorded, and unrecorded, mine entries

Mining risks – gas

5.6.2 Gas monitoring and a hazardous gas risk assessment will be required and is proposed (see Sections 6 & 10.3).

Mining risks – combustion

5.6.3 Where coal is exposed during any site preparatory earthworks, or within excavations, care should be taken to avoid the potential for spontaneous coal combustion.

5.6.4 If any foundation excavation comes into contact with coal, the foundation should be taken through the coal seam, into underlying natural in-situ strata of adequate bearing. The full thickness of coal should then be sealed with mass concrete fill placed as soon as possible after exposing the seam to prevent the ingress of air.

5.6.5 By virtue of the provisions of the Coal Industry Act 1994 interests in unworked coal and coal mines previously vested in the British Coal Corporation are now vested in the Coal Authority. The Developer will need to contact the Coal Authority to dig or carry away such coal as they encounter in connection with redevelopment of the site (this is often referred to as incidental coal).

5.6.6 Any ground investigation and\or drilling for grouting purposes should be carried out to HSE and Coal Authority guidelines to minimise the risk of coal combustion and potential for migration of mine gases into neighbouring properties.

Mining risks – mine entries

5.6.7 The Coal Authority hold records of 40 known mine entries on, or adjacent to, the site, all but one (off-site shaft) of which are believed to remain uncapped.

5.6.8 The majority of these mine entries are located in the vicinity of Lady Wood, beyond areas of proposed development. There are only 3 known shafts within the proposed development. However, it is possible that in addition to these known entries several unrecorded mine entries, possibly including bell pits exist.

5.6.9 The Coal Authority discourage development over or adjacent to shafts. However, such features are typically of less concern where they only extend to relatively shallow seams. The recommended no build zone around deep shafts is usually defined by a line drawn up at 45° from the top of the shaft, where it intercepts rock head.

5.6.10 Once located, each shaft should be accurately located by grid co-ordinates, proved to its base, pressure grouted and then be capped off at rockhead level. A shaft cap is generally required to be twice the shaft diameter and designed to support the depth of fill above plus any surcharge loads. Detailed cap design is beyond the scope of this report but should also include gas venting measures.

Mining risks – surface stability

5.6.11 Mineworkings which could affect surface stability are probably present beneath the majority of the site. Coal is likely to have been extracted by pillar & stall methods.

5.6.12 In addition, there may also have been earlier, unrecorded mineworkings via bell pits and/or pillar and stall methods, indeed several CA abandonment plans record the presence of 'old workings', and if present these could result in unpredictable subsidence. Individual pillars may collapse at any time, leading to settlement in the overlying strata. As the mine roof degrades and collapse the void migrates upwards, sometimes causing a surface collapse or crown hole.

5.6.13 The vertical distance through which a void can migrate is difficult to assess. Made ground and superficial deposits are considered to have no inherent strength and the assumption is generally made that if a void reaches the base of these formations, it will reach the surface.

5.6.14 CIRIA C758D[2] notes that given the limited evidence of structural damage caused by pillar failure, compared with that resulting from roof collapses, engineering assessment of the potential for surface instability has focused on the latter. Failure of roof strata results in the progressive transmission of the void upwards through overlying rock. The extent of 'void migration' can be influenced by factors such as: strata dip; bulking characteristics of the collapsed rock or soil; capability for arching of the collapsed zone; groundwater flow and the presence of strong and intact rock layers with the ability to span that may attenuate the upward movement.

5.6.15 The limit height on the void migration, where no appreciable surface subsidence results, is often termed 'acceptable cover', with its determination based upon a criterion reflecting the worked thickness of the seam and the rock cover. The acceptable cover criterion is generally represented as ht, where 'h' is the thickness of rock above the workings expressed as a multiple of t, the worked thickness. This has been a popular approach because the two elements can be reasonably well determined via conventional ground investigation.

5.6.16 Most evaluations of required bedrock cover come from the examination of Coal Measures mines. In these, it has been observed that the height of migration in bedrock might, exceptionally, extend to 10 times the height of the original extraction. Consequently, the 10t criterion has, for over 30 years, been adopted by the industry as providing reasonable assurance against surface subsidence resultant from roof collapse in old, room and pillar mines. However, collapses might attenuate within a lesser cover and there will be circumstances where using the 10t criterion could be considered overly conservative.

5.6.17 That said, a Coal Authority Technical Guidance Note[3] which describes a subsidence event that affected a number of properties on a housing estate in north-east England in 2016, concluded that the 10 times rock cover guidance is only a 'rule of thumb' for crown hole collapses. Other subsidence mechanisms can occur, such as pillar failure, for which the 10 times rock cover rule of thumb is not an appropriate guide.

5.6.18 Mitigation of the risks posed by the shallow mineworkings will be required, and this could be achieved in one of two ways:

- Extraction of the remaining coal
- Consolidation, via drilling & grouting

[2] *CIRIA C758D:2019. Abandoned mine workings manual*
[3] *Coal Authority, TGN01/2019. Findings from a large subsidence event on a residential estate.*

5.7 Mine water emissions

5.7.1 Springs and areas of very waterlogged ground are present across localised parts of the site. It is likely that at least some springs are a result of waters draining from mineworkings via adits, most notably across Lady Wood (the far-west) where the CA record a very high concentration of mine adits.

5.7.2 Mine waters can commonly include very high concentrations of contaminants, most notably dissolved metals (including iron), which have leached out from the underground seams.

5.7.3 At this stage it cannot be discounted that some spring waters at this site might yield significant contaminant concentrations that pose a risk to human or environmental receptors.

5.7.4 A request for information was sent to the Coal Authority and is included in Appendix E.

5.7.5 The Coal Authority have no records of mine water monitoring locations, treatment sites or specific discharges in the area, although this does not mean that no issues are present.

5.7.6 It is likely that the water discharging here has interacted with mine workings and could therefore be described as mine water. This water is likely to contain elevated concentrations of minerals associated with the Coal Measures including iron which is often seen as ochreous (orange) deposits around discharges. These constituents would also be likely to occur in natural groundwater occurring in this area.

5.7.7 The CA note that "acid mine drainage" is rare in the UK and is related to specific conditions unlikely to be present at this site.

5.8 Mineral safeguarded areas

5.8.1 The site is underlain by at least 5 seams of coal, although some areas have previously been subject to opencast extraction, and might therefore be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA).

5.8.2 MSAs are areas of known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come. The purpose of MSAs is not to preclude automatically other forms of development, but to make sure that mineral resources are adequately and effectively considered in land-use planning decisions.

5.8.3 Specialist guidance on Mineral Safeguarding "A Guide to Mineral Safeguarding in England" has been produced by The Coal Authority and the British Geological Survey.

5.8.4 Paragraph 204 of the National Planning Policy Framework (NPPF) requires Local Authorities, when preparing Local Plans to:

- Define Minerals Safeguarding Areas and adopt appropriate policies in order that known locations of specific minerals resources of local and national importance are not needlessly sterilised by non-mineral development, whilst not creating a presumption that resources defined will be worked; and define Minerals Consultation Areas based on these Minerals Safeguarding Areas.
- Set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible, if it is necessary for non-mineral development to take place.

5.8.5 NPPF Paragraph 144 notes that when determining planning applications, local planning authorities should give weight to the benefits of the mineral extraction.

5.8.6 As a consequence of the NPPF, and the presence of coal beneath the site, the Local Authority may require The Developer to consider the opportunity to recover (extract) the coal. Applicants submitting planning applications may need to demonstrate to the Local Authority that they will extract the coal, unless:

- It can be shown it is not economically viable to do so, or
- It is not environmentally acceptable to do so, or
- The need for the development outweighs the need to extract the coal, or
- The coal will not be sterilised by the development

5.9 Coal extraction

Kirklees MBC Policy

5.9.1 The Council have a Unitary Development Plan (UDP), adopted in 1999 with some revision in 2007. Section 6.10 (Minerals) of the UDP notes that: "I*n West Yorkshire opencast coal mining is concentrated in Leeds and Wakefield Districts. There has not been an operational opencast coal mine in Kirklees since 1984 perhaps because the local geology is more difficult and because of the extent of previous extraction in the exposed coalfield within Kirklees during the 1950's and 1960's. Unlike aggregates there is no national or regional guidance on the level of production required or where it should be met; MPG3 leaves that to market forces. For these reasons no allocations for opencast coal mining are considered necessary."*

5.9.2 However, Kirklees Council has to comply with national planning policy to extract coal where it is feasible in order to avoid sterilisation caused by building over it. In essence Section 6.10 is concerned with coal extraction where no subsequent development is proposed; this is quite different to the NPPF scenario with its emphasis on avoiding sterilisation of coal reserves.

5.9.3 Kirklees Council have also issued a Draft Local Plan (Strategy & Policies) in November 2015. Map 5 suggests the site (referred to as H2089) does not lie within a Mineral Safeguarded Area.

Site-specifics

5.9.4 Prior extraction of coal is encouraged by both the Coal Authority and Planning Authorities, largely because a potential mineral resource will not be sterilised by the development. However, it is worth noting that the UK market for coal is changing (driven by government carbon emission targets) – most notably very few power stations are still burning coal. Consequently, prior extraction of coal has become less attractive in recent times.

5.9.5 The Extraction Contractor would pay the landowner a disturbance allowance for the coal (likely to be between £2 and £4 per tonne). Consequently, there could be a significant financial benefit to this approach, since in essence any proposed earthworks (i.e. regrading) would be undertaken and there would be a considerable saving because grouting would not be required.

5.9.6 In order to pursue this option, it would be necessary to obtain a statutory licence from the Coal Authority.

5.9.7 In addition to commercial and planning considerations, advantages of coal extraction over grouting include the removal of development constraints associated with known mine entries.

5.9.8 Traffic movements (associated with coal export) are expected to be no greater than those associated with grouting (import of PFA and cement).

5.9.9 However, coal extraction is not without drawbacks; these include:

- The creation of 'high-walls' around the margins of the extraction area (essentially the whole of the site's perimeter).
- The time required to ensure significant settlement of the replaced overburden (anticipated residual settlement must be less than 25mm) is typically at least 12 months. However, the actual delay to build programme might be longer, since it is impossible to predict the actual time required for ongoing creep settlements to fall to tolerable levels. Prediction is hampered by uncertainties associated with groundwater rebound and the nature of the excavated material with respect to suitability for compaction.
- Extraction usually increases developer abnormal foundation costs.
- Local environmental issues associated with noise and dust.
- Public perception issues.
- Concerns that once an initial excavation has been opened, the coal extraction contractor might decide there is insufficient coal remaining and abort further work, or even run into financial difficulties, leaving KMBC or the Developer with increased foundation abnormals and no royalties.

5.9.10 Assuming the above factors do not preclude further consideration at the 'first hurdle', the viability of extraction is influenced by physical factors, most notably:

- the presence (or not) of old mineworkings;
- seam thickness (greater the better); and
- seam depth (shallower the better).

5.9.11 It is understood from preliminary enquiries, that extraction is viable where the overburden above a seam is less than 10 times the seam's thickness; in the north of this site (the "Miller's area) the overburden thickness is less than 10 times seam thickness for the Middleton Little and 3rd Brown Metal coal but greater than 10 times seam thickness for the Middleton Main.

5.9.12 Consequently, in theory prior extraction of the Middleton Little and 3rd Brown Metal coals might be economically viable.

5.9.13 However, extraction of the Middleton Little coal is unlikely to be viable because:

- The degree of previous extraction (historic mineworkings) appears to be in the order of 75%.
- If the Middleton Little were extracted, there might insufficient competent bedrock cover above deeper workings in the Middleton Main seam (which might therefore require grouting).
- The proximity of existing housing along Ravensthorpe Road.

5.10 Drilling & grouting

5.10.1 If shallow coal seams are not entirely removed by prior extraction, then it may be necessary to consolidate the mineworkings by drilling and grouting.

5.10.2 The necessary consolidation should be achieved by drilling holes on an appropriate grid (likely 3m to 5m spacings). A viscous grout composed of appropriate proportions of OPC, PFA, sand or pea gravel would then be injected into the workings via these holes.

5.10.3 Drilling and grouting operations should be carried out with engineering supervision, and be undertaken in accordance with a suitable, approved Specification tailored to the site-specifics associated with this site.

5.10.4 Proposals to treat the mineworkings and shafts will need to be discussed with both Kirklees Council (most notably Highways), and the Coal Authority well in advance of starting works on site.

6 HAZARDOUS GAS

6.1 Methane & carbon dioxide

6.1.1 The site is believed to be affected by sources of hazardous gas generation as it is:

- Located within 250m of known former landfill sites.
- Located within 250m of areas of quarrying and opencast coal extraction.
- Underlain by shallow mineworkings.

6.1.2 Consequently, monitoring is recommended in order to determine appropriate gas protection measures for the proposed dwellings.

6.2 Radon

6.2.1 Requirements with respect radon measures are set out in Building Regulations Approved Document C. Probability bandings (based on the proportion of properties in a given area that exceed the Action Level; currently 200 $Bq.m^{-3}$) are used to determine whether a property requires no, basic or full measures. At present Approved Document C advocates basic measures for the probability banding 3% to 10% (full measures if >10%).

6.2.2 The Public Health England UK radon map and the Landmark report indicate that the site is in an area where **between 1% and 3%** of homes are estimated to be above the action level. Consequently, basic radon protection measures may not be required in new dwellings.

6.2.3 However, Public Health England would like to see all new build include basic measures. Given that the site lies in an area where >1% of homes are estimated to be above the action level, the Developer might consider providing all new dwellings with basic radon protection measures.

7 POTENTIAL DEVELOPMENT CONSTRAINTS

7.1 Topography; significant regrade earthworks are anticipated.

7.2 An underground high-pressure **gas** main and overhead **electric** lines cross the site. These are likely to require either substantial development easements or diversion at significant cost.

7.3 There is a **culverted** stormwater drain (not shown on YW plans but see Section 2.2.18); this will need removal or incorporating into the sites new drainage system.

7.4 Where proposed highways cross **quarry** highwalls precautions must be taken to avoid unacceptable settlement.

7.5 Sterile 'no build' zones will be required around the 3 mine **shafts**. The no-build zone should be derived by assuming a 45° line from the point where the shaft meets rockhead, running away from the shaft to the finished ground level.

8 PREVIOUS INVESTIGATION FINDINGS

8.1 Lithos – "Miller's" area

8.1.1 Lithos have previously undertaken ground investigation on c. 7.2 hectares of land in the centre-north of this site ("Miller's" area).

8.1.2 Findings were provided in Report 2336/3, issued to Miller Homes in January 2018. Millers have granted permission to KMBC allowing Lithos to "re-use" the data obtained.

8.1.3 The 2018 ground investigation data will be assimilated with data to be collected from across the remainder of the current area of interest in early 2020. In the meantime, a brief summary of 2018 findings is included below.

8.1.4 The 2018 investigation comprised:

- 22 trial pits, TPs 301 to 322 (1.9m to 4.1m depth)
- 20 rotary open probeholes, PHs 207 to 219, 209a, 210a, 211a, 212a, 216a, 217a & 217b (10.0m to 36.0m depth), with spot cores to recover samples of coal for subsequent quality analysis
- 13 samples of Topsoil were analysed for a suite of chemical testing to check suitability for re-use
- 20 samples of residual soils and bedrock were submitted for geotechnical testing
- 7 samples of coal were recovered and submitted for coal quality analysis.

8.1.5 Shallow ground typically comprised the following:

- Topsoil to c. 0.3m.
- Subsoil (slightly gravelly clay) to between 0.3m & 0.7m.
- Cohesive Residual Soil (medium strength gravelly sandy clay).
- Granular Residual Soil (sandy gravel of sandstone).
- Coal Measures (bedrock; sandstone or mudstone) encountered from between 0.9m and 3.1m depth (ave. 2.1m).

8.1.6 No made ground, nor any visual or olfactory evidence of significant contamination was encountered.

8.1.7 The rotary probeholes encountered 5 coal seams in the following succession:

- 3rd Brown Metal (0.3m to 0.5m thick)
- An un-named seam (0.3m to 0.5m thick)
- Middleton Little (0.5m to 1.6m thick)
- Middleton Main (1.2m thick)
- An un-named seam (0.2m thick)

8.1.8 Evidence of workings was encountered in the Middleton Little and Middleton Main coal seams comprising voids, and areas of soft push/broken ground.

8.1.9 No evidence of workings was encountered in the 3rd Brown Metal Coal (although this only underlies a small part in the far south of the "Miller's" area) or the two un-named seams. It should be noted that the 3rd Brown Metal as identified above may actually be the 2nd Brown Metal Coal.

8.1.10 Report 2336/3 concluded that underground workings should be anticipated in the Middleton Main and Middleton Little Coal Seams. Mitigation of the risks posed by these workings will be necessary and could be achieved either by prior extraction or consolidation (drill & grout). However, if the Middleton Little Coal were extracted (i.e. opencast, with subsequent backfill of excavations) then there might be a need for grouting of the underlying, deeper Middleton Main Coal.

8.1.11 Mine entries were not located during Lithos' investigation as this lay beyond the scope of works.

8.1.12 Topsoil was found to be slightly 'contaminated' with arsenic but was considered suitable for re-use on site, although there might be implications is export off-site were proposed (further testing and assessment would be required). No further contamination was encountered.

8.1.13 Natural soils are of medium to high strength and cohesive soils are of medium shrinkability. Sub-surface concrete should be Design Sulphate Class DS-1 with an ACEC Classification of AC-1.

8.1.14 Foundations for 'traditional' two/three storey builds could comprise 'traditional' strip footings to a minimum depth of 600mm (granular founding stratum) or 900mm (cohesive founding stratum). Reinforcement of footings would be required where consolidated (i.e. grouted) seams remain at shallow depth.

8.1.15 The redundant 12" gas pipeline (see Section 2.2.21) was located with a CAT during Lithos' investigation.

8.2 Lithos – Lyttle land

8.2.1 An area of 7.2 ha in the north-west, beyond the area of current interest (the Lyttle land) was investigated in April 2017. This investigation had originally been intended to include the "Miller's" area, but access to that land was not granted until 2018, other than for the drilling of 2 probeholes. The aims of this investigation were to:

- Determine the extent of the Thornhill Power Station landfill (as outlined in the Envirocheck information (see Section 4.2)
- Confirm the depth of a gas main
- Determine the depth and thickness of an un-named coal seam

8.2.2 The 2017 investigation comprised:

- 14 trial pits, TPs 201 to 214 (1.9m to 4.1m depth)
- 7 rotary open probeholes, PHs 201 to 206 & 206A (10.0m to 36.0m depth)

8.2.3 Interestingly, no made ground was encountered within the licensed boundary of the former Thornhill Power Station landfill. This conflicts with data provided in the Envirocheck Report but is consistent with review of historical OS mapping. It was concluded that tipping, if indeed any took place at all, was restricted to the area of new planting (Lady Wood Extension) further to the south and west.

8.2.4 Ground encountered in the trial pits comprised: Topsoil (typically 300mm in thickness), over cohesive residual soils, which grade down into granular residual soils and eventually into bedrock.

8.2.5 Bedrock was encountered in all the pits, and typically comprised sandstone. Rockhead was encountered between 1.1m and 2.7m; average 2.0m. In addition, coal was encountered in TPs 205 & 213.

8.2.6 Five different coal seams (all intact) were encountered. Whilst there is some uncertainty regarding which specific seams were encountered, the probehole logs included tentative names.

8.2.7 An inspection pit was dug by hand, under NGN supervision, which demonstrated that the high-pressure gas main crossing lies at a depth of greater than 1.5m in the vicinity of a proposed new road. A CAT scan at 1.5m indicated that the main was possibly a further 1.7m deep.

9 LAND CONTAMINATION - PART IIA & PLANNING

9.1 Local Authorities have responsibilities with respect to land contamination in the context both of Part IIA of the Environmental Protection Act 1990, and Planning.

9.2 The contaminated land regime in Part IIA was introduced specifically to address the historical legacy of land contamination. It applies where there is unacceptable risk, assessed on the basis of the current use and the relevant circumstances of the land. It is not directed to assessing risks in relation to a future use of the land that would require a specific grant of planning permission. This is primarily a task for the planning system, which aims to control development and land use in the future.

Planning

9.3 As of 27th March 2012, Planning Policy Statement (PPS23) was replaced by the National Planning Policy Framework (NPPF). The NPPF (updated in February 2019) includes the following with respect to contamination and site investigation:

9.4 'Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

9.5 Planning policies and decisions should ensure that:

- The site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses, and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the environmental protection act 1990; and
- Adequate site investigation information, prepared by a competent person, is presented'.

9.6 Annex 2 of the NPPF states that 'all investigations of land potentially affected by contamination should be carried out in accordance with established procedures (such as BS10175 - 2017, Code of Practice for the Investigation of Potentially Contaminated Sites)'.

This site

9.7 Coal Measures bedrock is classified as a Secondary A Aquifer. The nearest surface watercourse is an un-named tertiary watercourse which issues in the West and flows in a northerly direction onto the Rover Calder (about 170m to the northwest). Therefore, the site's environmental setting is considered to be of moderate sensitivity.

9.8 With respect to human health, the proposed end use (residential) is also sensitive.

9.9 The site is predominantly greenfield and use as farmland is unlikely to have given rise to significant ground contamination. However, land beneath Lady Wood Extension is recorded as historic landfill and shown as a waste tip and slag heap on historical mapping.

9.10 Whilst current use of the site (farmland and woodland) is considered unlikely to have given rise to any significant ground and groundwater contamination, former colliery operations and landfill/tipping (most notably beneath Lady Wood and Lady Wood Extension) may well have.

9.11 It is considered that the site should be suitable for the proposed use subject to implementation of appropriate preparatory works.

10 GROUND INVESTIGATION DESIGN

10.1 Anticipated ground conditions & potential issues

10.1.1 Based on the data reviewed in Sections 4 to 9, anticipated ground conditions are expected to comprise:

Anticipated condition	Remarks
Made ground	Anticipated across Lady Wood & Lady Wood Extension; notably area of landfill/tip/slag/spoil heap. Deep Made Ground in footprints of former opencast areas and a small sandstone quarry.
Natural soils	Veneer of Topsoil over Residual Soils (gravelly clay & sandy gravel). Glaciofluvial deposits in northeastern corner.
Bedrock	Coal Measures Sandstone & Mudstone from between c. 1.0m & 3.0m depth.
Mineworkings	Anticipated from shallow depth in 2nd Brown Metal, Middleton Main, Middleton Little & Wheatley Lime Coal Seams from shallow to c. 50.0m depth. In addition, several mine entries present, most notably in Lady Wood (west).
Groundwater	Anticipated in bedrock; likely flow direction to the north. Waters likely to flow through underground mineworkings & localised springs may be the result of minewaters draining from former adits.

10.1.2 Based on the data above and that in Sections 2 (Site Description) and 3 (History), potential ground-related issues associated with this site are likely to include:

Type of issue	Specific issue	Remarks
Potential on-site contamination sources	1. Made Ground. 2. Farming related activities. 3. Minewaters.	1. Area of slag/refuse tip (Lady Wood Extension). Areas of former opencast coal extraction. Around buildings in Lady Wood. 2. See Section 10.2 below. 3. Potential emission of minewaters contaminated with metals.
Potential off-site contamination sources	1. Landfill.	1. Areas of landfill to the north; potential for generation & migration of hazardous ground gasses.
Potential geotechnical hazards	1. Shallow underground workings 2. Buried highwalls 3. Mine entries 4. Sloping topography 5. Cohesive soils 6. Deep made ground	1. In several seams of coal beneath site. 2. Around periphery of areas of former opencast. 3. Most notably across Lady Wood. 4. Some site regrade into developable levels is anticipated. 5. Potential for shrink/swell of soils influenced by trees. 6. Within areas of former opencast & landfill.
Other potential constraints	1. Underground & overhead utilities cross the site.	1. May be a requirement for diversion or easement.

10.2 Preliminary conceptual site model

10.2.1 A preliminary conceptual site model, presented as Drawing No 3901/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 10.1 inclusive of this report.

10.2.2 Historical plans show that the site has been occupied by arable farmland which is not considered likely to have caused significant ground contamination. Nonetheless, activities such as slurry spreading, the discharge of chemicals to ground, and unregulated burial have all occurred on farmland. Potential contaminants associated with farming activity might include any of the following:

Agricultural activity	Potential contaminant
Sewage farming, slurry spreading	Methane, metals, nitrates, oxygen depletion
Orchards	Metals, pesticides
Carcase burial	Anthrax & other biohazards
Plant & animal protection	Pesticides & herbicides
Soil conditioners	Metals, sulphates, PAH
Equipment maintenance	Hydrocarbons, metals
Waste burial, land levelling, backfilling ponds/quarries	Methane, metals, PAH etc
Naturally occurring contaminants	Arsenic, metals

10.2.3 Whilst it is likely that pesticides have been applied during arable use of the land, these are not likely to include the persistent organochloride pesticides such as Dieldrin, Aldrin, DDT etc. Pesticides routinely used on arable crops the UK (Phenoxy Acetic acid herbicide or PAAH) rapidly degrade in soils or leach via rainwater infiltration to groundwater. It is highly unlikely these would be detected by soil sampling and therefore these have not been included within the proposed sampling suite.

10.3 Ground investigation design & strategy

10.3.1 KMBC's requirements were outlined in tender documents and required probeholes and trial pits on a 50m grid across the site (alternate probeholes/trial pits), with installation of gas and water monitoring wells in 50% of the probeholes. It was acknowledged that further rotary drilling may be required to assess mining risk, which, if required, will be determined and costed at a later stage.

10.3.2 Whilst KMBC's requirements have been used as the basis for the proposed ground investigation, account has also been taken of the preliminary conceptual site model, the proposed development area and constraints associated with the allotments and areas of woodland. The proposed ground investigation scope is summarised below:

Exploratory holes	Purpose
About 40 trial pits	To determine the general nature of soils underlying the site, including the: • nature, distribution & thickness of shallow soils, including any made ground. • suitability of the ground for founding structures & highways.
Trial trenches	To determine the location & nature of buried highwalls around small sandstone quarry.
Shallow excavations	To locate the known mine entry (CA Ref. 4224419-027).
About 20 mini-BHs	To determine ground conditions in allotments & woodland (Lady Wood Extension) where access is constrained.
About 35 rotary probeholes	To check for the presence of voids or broken ground associated with possible unrecorded shallow mine workings
Including 17 probeholes	To install hazardous gas monitoring wells.

10.3.3 Proposed exploratory hole locations should provide a representative view of the strata beneath the site and to target potential areas of interest identified in Section 10.1.2 above. A nominal 50m grid spacing has been proposed by KMBC. Additional exploratory locations may be scheduled as necessary in light of the ground conditions actually encountered.

10.3.4 Representative soil samples of natural and any man-made ground should be taken during the works. The number of soil samples taken should be reflective of the geological complexity actually encountered, but in general about 3 samples should be taken from most exploratory holes.

10.3.5 The investigation should be undertaken in general accordance with:

- BS5930:2015 "Code of practice for site investigation"
- BS10175:2017 "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)

10.3.6 **Trial pitting / trenching** will enable determination of:

- Nature, distribution and thickness of shallow soils beyond the former opencast
- Suitability of the ground for founding structures and highways
- The location of buried highwalls (small sandstone quarry)
- Location of CA Shaft Ref. 4224419-027

Note: KMBC have already appointed Systra to location CA Shaft Ref. 423419-004 & 423419-005.

10.3.7 The in-situ shear strengths of any cohesive soils encountered should be determined by use of a hand-held shear vane.

10.3.8 The potential for **soakaways** should be reviewed in light of ground conditions actually encountered, and if considered likely, soakaway tests should be commissioned. Testing would remove any ambiguity with respect to Yorkshire Water queries.

10.3.9 Access constraints within allotments and areas of woodland (Lady Wood Extension) necessitate the use of **dynamic sampling** techniques (mini-boreholes). It should be noted that window sampling allows only a limited inspection of the ground (cf trial pitting). Consequently, some uncertainties may remain and a supplementary ground investigation may be required.

10.3.10 **Mini-boreholes** will allow the installation of gas monitoring wells.

10.3.11 Routine **geotechnical soils analysis** (moisture content, Atterberg limits, pH, water soluble sulphate) should be scheduled on about 30 samples.

10.3.12 The site is essentially Greenfield, and therefore testing of potentially **contaminated** samples should only be required if made ground is encountered in the exploratory holes; it would be prudent to allow for testing of up to 18 samples. In addition, analysis of at least 18 samples of topsoil should be undertaken in order to confirm its suitability for re-use. Analysis should include pH, metals, TOC, speciated PAH and asbestos ID.

10.3.13 Analysis of about 9 topsoil samples should be scheduled to check compliance with BS3882:2015 requirements, via testing for visible contaminants, sharps and clay/sand/silt content.

10.3.14 A total of 35 **probeholes** should be sufficient to determine whether or not old mineworkings are present in the shallow coal seams. If present, 35 probeholes should also be suffice to determine whether or not mineworkings pose a significant risk to surface stability of the site (via assessment of seam depths, thicknesses and thicknesses of overlying competent bedrock). However, if a potential risk is perceived to exist, further probeholes may be required to delineate the extent of workings in order to obtain fixed price quotations for the necessary consolidation works.

10.3.15 It will be necessary to submit an application (with the associated fee) to the Coal Authority (CA) for '*Permission to enter CA mining interests*'.

10.3.16 Monitoring wells should be installed in about 17 shallower probeholes and the dynamic sample boreholes. The generation potential of potential **gas** sources (landfill, areas of opencast & shallow underground workings) is considered likely to be moderate. Therefore, in accordance with CIRIA Report C665, it would be prudent to initially allow for 6 visits over a 3-month period. A hazardous gas risk assessment should be issued on completion of monitoring.

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

11 CONCLUSIONS & RECOMMENDATIONS

11.1 General

11.1.1 The site comprises c. 29.5 hectares of land located about 2.5km southwest of Dewsbury town centre which is occupied by cropped farmland, with woodland (c. 7.1ha) in the west and a school (c. 2ha) and allotment gardens (c. 1.1ha) in the east. Historically the site, and wider area, has been worked for coal by both underground and opencast methods with the most intense workings being in Lady Wood in the far-west.

11.1.2 It is understood that Kirklees MBC are considering sale of the site for a residential development. The Gateway Development falls within a much larger area (c. 156 hectares) which has been allocated for the construction of about 4,000 residential dwellings as well as three schools.

11.1.3 Topography across the site, and the wider area, generally slopes down to the north and northeast. The steepest slopes reach gradients of about 1v:6h in the centre-north, although the 'typical' gradient is c. 1v:12h.

11.1.4 The main issues considered in this report, and in particular in Sections 3, 4 & 5 are based on a review of historical maps and available geological/environmental data. This report provides an assessment of geoenvironmental issues and implications associated with the proposed residential development.

11.2 Mining and quarrying

11.2.1 BGS and CA data suggests that 9 coal seams underlie the site at shallow depth. Given dip (c. 2° to 3° to the east & south-east) and topography, the entire site is expected to be underlain by shallow coal in several seams.

11.2.2 A total of 40 mine entries are located in, or within 25m of, the site's boundary. The majority of these are located in the vicinity of Lady Wood, beyond areas of proposed development. Within the area proposed for development, there are only 3 known mine entries, CA Refs. 422419-027, 423419-004 & 423419-005.

11.2.3 All the named seams have been worked in the area, with the 2nd Brown Metal, New Hards and Wheatley Lime described as extensively worked. It is apparent from the abandonment plans reviewed that underground workings should be anticipated in the Middleton Main, Middleton little and 2nd Brown Metal coals. The abandonment plans also show areas of 'Old Workings' beyond the recorded mines.

11.2.4 In addition, some opencast extraction of the Middleton Little and 2nd Brown coals has taken place in the west, within the Lady Wood Extension, beyond areas of proposed development.

11.2.5 Mitigation of the risks posed by the shallow mineworkings will be required, and this could be achieved in one of two ways:

- Extraction of the remaining coal
- Consolidation, via drilling & grouting

11.2.6 There is a small sandstone quarry (mid-1800s), and some opencast extraction of the Middleton Little and 2nd Brown Coals has taken place; all shown on Drawing 3901/8. Opencast extraction occurred in the west, within the Lady Wood Extension, beyond areas of proposed development.

11.3 Hazardous gas

11.3.1 Potential sources of gas include: shallow mineworkings, opencast backfill and landfill (Lady Wood Extension) and quarry backfill.

11.3.2 Consequently, the site is considered to be at potential risk from migrating gas. As such, wells should be installed in probeholes to allow subsequent monitoring for hazardous gas in order to determine appropriate gas protection measures for the proposed dwellings.

11.3.3 Between 1% and 3% of homes are estimated to be above the radon action level.

11.4 Contamination

11.4.1 The site's environmental setting is considered to be of moderate sensitivity. With respect to human health, the proposed end use (residential) is also sensitive.

11.4.2 The site is essentially greenfield and no widespread contamination is anticipated. However, deep made ground and potential contamination is anticipated within the Lady Wood Extension.

11.5 Foundations

11.5.1 At present, no geotechnical ground investigation data is available and consequently it is only possible to estimate the ground conditions. Before firm foundation recommendations can be given, it will be necessary to undertake an appropriate ground investigation. However, tentative recommendations are provided below.

11.5.2 Made ground is not generally considered a suitable founding material and foundations should be taken through it, into underlying natural in-situ strata of adequate bearing capacity.

11.5.3 Published geological data and Lithos' previous investigation findings suggest that natural ground conditions comprise medium to high strength Residual Soils, with bedrock from depths of between about 1.0m and 3.0m.

11.5.4 Residual Soils or bedrock should provide sufficient bearing capacity to enable the adoption of strip footings for two storey housing.

11.5.5 If shallow mineworkings underlie the site, and require treatment, NHBC typically require foundations to be at least 300mm thick and reinforced. If the workings are at a depth of less than 5 times the seam thickness, then raft foundations may be required.

11.5.6 If rock is encountered at shallow depth, foundations should be placed entirely on rock and not partially on rock and partially on residual soil. This may, depending on surface gradient, necessitate significant over deepening of foundations.

11.6 Highways and external works

11.6.1 Given the steeply sloping nature of the site some regrade of site levels is likely to be required to create suitable development levels prior to construction.

11.6.2 Natural Residual Soils should yield a CBR of at least 3%. This value should be verified prior to or during construction.

11.7 Soakaways & drainage

11.7.1 Given topography soakaways are considered unlikely to provide a viable solution for the disposal of surface water across much of the site.

11.7.2 Alternative SUDS options (see CIRIA C697:2007 for further details) include:

- Swales – linear grassed features in which surface water can be stored or conveyed. Where suitable, swales can be designed to allow infiltration.
- Infiltration basins – vegetated depressions designed to store runoff and infiltrate it gradually into the ground.
- Pervious Pavements – provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate into subsurface storage, with subsequent infiltration or controlled discharge. Pavement could be porous (water able to infiltrate across entire surface material; e.g. reinforced grass), or permeable (water infiltrates via joints between concrete blocks).
- Ponds – designed to have permanent pool of water, but with capacity to provide temporary storage-controlled discharge.

11.7.3 Yorkshire Water have published a guide[4] for developers and designers outlining their design requirements for surface water attenuation assets.

11.7.4 With respect to detention basins, which should normally be dry, water table levels should be taken from borehole monitoring wells over 4 consecutive seasons, for at least 3 points in the basin area. The detention basin should be designed to ensure that there is a minimum of 1m of unsaturated soil between the maximum groundwater level and the lowest part of the structure.

11.8 Potential development constraints

11.8.1 Topography; significant regrade earthworks are anticipated.

11.8.2 Underground mineworkings are highly likely to require consolidation prior to construction.

11.8.3 Buried highwalls (associated with a small sandstone quarry) will necessitate sterile 'no-build' zones across their line.

11.8.4 Underground and overhead utilities present a potential development constraint unless they can be relocated.

11.8.5 The former colliery gas main may require excavation and removal. The groundworker should take care when excavating the pipe in case any residual gasses or liquors remain in the pipeline.

[4] *Design Requirements for Surface Water Attenuation Assets, February 2017.*

11.9 Proposed ground investigation

11.9.1 Whilst the site is considered suitable for its current and proposed use, the proposed change in use will require intrusive investigation.

11.9.2 This would include:

- Machine-excavated trial pits and dynamic sample boreholes to determine near surface ground conditions including depth to bedrock, the presence of obstructions, groundwater and stability
- Geotechnical soils analysis to enable foundation recommendations
- Chemical testing of soil and if necessary groundwater, samples to assess the significance of contamination, if any, as a result of former industrial land use
- Rotary probeholes to confirm depths and seam thicknesses in order to assess risks associated with possible old mineworkings and surface stability
- Gas monitoring and risk assessment

11.9.3 An appropriate ground investigation strategy is presented in Section 10.

Appendix A

General Notes

01 - Environmental setting
Generic notes – geoenvironmental Investigations

General

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

Geology, mining & quarrying

In order to establish the geological setting of a site, Lithos refer to BGS maps for the area, and the relevant geological memoir. Further information is sourced by reference to current and historical OS plans.

In July 2011, the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology. The CA, using its extensive records has prepared plans for all coalfield Local Planning Authorities, which effectively refines the defined coalfield areas into High Risk and Low Risk areas. **High Risk** areas are likely to be affected by a range of legacy issues that pose a risk to surface stability, including: mine entries; shallow coal workings; workable coal seam outcrops; mines gas; and previous surface mining sites. **Low Risk** areas comprise the remainder of the defined coalfield, and are areas where no known defined risks have been recorded; although there may still be unrecorded issues. Where a site lies within either a High or Low Risk area, a mining report is obtained from the CA.

Landfills

Reference is made to publicly available Government held digital data via **QGIS** (an Open Source Geographic Information System), data from Landmark or Groundsure, and sometimes the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site.

Historical OS plans are also 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 though 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, Lithos refer to BRE Report BR211[1], and the Public Health England website. Advice on the limitation of exposure of the population to radon in buildings was originally published in 1990 by the National Radiological Protection Board (NRPB), which joined the Health Protection Agency (HPA) in 2005; the HPA updated NRPB advice in July 2010[2]. The HPA became part of Public Health England in 2013.

The HPA recommended that the NRPB radon Action Level for homes be retained, and a new Target Level for radon in homes be introduced. The values of the Action Level and Target Level, expressed as the annual average radon concentration in the home, are 200 Bqm^{-3} and 100 Bqm^{-3} respectively. The Target Level was to provide an objective for remedial action in existing homes and preventive action in new homes.

The term 'radon Affected Area' is defined as those parts of the country with >1% of homes estimated to be above the Action Levels. The NRPB first indicated which parts of the country should be regarded as radon Affected Areas in 1990. A more detailed mapping method was developed by the HPA in conjunction with the British Geological Survey in 2007[3]. The level of protection needed is site-specific and can be determined by reference to this mapping on the Public Health England website, which indicates the highest radon potential within each 1km grid square. Each 1km grid square is classified on the basis of the percentage of existing homes within that grid square estimated to have radon concentrations above the Action Level. There are 6 'bands': <1%; 1 to 3%; 3 to 5%; 5 to 10%; 10 to 30%; and >30%.

The NRPB advised that action should be taken to reduce radon concentrations in existing homes if the radon concentration exceeded the Action Level of 200 Bqm^{-3} in room air averaged over a year; ten times the average UK domestic radon concentration. NRPB advice informed changes in the requirements for radon protection in new buildings.

- **Basic** preventive measures are required in new buildings, extensions, conversions and refurbishments if the probability of exceeding the Action Level is **>3%** in England and Wales, and >1% in Scotland and Northern Ireland.
- Provision for further preventive (**Full**) measures is required in new buildings if the probability of exceeding the Action Level is **>10%**.

At present Building Regulations Approved Document C advocates basic measures for the probability banding 3% to 10%, and full measures if >10%. However, Public Health England would like to see all new build include basic measures.

Action & Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hrs/yr and to all schools.

Hydrogeology

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure with respect to:

- Groundwater quality
- Recorded pollution incidents
- Licensed groundwater abstractions

From April 2010 the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply), but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are split into two different types of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels
- Bedrock - solid permeable formations e.g. sandstone, chalk and limestone

The maps display the following aquifer designations:

Principal aquifers: These are layers of rock or superficial deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary aquifers: These include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into three types:

- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers
- Secondary undifferentiated - In most cases, this is because the rock type in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics.

[1] BRE Report BR211, 2015: "Radon: guidance on protective measures for new buildings.

[2] Limitation of Human Exposure to Radon, Documents of the Health Protection Agency - Radiation, Chemical and Environmental Hazards, RCE-15. July 2010.

[3] Miles JCH, Appleton JD, Rees DM, Green BMR, Adlam KAM and Myers AH (2007). Indicative Atlas of Radon in England and Wales. Chilton, HPA-RPD-033.

Unproductive strata: These are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

The EA maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the map will be unproductive strata. However, for uncoloured areas on the superficial (drift) designation map it is not possible to distinguish between areas of unproductive strata and areas where no superficial deposits are present; to do this, it is necessary to consult the published geological survey maps.

For the purposes of the EA's Groundwater Protection Policy the following default position applies, unless there is site specific information to the contrary:

- If no superficial (drift) aquifers are shown, the bedrock designation is adopted
- In areas where the bedrock designation shows unproductive strata (the uncoloured areas) the superficial designation is adopted
- In all other areas, the more sensitive of the two designations is used (e.g. If secondary superficial overlies principal bedrock, an overall designation of principal is assumed)

The EA have also designated groundwater 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

Reference is made to publicly available Government held digital data via QGIS, and Landmark or Groundsure 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 6 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 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 (Flood Zone 3) 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 (Flood Zone 2) 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. Where there is no blue shading (Flood Zone 1), there is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

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, 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 who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for: proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and any new development in Flood Zones 2 and 3.

COMAH & explosive sites

Lithos obtain information from Landmark or Groundsure with respect to Control of Major Accident Hazards (COMAH) or explosive sites within 1km of the proposed development site. Lithos' 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 site model

The site's environmental setting (and proposed end use) is used by Lithos 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 receptors.

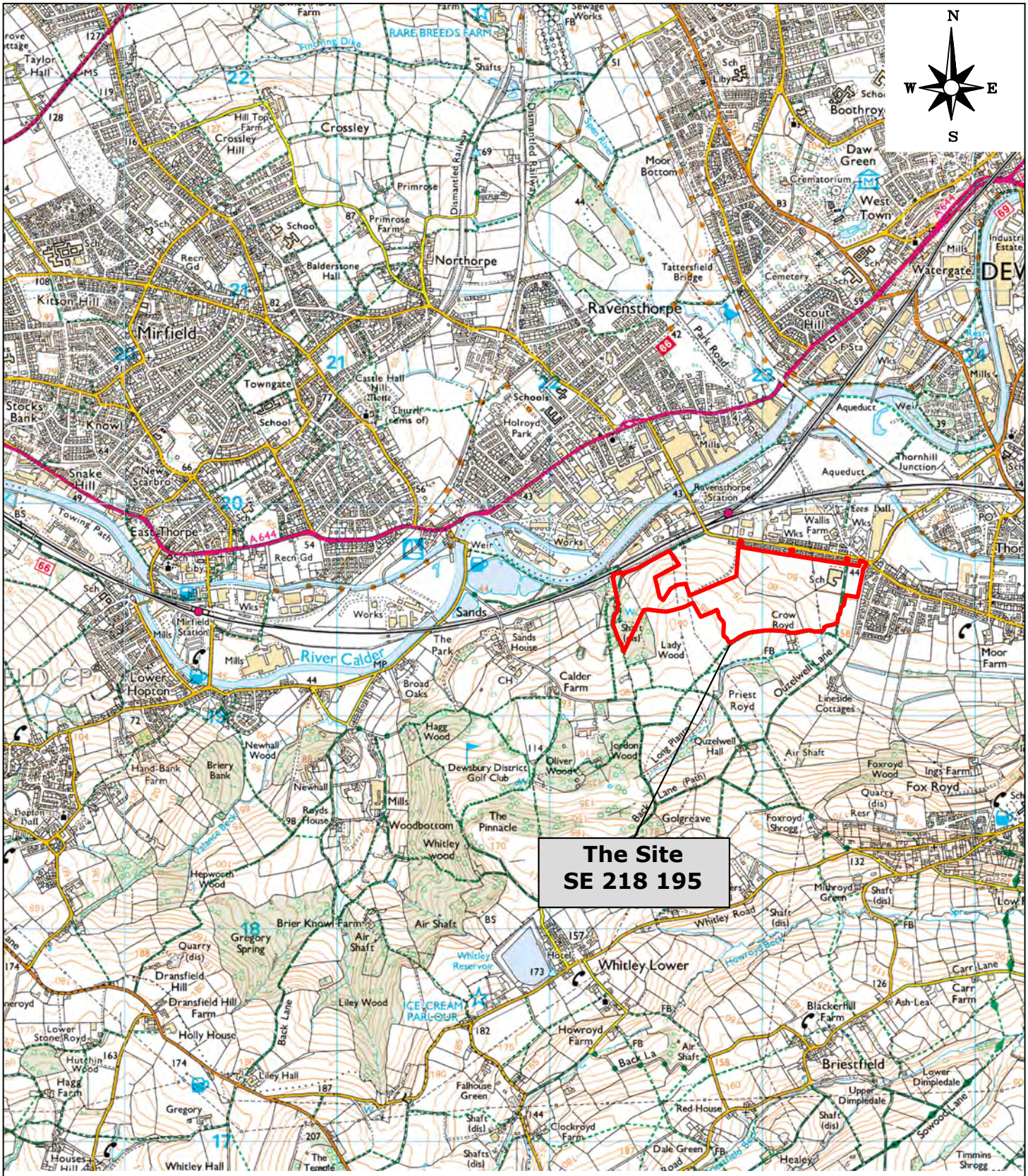
Potential pollutant linkages are shown on a preliminary conceptual site model (pCSM). A CSM is essentially a cross-section through a site that reflects both the surface topography and underlying geology, and shows surface features of interest. The most significant sources of contamination are then superimposed onto this cross-section together with potential receptors (human health & controlled waters), and plausible pathways between the two. In addition to environmental issues, the CSM should also highlight geotechnical issues.

A pCSM is prepared after consideration of all available "desk study" data, and before design of the ground investigation. Data reviewed should include historical plans (with superimposition on a current-day plan), previous SI reports, geological maps etc. The pCSM, in conjunction with knowledge of site constraints (buildings, services, slopes etc) is used to design the ground investigation.

The revised CSM takes account of data obtained during the ground investigation, including the distribution of made ground, the nature and distribution of contamination etc.

Appendix B

Drawings



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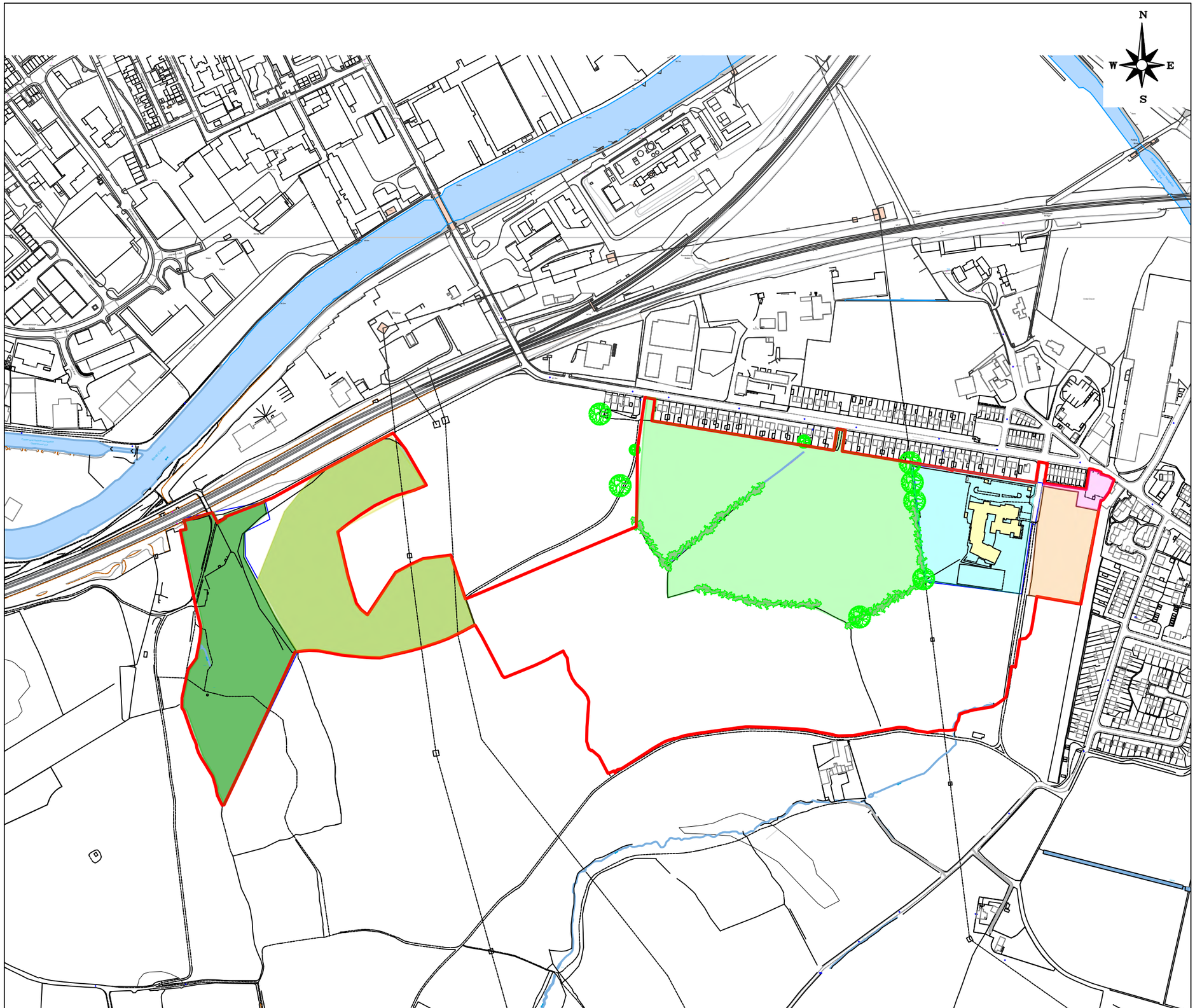
CLIENT	KIRKLEES COUNCIL
JOB TITLE	DEWSBURY RIVERSIDE CENTRAL GATEWAY
DRAWING TITLE	SITE LOCATION PLAN
DRAWN	GLM
DATE	25/11/2020
CHECKED	REG
DATE	25/11/2020
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	3901/1
REVISION	



NOTES

- ALLOTMENT GARDENS
- MOSQUE PLAY SCHOOL/CAR PARK
- RAVENSTHORPE SCHOOL
- 'MILLERS' AREA
- LADY WOOD EXTENSION
- LADY WOOD
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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KIRKLEES COUNCIL

JOB TITLE

DEWSBURY RIVERSIDE CENTRAL GATEWAY

DRAWING TITLE

SITE SUB-AREAS PLAN

DRAWN	DATE	STATUS
GLM	25/11/2020	FOR COMMENT ☐
		FOR APPROVAL ☐
CHECKED	DATE	DRAFT ☐
REG	25/11/2020	FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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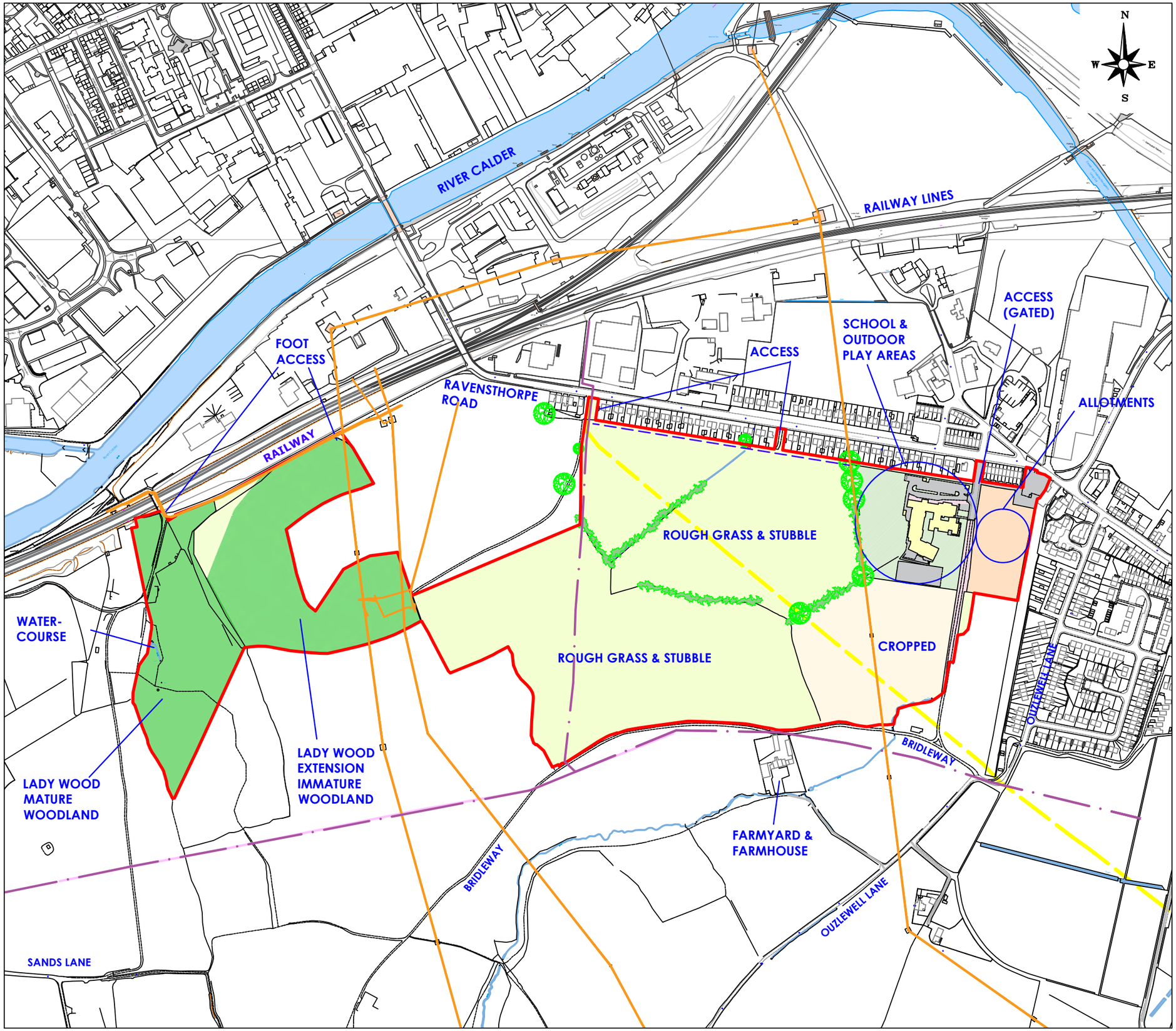

NOTES

- GRASS/ROUGH STUBBLE
- CROPPED LAND
- MACADAM HARDSTAND
- BUILDING
- ALLOTMENT GARDENS
- HARDCORE/TRACK
- WOODLAND
- WATERCOURSE/SURFACE WATER
- OVERHEAD ELECTRICAL UTILITY
- HIGH PRESSURE GAS UTILITY
- REDUNDANT COLLIERY GAS UTILITY
- STORM DRAINAGE UTILITY
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

DEWSBURY RIVERSIDE CENTRAL GATEWAY

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
GLM	07/12/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	07/12/2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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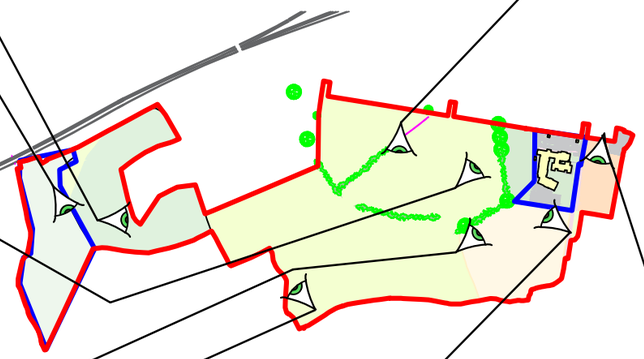







NOTES

- GRASS/ROUGH STUBBLE
- CROPPED LAND
- MACADAM HARDSTAND
- BUILDING
- ALLOTMENT GARDENS
- HARDCORE/TRACK
- WOODLAND
- APPROXIMATE SITE BOUNDARY
- LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

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JOB TITLE

DEWSBURY RIVERSIDE CENTRAL GATEWAY

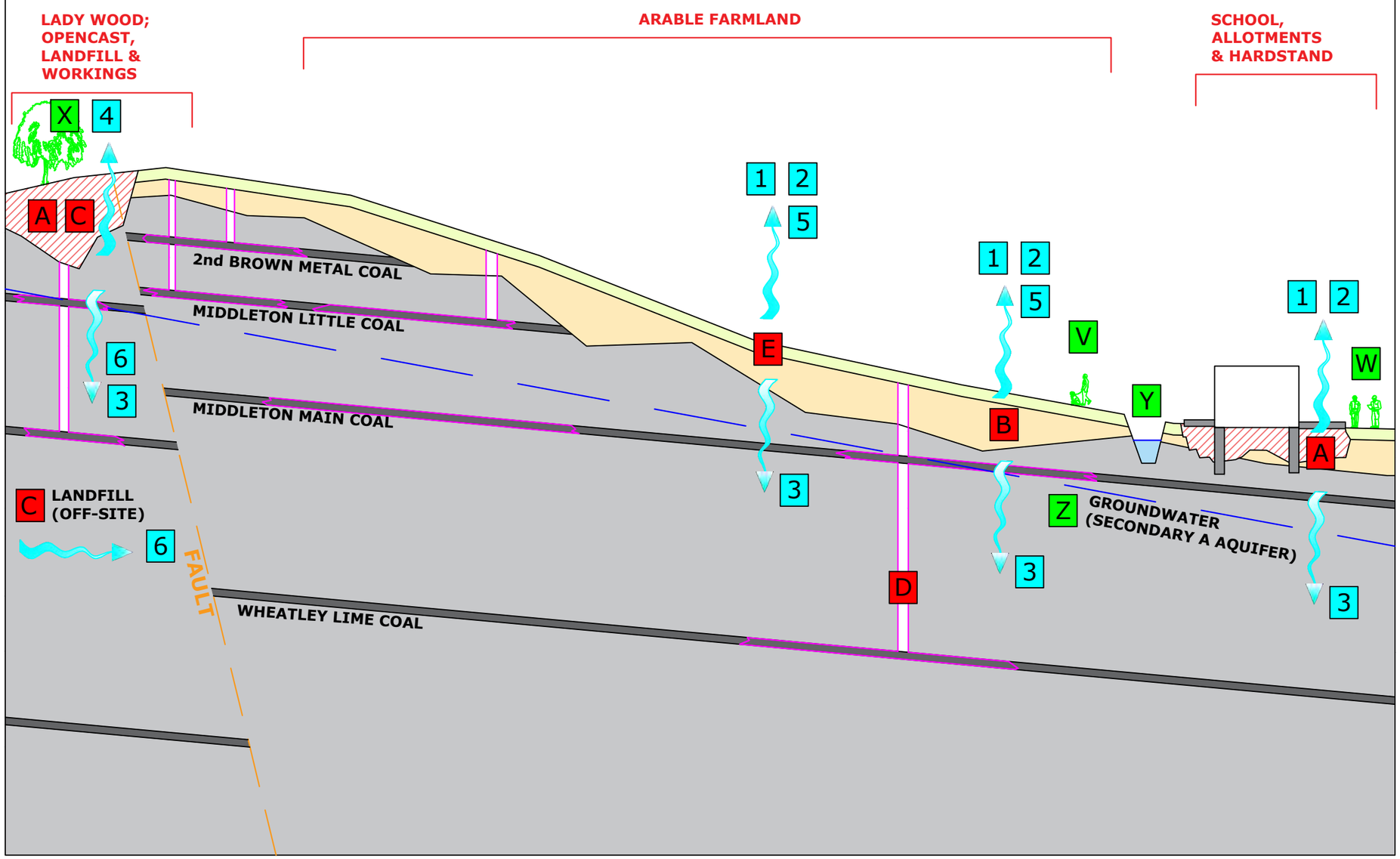
DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
GLM	22/12/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	22/12/2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
NOT TO SCALE	A3	3901/4	

SITE EXTENTS



KEY
MADE GROUND
TOPSOIL
RESIDUAL SOIL
LOWER COAL MEASURES
COAL

SOURCES
A MADE GROUND (INORGANICS)
B LEAKAGE/SPILLAGE (ORGANICS)
C LANDFILL
D MINEWORKINGS
E FARMING ACTIVITIES

PATHWAYS
1 DERMAL CONTACT
2 INGESTION/INHALATION
3 LEACHING OF CONTAMINANTS
4 UPTAKE BY PLANTS
5 VOLATILISATION
6 MIGRATION OF GAS

RECEPTORS
V END USERS (RESIDENTS)
W SITE WORKERS
X VEGETATION
Y SURFACE WATERS
Z GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

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CLIENT

KIRKLEES COUNCIL

JOB TITLE

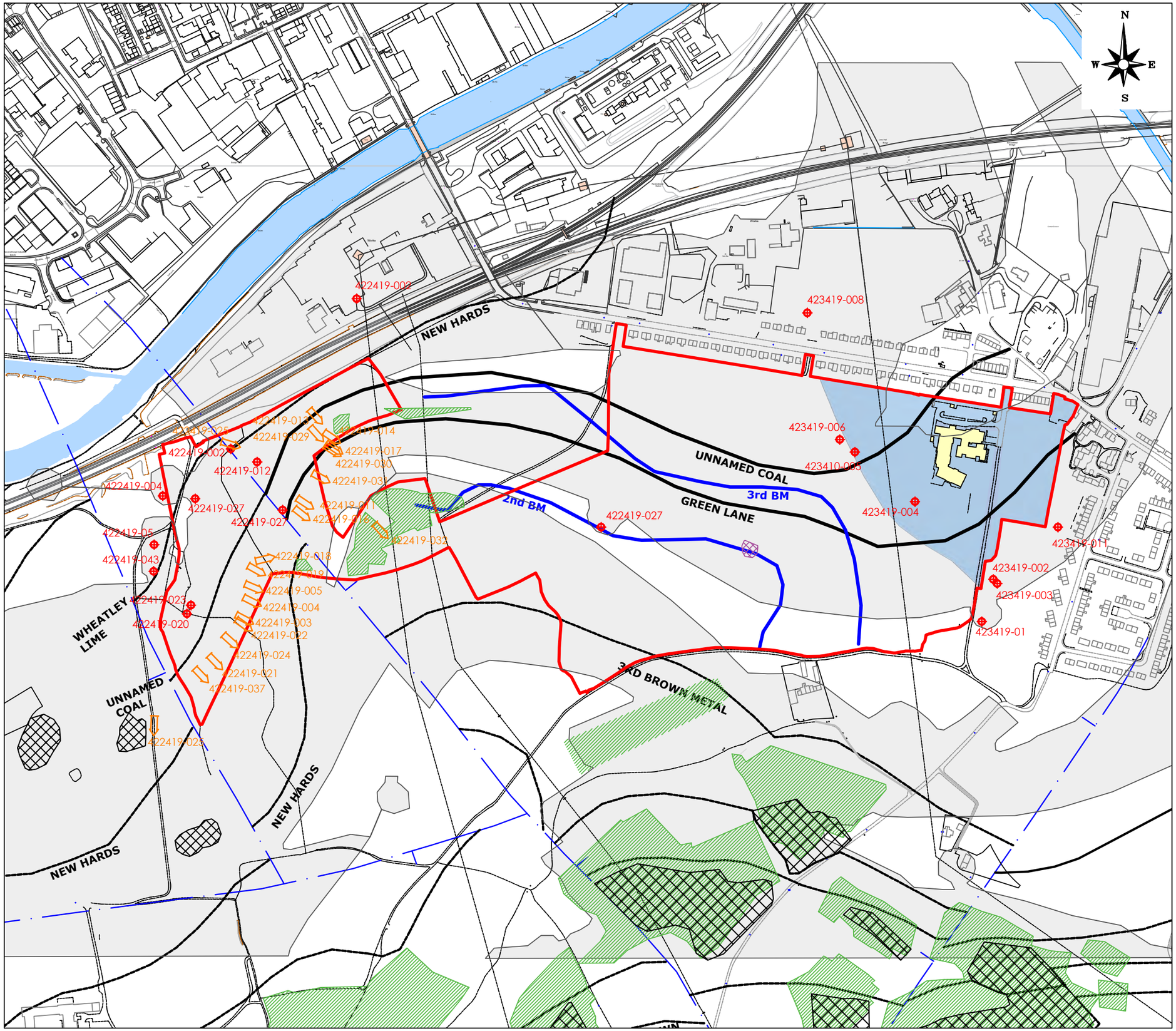
DEWSBURY RIVERSIDE CENTRAL GATEWAY

DRAWING TITLE

PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
GLM	09/12/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	09/12/2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	3901/5	



NOTES

- GLACIOFLUVIAL DEPOSITS (BASED ON BGS MAPPING)
- COAL AUTHORITY DEVELOPMENT HIGH RISK AREA
- FORMER SANDSTONE QUARRY (BASED ON HISTORICAL OS MAPPING)
- AREA OF OPENCAST EXTRACTION (BASED ON CA REPORT)
- AREA OF OPENCAST EXTRACTION/SPOIL HEAP (BASED ON BGS MAPPING)
- COAL OUTCROP & SEAM NAME (BASED ON BGS MAPPING)
- COAL SEAM OUTCROP & NAME (BASED ON NCB DRAWING)
- KNOWN SHAFT LOCATION
- KNOWN ADIT LOCATION
- APPROXIMATE LINE OF GEOLOGICAL FAULT
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

KIRKLEES COUNCIL

JOB TITLE

DEWSBURY RIVERSIDE CENTRAL GATEWAY

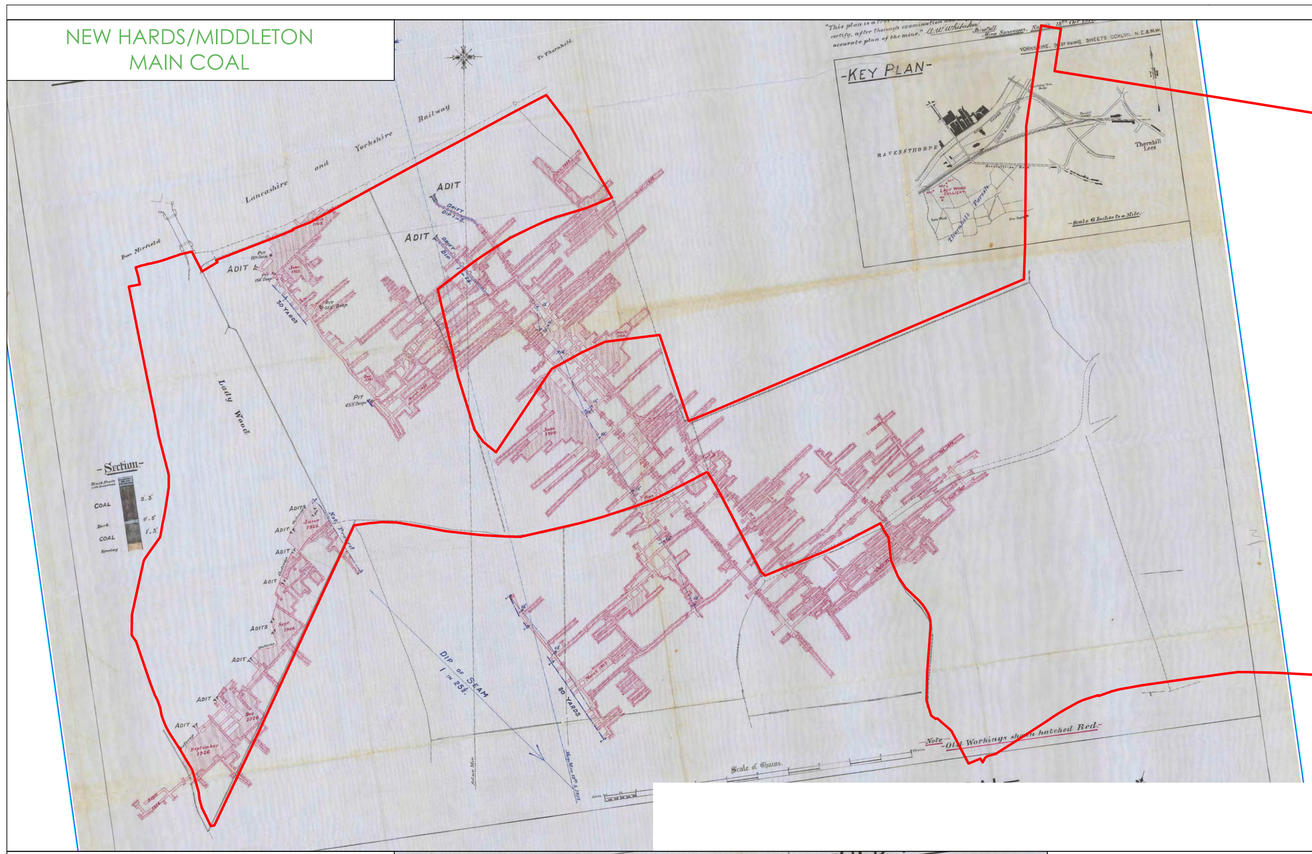
DRAWING TITLE

COAL MINING & GEOLOGICAL FEATURES

DRAWN	DATE	STATUS
GLM	09/12/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	09/12/2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3901/8	

NEW HARDS/MIDDLETON
MAIN COAL



GREEN LANE/MIDDLETON
LITTLE COAL

OLD HARDS/2ND BROWN
METAL COAL

Catalogue No.: 9482 Sheet Info:
Date: 18/02/2016
Database Right and Copyright, The Coal Authority 2003. Unauthorised Use Prohibited.
Andrea Holmes - The Coal Authority 200 Lichfield Lane,Mansfield,Notts,NG18 4RG,England
Scale: 1 CHAIN TO 1 INCH (1 TO 792)
The Coal Authority
Catalogue No.: 9482 Sheet Info:
Date: 18/02/2016
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NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM COAL AUTHORITY ABANDONMENT PLAN FOR LADY WOOD COLLIERY REF. 9482.
PLAN PREPARED FOR LADY WOOD COLLIERY, THORNTON LEES, DEWSBURY; WORKINGS BY MR FOSTER-TAYLOR; DATE OF ABANDONMENT 16th MAY 1928

REV.	DESCRIPTION	DATE

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KIRKLEES COUNCIL

JOB TITLE
DEWSBURY RIVERSIDE CENTRAL GATEWAY

DRAWING TITLE
COAL AUTHORITY ABANDONMENT PLAN - LADY WOOD COLLIERY (MIDDLETON MAIN, MIDDLETON LITTLE & 2ND BROWN METAL COALS)

DRAWN	DATE	STATUS
GLM	04/12/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	04/12/2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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3986 Cert. No.

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Nov 1972

Date 12.7.73

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knowledge and
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986 Cert. No

N
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OLD WORKINGS

Not Known

Not Known

27/-

18

THESE WORKINGS COPIED FROM
ABANDONMENT PLAN No. 2363

ABANDONED 1888

54/-

OLD WORKINGS

NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM COAL AUTHORITY
ABANDONMENT PLAN REF. NE774. COLLIERY
NOT STATED. FIRST EXTRACTION JULY 1957,
ABANDONED 18th APRIL 1973

REV.	DESCRIPTION	DATE

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CLIENT
KIRKLEES COUNCIL

JOB TITLE
DEWSBURY RIVERSIDE CENTRAL GATEWAY

DRAWING TITLE
COAL AUTHORITY ABANDONMENT PLAN (MIDDLETON MAIN COAL)

DRAWN	DATE	STATUS
GLM	04/12/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	04/12/2020	DRAFT ☐
		FINAL ☑

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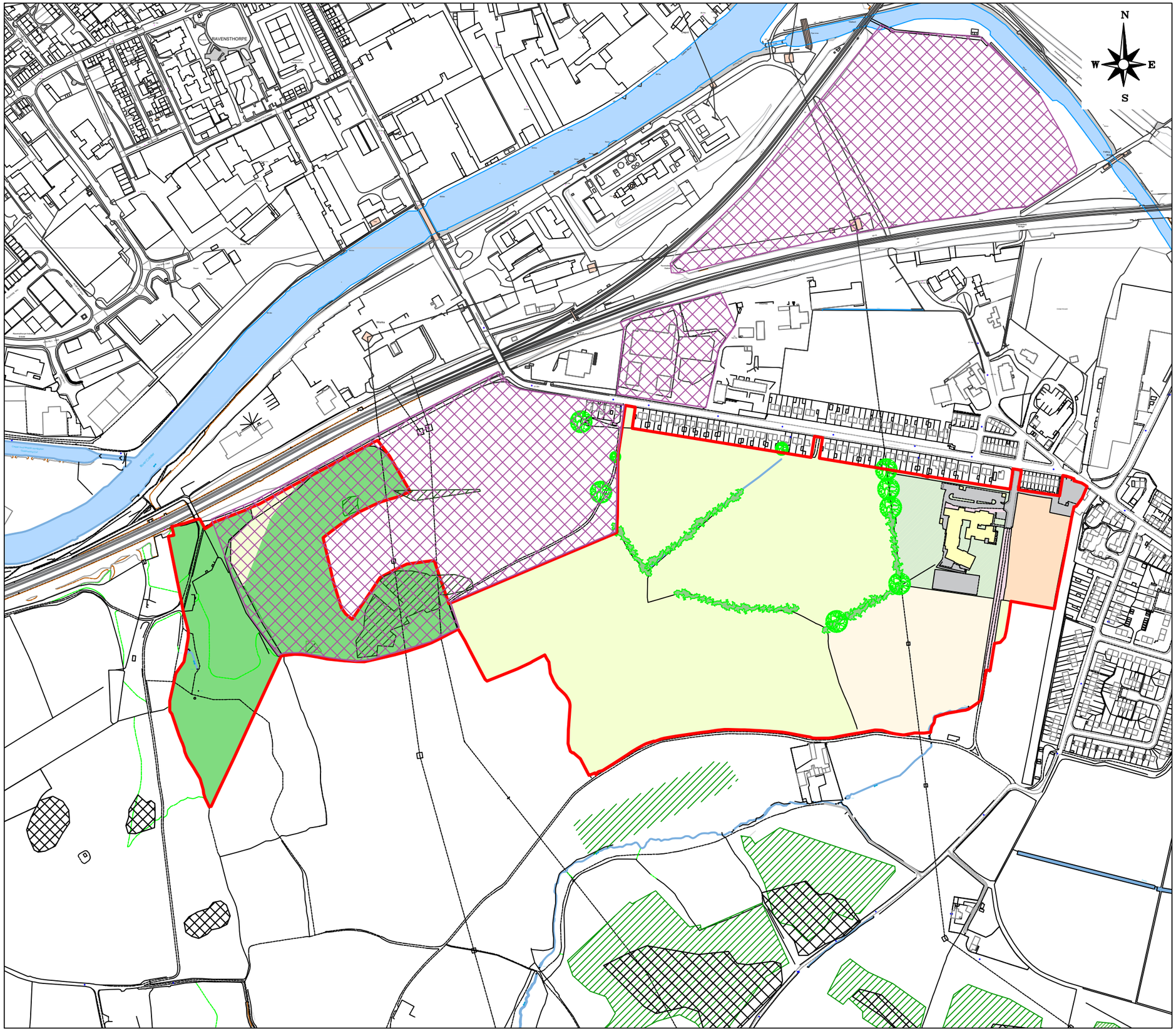

NOTES

- GRASS/ROUGH STUBBLE
- CROPPED LAND
- MACADAM HARDSTAND
- BUILDING
- ALLOTMENT GARDENS
- HARDCORE/TRACK
- WOODLAND
- AREA OF LANDFILL (BASED ON LANDMARK/EA RECORDS)
- SURFACE WATER/WATERCOURSE
- AREA OF OPENCAST EXTRACTION (BASED ON CA REPORT)
- AREA OF OPENCAST EXTRACTION/SPOIL HEAP (BASED ON BGS MAPPING)
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

DEWSBURY RIVERSIDE CENTRAL GATEWAY

DRAWING TITLE

ENVIRONMENTAL FEATURES

DRAWN	DATE	STATUS
GLM	09/12/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	09/12/2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1000	A3	3901/10	

Appendix C

Commission

023/3901/REG

1st December 2020

Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

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www.lithos.co.uk

Mr S Tucker
Barton Willmore
Tower 12
Bridge Street
Spinningfields
Manchester
M3 3BZ

Dear Stephen

Dewsbury Riverside Central Gateway

Further to our recent meetings with Kirklees Council (KC), please find attached our updated (additions in blue text) for costed proposal for undertaking the Stage 1, Technical Due Diligence for this site.

This proposal now also allows for some dynamic sampling (mini-boreholes) in the Allotments and Woodland.

We understand that Barton Willmore have now been appointed as the Consultant for all three elements (Stages 1, 2 & 3), and that Lithos will be appointed to undertake Stage 1 by Barton Willmore rather than the KC direct. However, to simplify matters relating to reliance on our work, Lithos reports will be issued in joint names (Barton Willmore & Kirklees Council).

Review of the information supplied at tender stage suggests that the site consists of a single parcel of land of approximately 30 hectares south of Ravensthorpe Road. However, there are at least 5 sub-areas of significance for various reasons:-

- Area previously investigated by Lithos for **Miller** Homes (c. 7.2 ha). Lithos issued a comprehensive SI Report to Miller Homes (Ref. 2336/3, dated January 2018) and Millers have recently granted permission to KC allowing Lithos to "re-use" the data obtained. Consequently, no significant further ground investigation is anticipated within this sub-area and the data obtained in 2008 will be included within our new Report(s).
- Primary **school** (c. 2.0 ha). At tender stage, it was agreed that no intrusive ground investigation would be possible within this sub-area.
- Existing **allotments** (c. 1.1 ha). Some ground investigation might be possible here, but the scope will need to be agreed with KC. Only 2 (of 24) plots are currently vacant. If we are able to gain access, we will advance a couple of trial pits and a couple of probeholes here. We should be able to advance about 8 mini-boreholes in this area.
- **Lady Wood** (c. 3.1 ha). At tender stage, it was agreed that no ground investigation was required within this sub-area, as the woodland is to be retained "as is".
- **Woodland** (c. 4.0 ha), adjacent to, and east of, Lady Wood. No development is proposed in this sub-area, and ground investigation will be limited to about 12 mini-boreholes to check for the presence of landfill.

APPROACHABLE REGISTERED ac UKAS MANAGEMENT SYSTEMS 8320
CHAS Accredited Contractor CHAS.co.uk
CQMS Safety Scheme
Constructionline A UK GOVERNMENT CERTIFICATION SERVICE
AGS Association of Geotechnical & Geoenvironmental Specialists

Previous work by Lithos suggests the wider site:

- Appears to have mostly remained undeveloped throughout its history, with the exception of the existing school and allotments (north-east) and coal mining activities.
- The Woodland sub-area (and adjacent Lyttle land) is shown by the EA to be underlain by a known landfill site; Thornhill Power Station landfill, but previous investigation within the Lyttle land found no evidence of this.
- Is not within a groundwater source protection zone.
- Is in an area where the risk of encountering UXO is considered low.
- Is directly underlain by Coal Measures bedrock; mostly interbedded mudstone, siltstone & sandstone, but with a more significant bed of sandstone in the south (Lepton Edge Rock). Strata dip gently to the north. In the far north-east bedrock might be overlain by Glaciofluvial Deposits.
- Is located mostly within a Coal Mining Development High Risk Area due to the presence of several shallow coal seams and numerous mine entries (especially in the vicinity of Lady Wood).
- Is crossed by an underground high-pressure gas main, and overhead electricity lines.

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 site and reviewed available internet data and our geological maps in order to minimise the likelihood of further work.

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, LCRM etc). Our Report may not be fully compliant with Eurocode 7 (EC7) and will not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. Our ground appraisal is intended to assist others as they proceed with design of the proposed development.

This proposal allows for the following works:

Desk study: Environmental search data and historical maps (obtained from Landmark or Groundsure), will be reviewed in order to determine whether past land uses have had any effect on the proposed development. In addition, published geological plans of the area will be examined.

Given the site's location within a Coal Mining High Risk Area, a Consultant's mining report will be obtained, and abandonment plans for known shallow mineworkings will be reviewed.

We will also visit site to review current operations and undertake a walkover survey.

On completion of the desk study, we will issue a "Phase 1 Desktop" Report, with a coal mining risk assessment prepared in accordance with Coal Authority guidance (either included within the Desk Study, or as a separate document; KC to confirm preference).

Fieldwork: In accordance with tender requirements, this proposal allows for probeholes/trial pits to be undertaken on a 50m grid across the site (alternate probeholes/trial pits). However, as discussed above, no significant intrusive investigation is currently anticipated in the following sub-areas: Millers; primary school; Lady Wood; or the Woodland.

We have allowed for the excavation about 40 no. trial pits and the drilling of about 35 no. probeholes, with all pits and probeholes to be supervised and logged by an experienced geoenvironmental engineer.

Given nature of the land and the time of year, we have allowed for pits to be dug using a tracked 360° excavator.

Trial pitting / trenching will enable us to determine the:

- Nature of any made ground, including:
  - visual/olfactory evidence of potential contamination and the proportion of undesirable elements e.g. biodegradable matter, relict foundations etc
  - the proportion of "oversize", boulder-sized material
- Nature, distribution and thickness of shallow soils
- Suitability of the ground for founding structures and highways

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.

We will make every effort to compact arisings and 'sweep' them over each trial 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 up to 400mm proud at each trial pit location. At this stage, no allowance has been made for any further reinstatement such as removal of excess arisings, replacement of turf.

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.

Based on anticipated ground and topography, **soakaways** are considered unlikely to provide a satisfactory solution for surface water drainage, and no allowance has been made for soakaway testing at this stage. If required, or considered feasible based on the ground actually encountered, soakaway tests could be undertaken for an additional fee of about £ per day.

The site is underlain by several shallow coal seam, including the Middleton Little, the 2nd & 3rd Brown Metal, and therefore we have allowed for the drilling of 35 **rotary probeholes** to check for the presence of mineworkings. This drilling should be sufficient to determine whether old mineworkings are present and pose a significant risk to surface stability of the site. However, if a potential risk is perceived to exist, further probeholes may be required to delineate the extent of workings in order to obtain fixed price quotations for the necessary consolidation works. It was acknowledged by KC during the tender period that further rotary drilling may be required to assess mining risk, and if so this was to be assessed and costed at a later stage.

It will be necessary to submit an application (with the associated fee) to the Coal Authority (CA) for 'Permission to enter CA mining interests'; and we have allowed for this. Given the site's size and location, we should be able to avoid the need to drill holes within 50m of surrounding residential properties and therefore, in accordance with CA requirements, we should be able to use air as the flushing medium. However, some probeholes may need to be advanced using water as the flushing medium (as reinforced by recent CA guidance on managing the risk of hazardous gas). Our drilling sub-contractor will need to locate the wash outs close to the site, and procure a standpipe and licence from Yorkshire Water.

With reference to the control, management and disposal of surplus water and flush arising from the works, (and in order to avoid additional costs associated with the provision of a telehandler to transfer a weir tank between boreholes, and the provision of a pump to transfer surplus water from the weir tank to an approved disposal point), we have made provision for a sand bag bund at the foot of the drilling mast, at each borehole to contain the majority of the drill cuttings. However, we have assumed that potentially discoloured surplus water will be allowed to flow and settle into the field.

Mini-boreholes are proposed here in order to:

- Allow investigation within areas of restricted access (Allotments & Woodland).
- Allow the installation of gas monitoring wells.
- Assess of the density of granular soils either via discrete SPTs or dynamic probing
- Minimise disturbance of the surface (Allotments).

However, dynamic sampling can typically only reach depths of 3m to 4m due partly rig capacity and partly to hole instability (unlike drilling using a cable percussion rig, steel casings are not used as a temporary liner to prevent borehole collapse).

We have allowed for all exploratory holes to be picked-up by a **surveyor** (co-ordinates/ground levels will be included on the logs).

This site is predominantly greenfield but is underlain by shallow mine workings and there may be landfill in the southwest. Consequently, we have allowed for the installation of wells in 17 probeholes and monitoring for hazardous **gas** (and any shallow groundwater).

The generation potential of these gas sources is considered likely to be Low to Moderate, but as required for the purposes of tendering, we have initially allowed for 6 visits over a 3-month period. A hazardous gas risk assessment will be issued on completion of monitoring.

Testing: This will comprise routine **geotechnical** soils analysis, including 30 moisture content & Atterberg limits, and 30 pH & water-soluble sulphate.

The site is understood is predominantly Greenfield, at this stage, we have no reason to expect wide areas of the site to be underlain by significant thicknesses of made ground. Consequently, we have only allowed for **contaminant** testing of up to 18 made ground samples, plus a further 18 samples of topsoil to confirm its suitability for re-use. The test suite will include heavy metals, speciated PAH, and banded TPH (with supplementary speciation as/where appropriate). Visible contaminants, sharps and the clay/sand/silt content of 9 topsoil samples will be determined to check compliance with BS3882 requirements.

If more significant made ground is encountered, we will inform you immediately and provide costs for the recommended chemical testing.

Within in our proposal we have allowed for the screening (ID) of 36 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results. Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

Reporting & timescales: On completion of the desk study, fieldwork and laboratory testing a comprehensive, factual and interpretative report will be issued. This will contain exploratory hole logs, 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 include consideration of foundation types.

At the time of writing, fieldwork could be commenced within 3 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 5 weeks of fieldwork completion. This report will comment on issues associated with hazardous gas, but the gas risk assessment will not be issued until monitoring is completed.

A completed copy of the **YW** Contaminated Land Assessment Form will be included in an Appendix to our Report.

Our proposal allows for the preparation of a separate Remediation Strategy report as required by the tender.

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.

We will submit invoices for this project at the milestones defined below:

- 1st milestone invoice (Item A) on issue of the Desk Study & Mining Risk Assessment
- 2nd milestone invoice (Items B to F) within 5 days of fieldwork completion, with exploratory hole logs and an interim letter report outlining our initial findings
- 3rd milestone invoice (Items G to J) on issue of the final SI report
- 4th milestone invoice (Item K) on issue of the Remediation Strategy
- 5th and final invoice (Item L) after completion of the gas monitoring/issue of the supplementary letter report

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements. However, this investigation is expected to last for at least 7 working days and therefore this proposal includes for provision of a Welfare Unit, with the benefit of full canteen facilities, hot water with full size sink, toilet and drying room.

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 make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, Lithos 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).

It would be appreciated if you could forward copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), prior to the proposed fieldworks.

Under the **CDM** Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

If no other designers or contractors have been appointed, Lithos could perform the role of Principal Contractor but only for the duration of the site investigation outlined in this proposal. If you require us to perform the role of Principal Contractor, please make this clear in your instruction. It should be noted that we are not suitably qualified to perform either role where other designers or contractors are also appointed.

It is anticipated that the site investigation outlined in this proposal will be undertaken several months before any construction is commenced on site. Consequently, our works can be considered in isolation and, given the anticipated number of person days on site, this site investigation is not notifiable to the HSE.

Terms & conditions: This work will be undertaken in accordance with a sub-consultancy Agreement to be agreed between Barton Willmore and Lithos. However, if the Appointment term expires or remains unsigned, works will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

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

Yours sincerely



Mark Perrin
Director
for and on behalf of
LITHOS CONSULTING LIMITED

Terms and Conditions for the Appointment of Lithos Consulting Limited

V006.18

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" shall mean these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording the Client's unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing:

"Client" shall mean the party for whom the Services are being provided by Lithos;

"Documents" shall mean all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of Lithos, and whether in paper form or stored electronically or on disk, or otherwise;

"Lithos" shall mean Lithos Consulting Limited whose registered office is at Parkhill, Walton Road, Wetherby, West Yorkshire, LS22 5DZ.

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Parties" shall mean the Client and Lithos

"Project" shall mean the project described in the Proposal and any enquiry from the Client on which Lithos has based its Proposal;

"Proposal" means the offer document prepared by Lithos in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by Lithos pursuant to the Agreement and as set out in the Proposal and shall include any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment".

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 The Client agrees to engage Lithos and Lithos agrees to provide the Services in accordance with the provisions of the Agreement.

3 OBLIGATIONS OF LITHOS

3.1 Lithos shall perform the Services using the reasonable standard of skill and care normally exercised by similar professional Environmental firms in performing similar services under similar conditions.

3.2 Lithos shall use all reasonable endeavours to perform the Services in accordance with all relevant environmental and safety legislation.

4 OBLIGATIONS OF THE CLIENT

4.1 Throughout the period of this Agreement the Client shall afford to Lithos or procure the affording to Lithos of access to any site where access is required for the performance of the Services.

4.2 The Client accepts responsibility for ensuring that Lithos is notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards known or suspected by the Client, which the Client shall clearly mark on the ground or identify on accurate location plans supplied to Lithos prior to the commencement of the Services. The Client shall also inform Lithos in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. The Client shall indemnify Lithos against all costs, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If the Client discovers any conflict, defect or other fault in the information or designs provided by Lithos pursuant to the Agreement, he will advise Lithos in writing of such defect, conflict or other fault and Lithos shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 INTELLECTUAL PROPERTY

5.1 The copyright in all Intellectual Property prepared by or on behalf of Lithos in connection with the Project for delivery to the Client shall remain vested in Lithos.

5.2 The Client shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable the Client to copy and use the Intellectual Property but solely for its own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by Lithos.

5.3 Should the Client wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, it must obtain the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and shall be upon such terms as may be required by Lithos. Lithos shall not be liable for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on behalf of Lithos.

5.4 Ownership of any proposals submitted to the Client that are not subsequently confirmed as part of the Services to be provided for the Client remain with Lithos and such proposals must not be used as the basis for any future work undertaken by the Client or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of the Client being in default of payment of any fees or other amounts due, Lithos may suspend further use of the licence on giving 2 days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 TITLE

6.1 Lithos shall transfer only such title or rights in respect of the Documents as it has, and if any part is purchased from a third party Lithos shall transfer only such title or rights as that party had and has transferred to Lithos.

6.2 Title in the Documents shall remain with and shall not pass to the Client until the amount due under the invoice(s) (including interest and costs) has been paid in full.

6.3 Until title passes, the Client shall hold the Documents as bailee for Lithos and shall store or mark them so that they can at all times be identified as the property of Lithos.

6.4 At any time before title passes (save and except where payment is not due), but only after prior consultation with the Client, Lithos may without any liability to the Client repossess and use or sell all or any of part of the Documents and by doing so terminate the right of the Client to use, sell or otherwise deal in the Documents.

6.5 Lithos may maintain an action for the price of the Documents notwithstanding that title in them has not passed to the Client.

7 CONFIDENTIALITY AND DATA PROTECTION

7.1 Lithos undertakes not to divulge or disclose to any third party without the written consent of the Client information which is designated confidential by the Client or which can reasonably be considered to be confidential and arises during the performance of the Services unless required to do so by law or necessary in the proper performance of its duties in relation to the Project, or in order to make full frank and proper disclosure to its insurers or intended insurers, or to obtain legal or accounting advice.

7.2 Subject to the above and Lithos' Privacy Policy which can be found on www.lithos.co.uk, Lithos shall be permitted to use information related to the Services it provides in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

8 THIRD PARTIES

8.1 The Agreement or any part thereof or any benefit or interest thereunder may not be assigned by the Client without the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and Lithos will only agree to an assignment on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any assignment.

8.2 The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

8.3 Lithos will consider and may consent to any request from the Client for Lithos to enter a collateral warranty with a third party with regard to the Services provided under the Agreement. The giving of such consent shall be at the discretion of Lithos and Lithos will only enter a collateral warranty on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any collateral warranty.

9 INSURANCE

9.1 Lithos warrants to the Client that there is in force a policy of Professional Indemnity insurance covering its liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, Lithos agrees to use reasonable endeavours to maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under the Agreement, provided such insurance is available at commercially reasonable rates having regard, inter alia, to premiums required and policy terms obtainable.

9.2 If for any period such insurance is not available at commercially reasonable rates, Lithos shall forthwith inform the Client and shall obtain in respect of such period such reduced level of Professional Indemnity insurance as is available and as would be fair and reasonable in the circumstances for Lithos to obtain.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, Lithos' liability under or in connection with the Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either five million pounds in the aggregate (unless it is a pollution, contamination or asbestos claim in which case it is two million pounds in the aggregate) or 10 times the total value of invoices issued to the Client for consultancy work instructed under the Agreement.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against Lithos after the expiry of a period of six years from the date of the completion (or termination) of the Services under the Agreement.

10.3 Whilst Lithos will scan all potential exploratory locations with a Cable Avoidance Tool, Lithos shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 Lithos shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by Lithos or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless Lithos has been advised in writing of the same by the Client and has been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 PAYMENT

11.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

11.2 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

11.3 If the Client disputes the amount included for payment in an invoice a written notice must be served on Lithos by the Client not later than 14 days before the final date for payment. If no notice is given the amount due shall be the amount stated in the invoice.

11.4 In the event of failure on the part of the Client to pay any monies in accordance with the foregoing payment provisions, Lithos will be entitled to charge interest on any monies owed to it by the Client, such interest to be at a rate of 8% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis.

12 DELAY

12.1 Lithos will comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond its reasonable control and in the event of any such circumstances arising Lithos undertakes to complete the Services within a reasonable period, but will not be liable to the Client for any delay as a result.

13 TERMINATION

13.1 The Agreement may be terminated by either party in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

13.2 If for any reason the performance of the Services by Lithos is suspended for a period in excess of three calendar months then Lithos shall be entitled to terminate its appointment in respect of the Services by seven days written notice to the Client.

13.3 If the Client shall fail to pay in full any sum due under the terms of the Agreement by the final date for payment for that sum and no effective notice of intention to withhold payment has been issued, Lithos may serve written notice on the Client demanding payment within 14 days of such notice. If the Client shall fail to comply with such notice, Lithos shall be entitled to terminate its employment under the Agreement forthwith.

13.4 Any termination of the appointment of Lithos howsoever caused shall be without prejudice to the right of Lithos to require payment for all services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

14 NOTICES

14.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to the address of Lithos set out above or to the registered address of the Client.

14.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by first class post.

15 ENTIRE AGREEMENT

15.1 The Agreement constitutes the complete and entire agreement between the Client and Lithos with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against Lithos in respect of the Services can only be made in contract under the provisions of the Agreement and not otherwise under the law or tort or otherwise.

15.2 No amendments, modifications or variation of the Agreement shall be valid unless made in writing and agreed to by both the Client and Lithos; such agreement must be recorded in writing by at least one of the Parties.

15.3 Lithos will not be bound by any standard or printed terms or conditions furnished by the Client in any of its documents unless Lithos specifically states in writing separately from such documents that it intends such terms and conditions to apply.

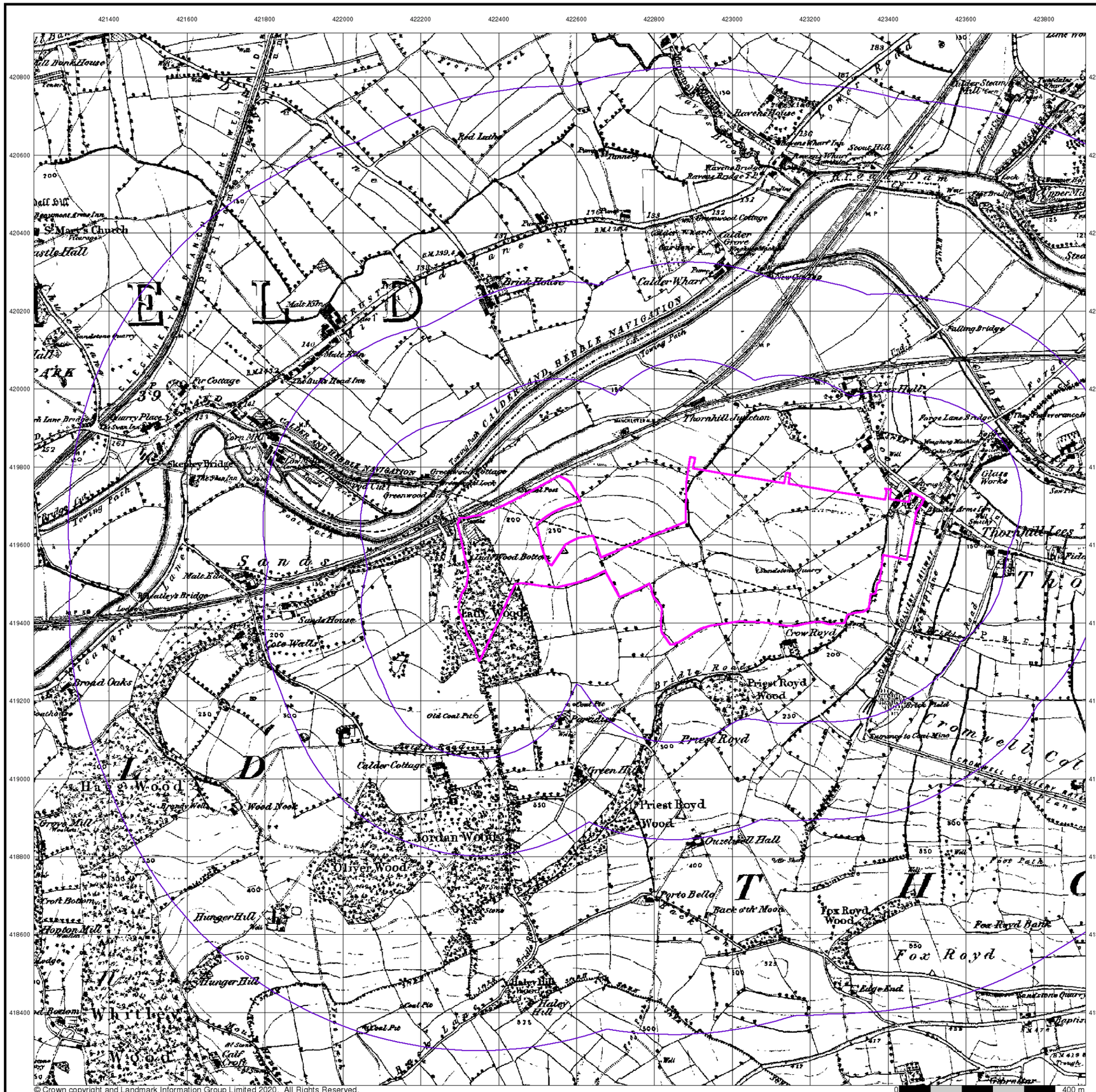
16 DISPUTES AND GOVERNING LAW

16.1 The Agreement shall be governed by and construed in accordance with English law and the Parties irrevocably and unconditionally submit to the jurisdiction of the English Courts.

16.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between the Parties may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Appendix D

Historical OS Plans



LITHOS CONSULTING

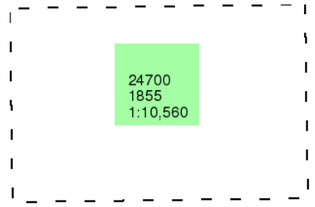
Yorkshire

Published 1855

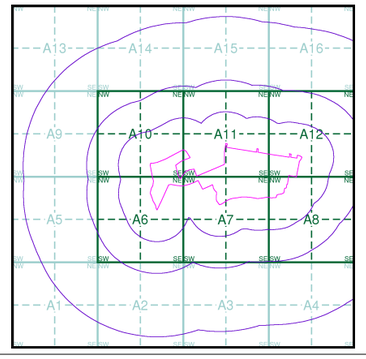
Source map scale - 1:10,560

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

Map Name(s) and Date(s)



Historical Map - Slice A



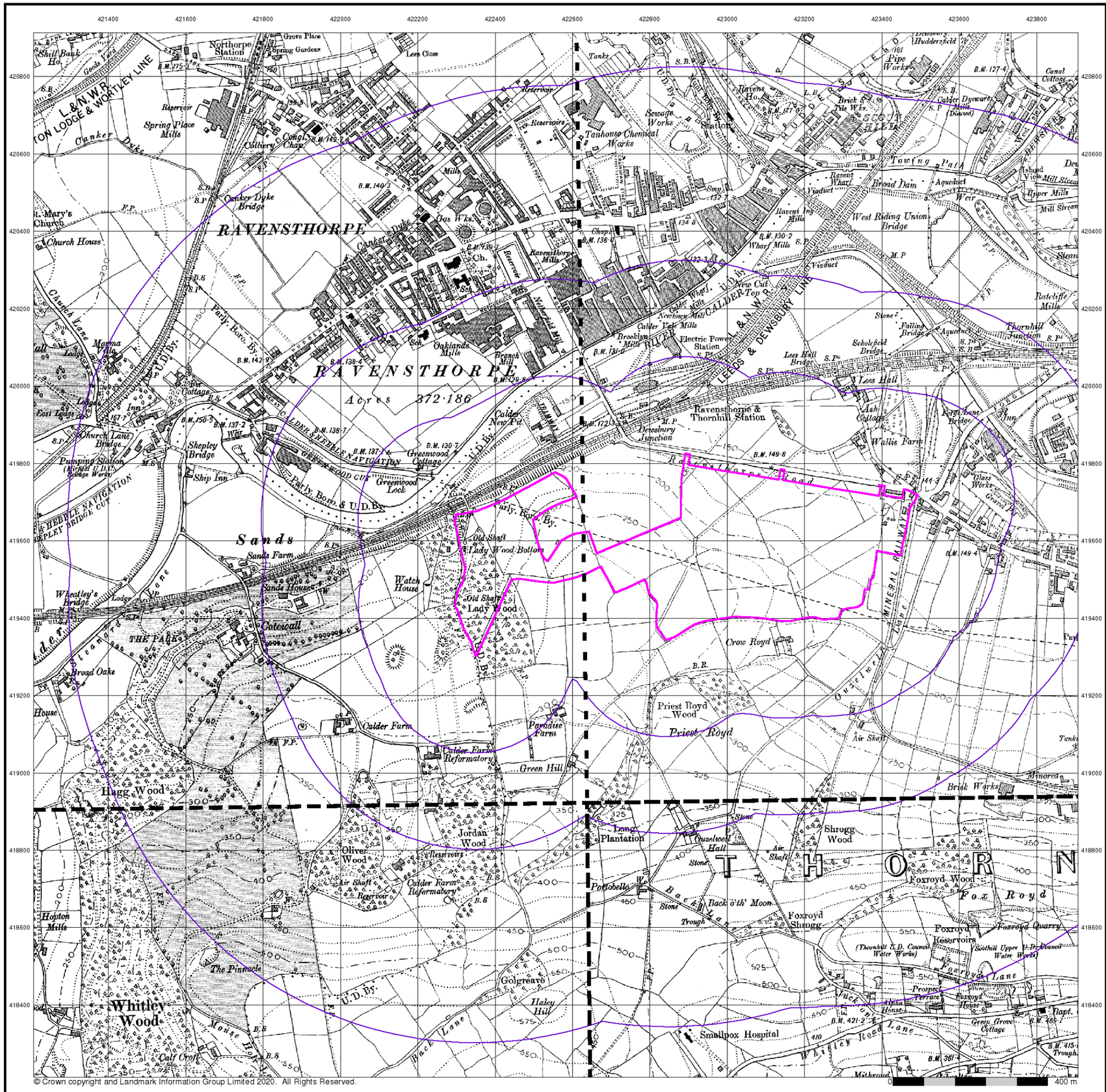
Order Details

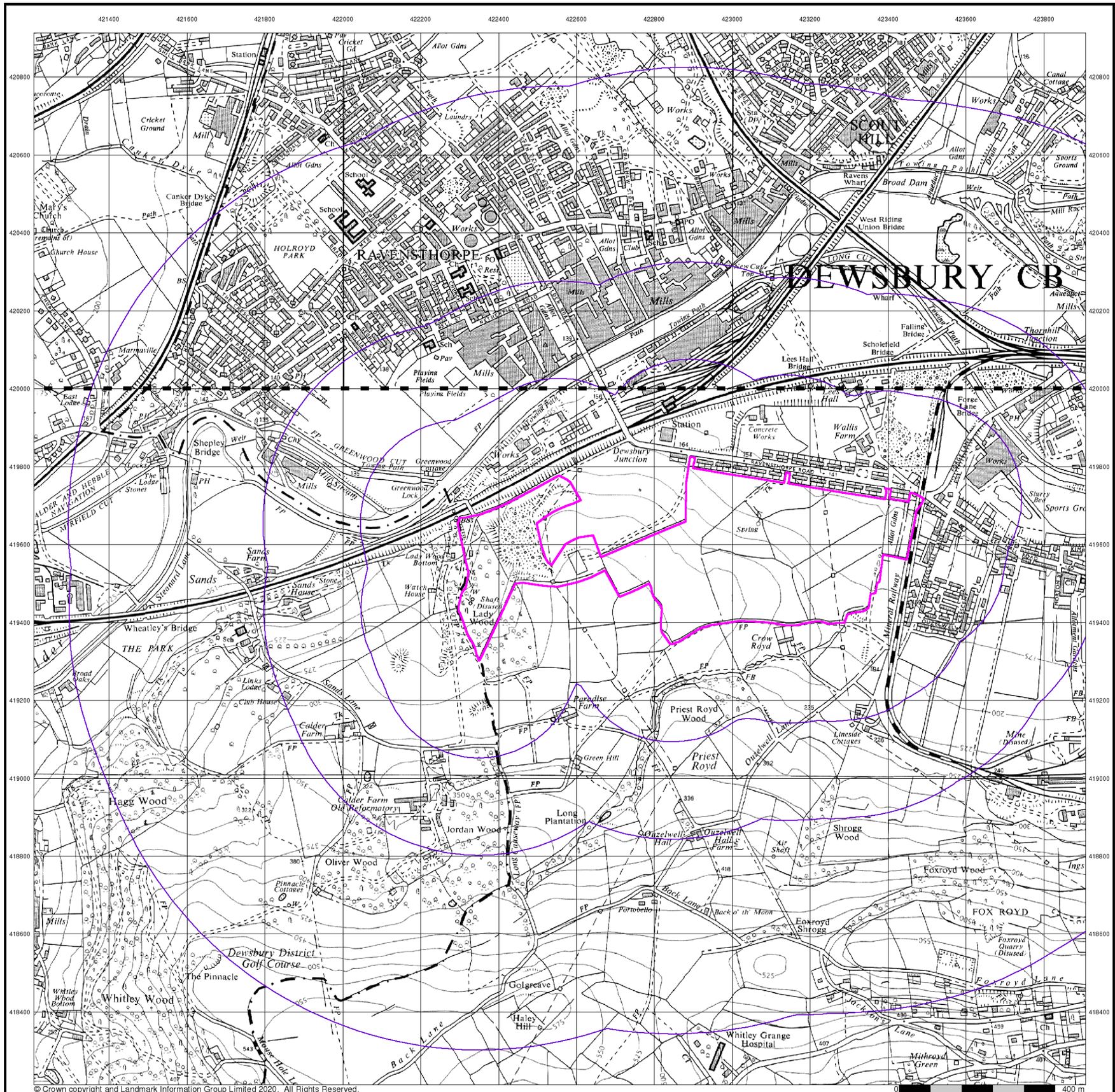
Order Number:	269449509_1_1
Customer Ref:	3901
National Grid Reference:	422680, 419550
Slice:	A
Site Area (Ha):	30.39
Search Buffer (m):	1000

Site Details

Dewsbury Riverside Gateway, DEWSBURY, WF12 9EE

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


RAVENSTHORPE
RAVENSTHORPE
Acres 372·186
Sands
THE PALE
Whitley Wood
Hagg Wood
Jordan Wood
Oliver Wood
Hopton Mills
Broad Oaks
Whitley Road
Back Lane
Ravensthorpe & Thornhill Station
Calder New Pit
Calder Farm
Calder Farm Reformatory
Paradise Farm
Green Hill
Priest Royd Wood
Priest Royd
Crow Royd
Long Plantation
Golgreave
Haley Hill
The Pinnacle
Foxroyd Wood
Foxroyd
Foxroyd Shrogg
Foxroyd Reservoirs
Foxroyd Quarry
Shrogg Wood
Quelsicoat Hall
Smallpox Hospital
Lees Hall
Lees Hall Bridge
Scholefield Bridge
Wallis Farm
Ash Cottage
Ravens Ho.
Ravens Wharf
Ravens Ing Mills
Broad Dam
West Riding Union Bridge
Towing Path
Aqueduct
Viaduct
Thornhill Junction
Ratcliffe Mills
Failing Bridge
Wharf Mills
Calder Wharf
Calder Vale Mills
Brooklyn Mills
Oaklands Mills
Branch Mill
Mahogfield Mill
Ravensthorpe Mills
Spring Place Mills
Colliery Chap.
Spring Gardens
Grove Place
Lees Close
Northorpe Station
Tanhouse Chemical Works
Sewage Works
Pipe Works
Brick & Tile Wks.
Calder Dyeware Mills (Disused)
Glass Works
Canal Cottage
Island View
Upper Mills
Mill Stream
Church House
St. Mary's Church
Church Lane Bridge
Shipley Bridge
Greenwood Cottage
Greenwood Lock
Ship Inn
Pumping Station (Thornhill U.D.C. Sewage Works)
Wheatley's Bridge
Sands Farm
Sands House
Watch House
Old Shaft
Lady Wood Bottom
Catcowall
Calder Farm Reformatory
Air Shaft
Reservoirs
Portobello
Back o'th' Moon
Brick Works
Mineral Line
Smithy
Mithroyd
Foxroyd Lane
Prospect Terrace
Foxroyd House
Green Grove Cottage
Chapl.
Tanks
Stone
Trough
Mouse Hole
Calf Croft
Gas Wks.
Sch.
Ch.
Reservoir
Lodge
Inn
Farm
Cottage
Mills
Works
Station
Bridge
Aqueduct
Viaduct
Tunnel
Quarry
Pond
Baptist
Chapel
Dismantled
Stream
Weir
Sluice
Pond
Tunnel
Quarry



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Ordnance Survey Plan

Published 1966 - 1967

Source map scale - 1:10,000

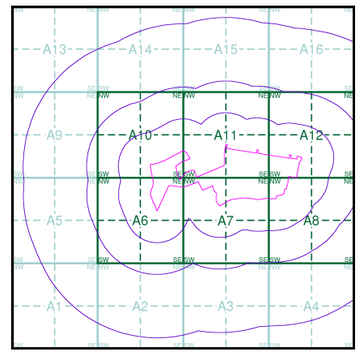
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some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

Map Name(s) and Date(s)

SE22SW
1967
1:10,560

SE21NW
1966
1:10,560

Historical Map - Slice A



Order Details

Order Number:	269449509_1_1
Customer Ref:	3901
National Grid Reference:	422680, 419550
Slice:	A
Site Area (Ha):	30.39
Search Buffer (m):	1000

Site Details

Dewsbury Riverside Gateway, DEWSBURY, WF12 9EE

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Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

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269449509_1_1

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3901

National Grid Reference:
422680, 419550

Slice:
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Site Area (Ha):
30.39

Search Buffer (m):
1000

Site Details:

Dewsbury Riverside Gateway
DEWSBURY
WF12 9EE

Client Details:

Mr G Morton
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

Contents

Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	79
Hazardous Substances	94
Geological	95
Industrial Land Use	110
Sensitive Land Use	147
Data Currency	148
Data Suppliers	153
Useful Contacts	154

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Sita Sensitivity mapa and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is producad by querying the Landmark database to a distance defined by the client from a sita boundary provided by the client.
In this datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

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Report Version v53.0

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Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes	Yes	Yes	n/a
Contaminated Land Register Entries and Notices	pg 5				3
Discharge Consents	pg 6	2	5	10	32
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls	pg 18		5		16
Integrated Pollution Prevention And Control	pg 21			19	17
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 31		6	8	5
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 33	Yes			
Pollution Incidents to Controlled Waters	pg 33		3	4	42
Prosecutions Relating to Authorised Processes	pg 42			1	1
Registered Radioactive Substances					
River Quality	pg 42		4	1	4
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points	pg 44				8
Substantiated Pollution Incident Register	pg 51			3	1
Water Abstractions	pg 52		2	12	17 (*16)
Water Industry Act Referrels	pg 64			2	
Groundwater Vulnerability Map	pg 64	Yes	n/a	n/a	n/a
Groundwater Vulnerability - Soluble Rock Risk			n/a	n/a	n/a
Groundwater Vulnerability - Local Information			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 65	Yes	n/a	n/a	n/a
Superficial Aquifer Designations	pg 65	Yes	n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences	pg 65		Yes	n/a	n/a
Flooding from Rivers or Sea without Defences	pg 67		Yes	n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas	pg 67		Yes	n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 68	6	26	11	49

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Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites	pg 79	1			
Historical Landfill Sites	pg 79	1	3		3
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)	pg 80		2		
Licensed Waste Management Facilities (Locations)	pg 81		2	9	3
Local Authority Landfill Coverage	pg 84	1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)	pg 84	4	7	3	8
Potentially Infilled Land (Water)	pg 85		1	2	3
Registered Landfill Sites	pg 86		2	2	2
Registered Waste Transfer Sites	pg 88			3	5
Registered Waste Treatment or Disposal Sites	pg 91			2	3
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)	pg 94				1
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents	pg 94				1
Planning Hazardous Substance Enforcements					

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Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Geological					
BGS 1:625,000 Solid Geology	pg 95	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 95	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 103	1	1	3	8
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas	pg 106	Yes	n/a	n/a	n/a
Mining Instability	pg 106	Yes	n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 106	Yes	Yes	n/a	n/a
Potential for Compressible Ground Stability Hazards	pg 106		Yes	n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 107	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 108	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 108	Yes	Yes	n/a	n/a
Radon Potential - Radon Affected Areas	pg 109	Yes	n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 110		21	96	100
Fuel Station Entries	pg 129				3
Points of Interest - Commercial Services	pg 129		5	28	35
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production	pg 135		21	27	32
Points of Interest - Public Infrastructure	pg 142		6	12	27
Points of Interest - Recreational and Environmental	pg 145		1		7
Gas Pipelines					
Underground Electrical Cables					

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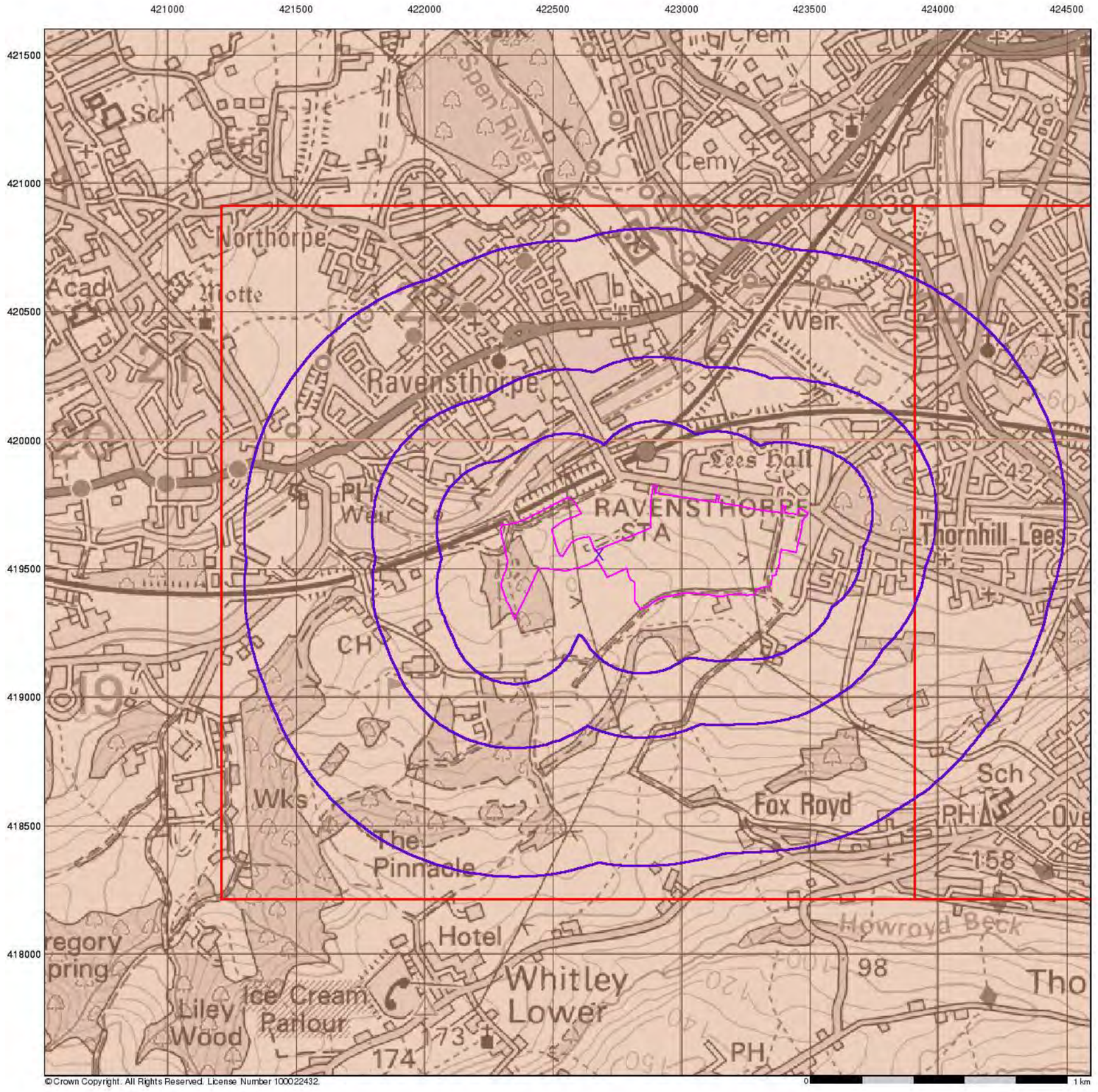
Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland	pg 147			1	1
Areas of Adopted Green Belt	pg 147	1			1
Areas of Unadopted Green Belt	pg 147	1			1
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves	pg 147				2
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones	pg 147				1
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



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Bedrock Aquifer Designation

General

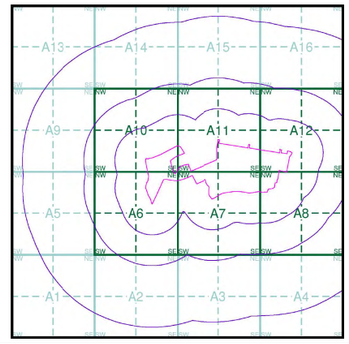
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A

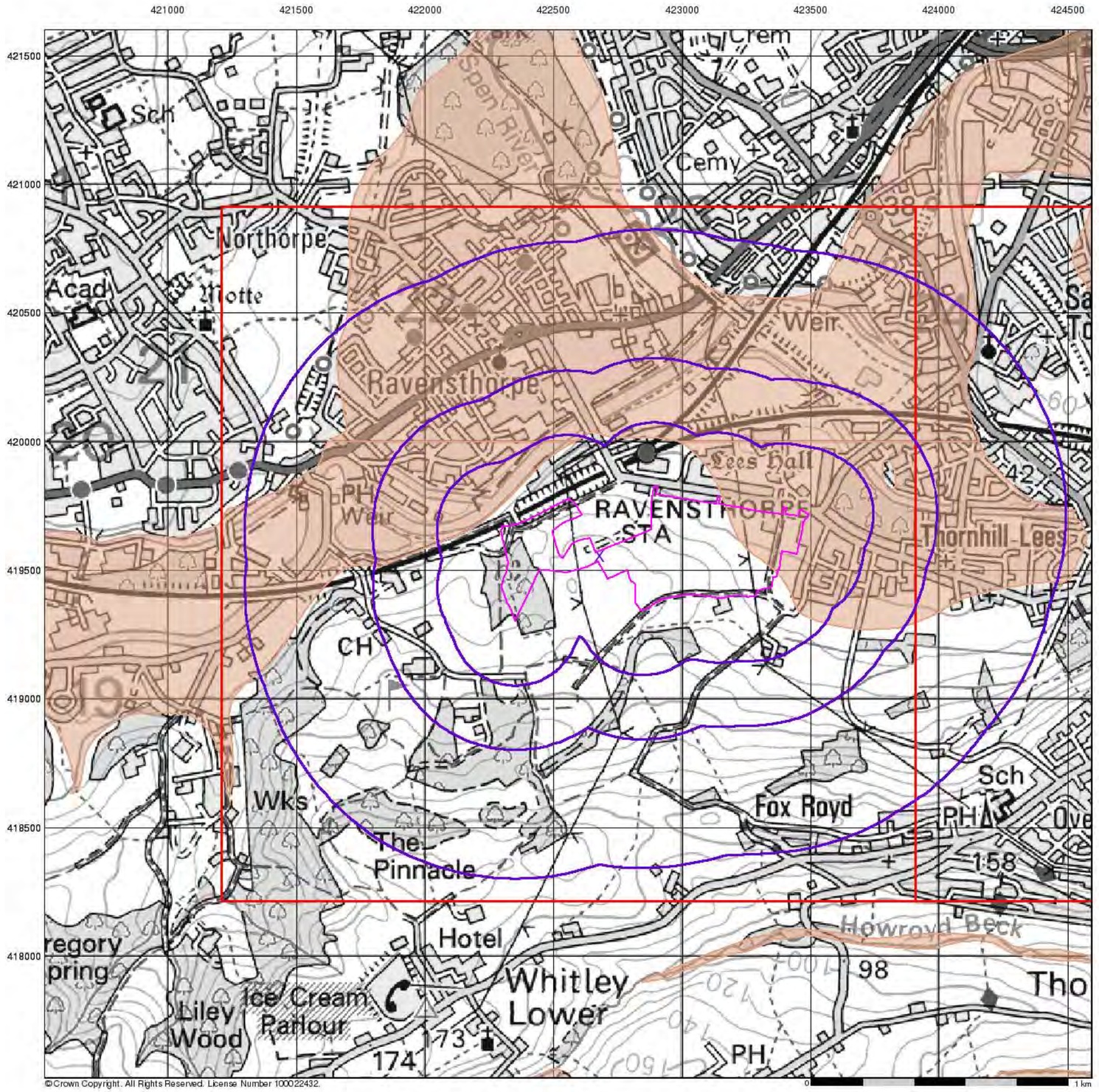


Order Details

Order Number:	269449509_1_1
Customer Ref:	3901
National Grid Reference:	422680, 419550
Slice:	A
Site Area (Ha):	30.39
Search Buffer (m):	1000

Site Details

Dewsbury Riverside Gateway, DEWSBURY, WF12 9EE



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Superficial Aquifer Designation

General

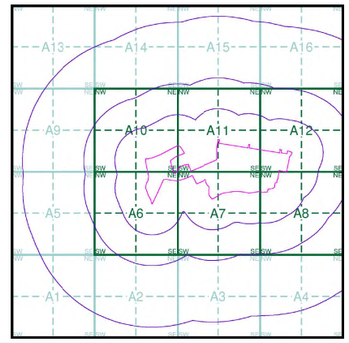
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



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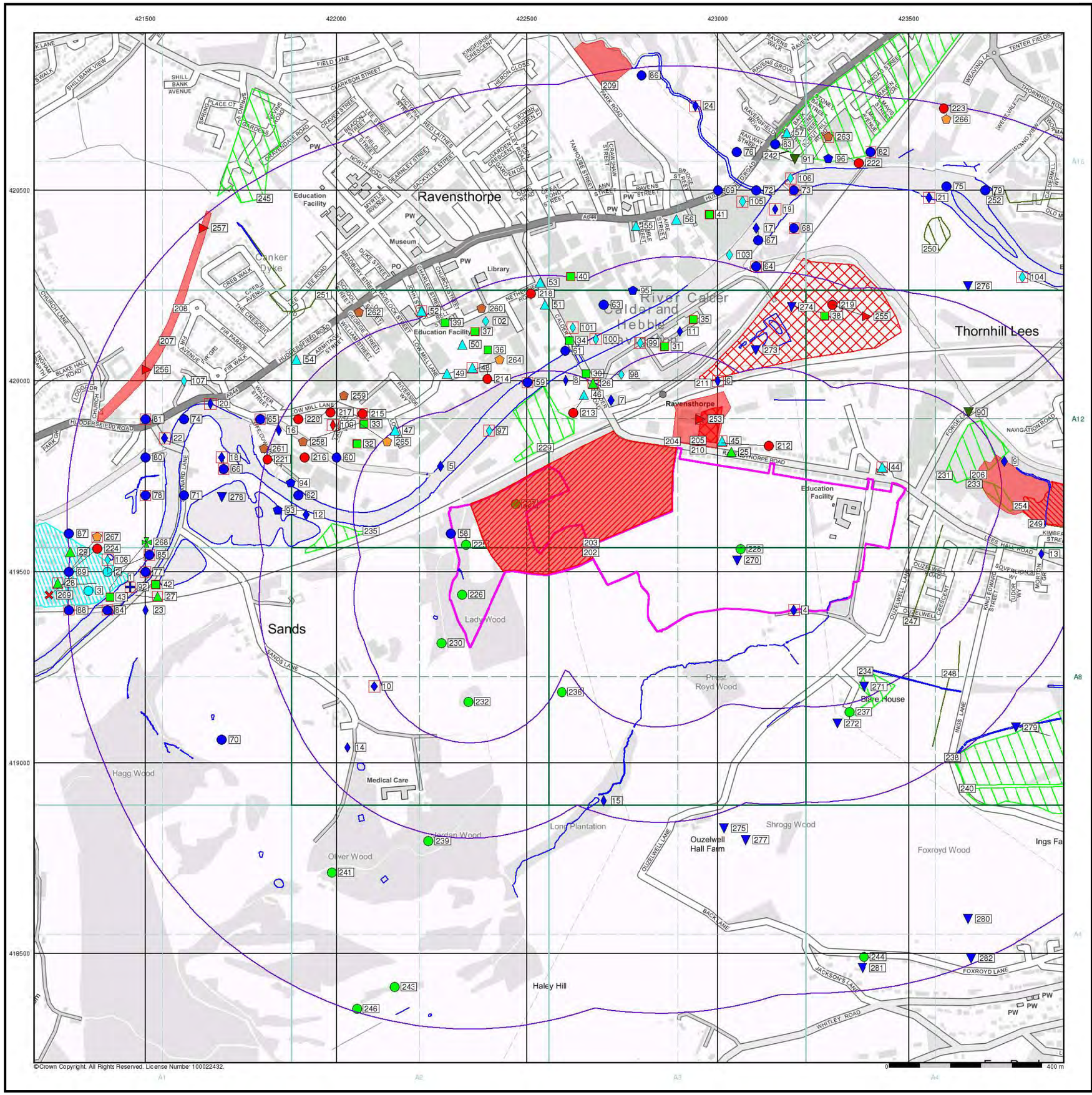

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General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID

Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Hazardous Substances

COMAH Site | Explosive Site | NIHHS Site

- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

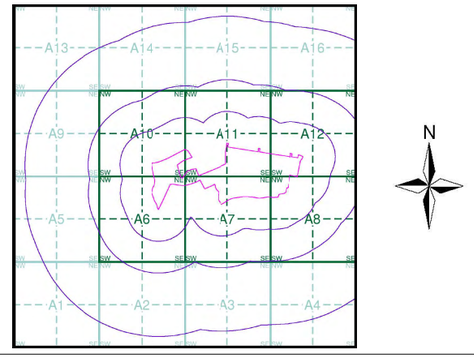
Geological

- BGS Recorded Mineral Site

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Site Sensitivity Map - Slice A



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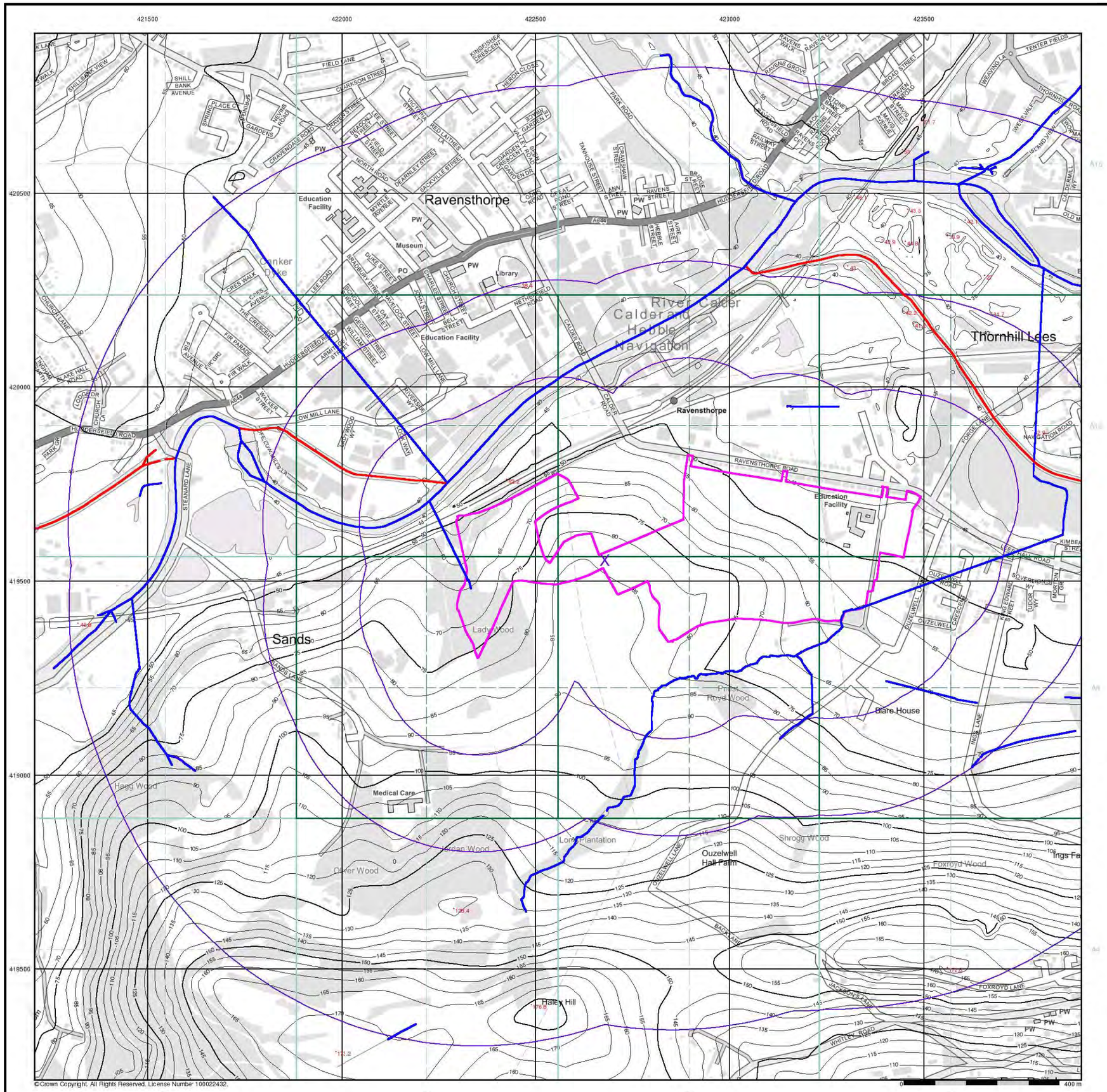

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General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

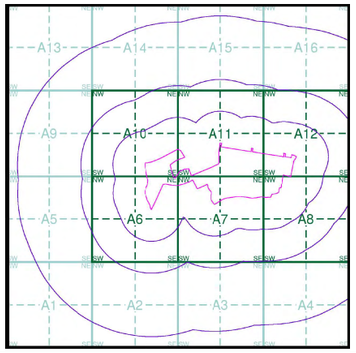
OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

Contours (height in meters)

- Standard Contour
- Master Contour
- Spot Height
- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



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Fax: 0844 844 9951
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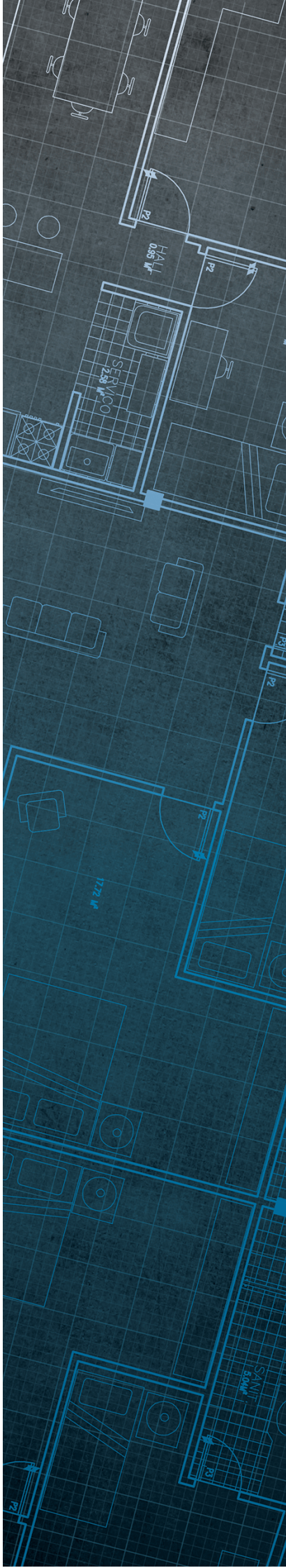
The Coal Authority

Consultants

Coal Mining Report

Dewsbury Riverside Gateway
WF12 9EE

Date of enquiry:	**26 November 2020**
Date enquiry received:	**26 November 2020**
Issue date:	**26 November 2020**
Our reference:	**51002322476001**
Your reference:	**PO16816/glm/3901**



Consultants

Coal Mining Report

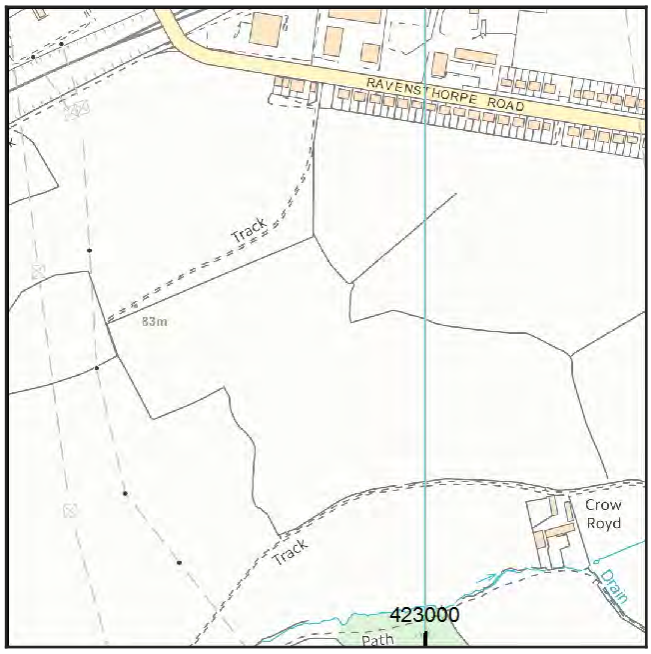
This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

LITHOS CONSULTING

Enquiry address

Dewsbury Riverside Gateway
WF12 9EE



Approximate position of property

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/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	MIDDLETON MAIN	Coal	6NF8	4	Beneath Property	3.0	South-East	114	1833
unnamed	MIDDLETON LITTLE	Coal	6NI7	5	Beneath Property	2.4	East	84	1926
unnamed	MIDDLETON MAIN	Coal	6NC8	8	Beneath Property	3.2	South-East	114	1926
unnamed	MIDDLETON LITTLE	Coal	6NH7	9	Beneath Property	2.5	East	84	1926
unnamed	MIDDLETON MAIN	Coal	6ND8	14	Beneath Property	3.2	South-East	114	1926
unnamed	MIDDLETON MAIN	Coal	6NE8	31	Beneath Property	3.1	South-East	114	1927
unnamed	TOP BEESTON	Coal	6NCA	97	Beneath Property	3.5	South	137	1909
unnamed	TOP BEESTON	Coal	6NDA	108	South-East	2.9	East	97	1903
unnamed	WHINMOOR	Coal	6NFA	123	North-West	2.0	South-East	41	1909
unnamed	BLACK BED	Coal	6NGA	154	Beneath Property	2.5	North-East	76	1915
unnamed	BETTER BED	Coal	6NIA	237	Beneath Property	3.1	East	60	1909

Probable unrecorded shallow workings

Yes.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

Entry type	Reference	Grid reference	Treatment description	Mineral	Conveyancing details
Shaft	422419-002	422554 419858	was found filled and subsequently capped with an 8.5m x 8.5m x 0.75m thick reinforced concrete cap at rockhead in 2003 by IMC Ltd on behalf of the Coal Authority	Coal	
Shaft	422419-003	422333 419446		Coal	
Shaft	422419-004	422302 419599		Coal	
Shaft	422419-005	422344 419596		Coal	
Shaft	422419-006	422290 419536		Coal	
Shaft	422419-007	422290 419501		Coal	
Shaft	422419-009	422388 419674		Coal	
Shaft	422419-010	422425 419643		Coal	
Shaft	422419-011	422458 419581		Coal	
Adit	422419-012	422376 419669		Coal	
Adit	422419-013	422490 419714		Coal	
Adit	422419-014	422493 419688		Coal	
Adit	422419-015	422421 419514		Coal	
Adit	422419-016	422422 419509		Coal	
Adit	422419-017	422488 419628		Coal	
Adit	422419-018	422406 419499		Coal	
Adit	422419-019	422407 419487		Coal	
Adit	422419-020	422404 419467		Coal	
Adit	422419-021	422395 419442		Coal	
Adit	422419-022	422396 419437		Coal	
Adit	422419-023	422380 419417		Coal	
Adit	422419-024	422360 419391		Coal	
Adit	422419-025	422343 419374		Coal	
Shaft	422419-026	422390 419660		Coal	

Entry type	Reference	Grid reference	Treatment description	Mineral	Conveyancing details
Shaft	422419-027	422873 419558		Coal	
Adit	422419-028	422509 419680		Coal	
Adit	422419-029	422502 419674		Coal	
Adit	422419-030	422473 419598		Coal	
Adit	422419-031	422473 419583		Coal	
Adit	422419-032	422576 419564		Coal	
Adit	422419-037	422291 419312		Coal	
Shaft	422419-043	422339 419457		Coal	
Shaft	423419-001	423369 419436		Coal	
Shaft	423419-002	423389 419486		Coal	
Shaft	423419-003	423383 419491		Coal	
Shaft	423419-004	423282 419592		Coal	
Shaft	423419-005	423203 419656		Coal	
Shaft	423419-006	423184 419672		Coal	
Shaft	423419-008	423141 419838		Coal	
Shaft	423419-011	423468 419558		Coal	

Abandoned mine plan catalogue numbers

The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

FGB823	11057	FGB822
FGB551	2363	GCR56
FGB217	14457	10527

Our records show we have more plans than those shown above which could affect the enquiry boundary.

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

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Outcrops

Seam name	Mineral	Seam workable	Distance to outcrop (m)	Direction to outcrop	Bearing of outcrop
LOW FENTON	Coal	Yes	Within	N/A	13
LOW FENTON	Coal	Yes	Within	N/A	134
MIDDLETON LITTLE	Coal	Yes	Within	N/A	58
MIDDLETON LITTLE	Coal	Yes	Within	N/A	88
MIDDLETON MAIN	Coal	Yes	Within	N/A	42
MIDDLETON MAIN	Coal	Yes	Within	N/A	210
MIDDLETON MAIN	Coal	Yes	Within	N/A	211
WHEATLEY LIME	Coal	Yes	Within	N/A	220

Geological faults, fissures and breaklines

Please refer to the 'Summary of findings' map (on separate sheet) for details of any geological faults, fissures or breaklines either within or intersecting the enquiry boundary.

Fault under or close to the property recorded.

Opencast mines

Please refer to the “Summary of findings” map (on separate sheet) for details of any opencast areas within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

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Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations

None recorded within 50 metres of the enquiry boundary.

Remediated sites

Distance to site remediation (m)	Direction
30.9	East
17.0	East
Within	N/A

See Section 4 for further information.

Coal mining subsidence

There are 1 claim(s) within 50 metres of the property boundary that do not match the property address. These are shown on the enquiry boundary plot.

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

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

If further subsidence damage claims information is required, please visit www.groundstability.com.

See Section 4 for further information.

Mine gas

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

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Section 3 – Licensing and future mining activity

Future underground mining
None recorded.

Coal mining licensing
None recorded within 200 metres of the enquiry boundary.

Court orders
None recorded.

Section 46 notices
No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

Withdrawal of support notices
The property is in an area where a notice to withdraw support was given in 1947.

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

Payments to owners of former copyhold land
The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

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Section 4 – Further information

The following potential risks have been identified and as part of your risk assessment should be investigated further.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

Remediated sites

The site is within an area of previous interest. It is close to where the Coal Authority has investigated and where necessary remediated mine entries and/or shallow coal mine workings following specific reported hazards.

The site requires further investigation and may influence your risk assessment. We recommend that you order the Coal Authority **Surface Hazards Incident Report**, which will include more information about the hazard.

Coal mining subsidence

The site is within an area of previous interest. It is close to where the Coal Authority or licensed mine operator has investigated and where necessary remediated issues relating to coal mining subsidence.

The site requires further investigation and may influence your risk assessment. We recommend that you order the appropriate **Coal Authority Subsidence Claims Report**, which will include more information about the hazard.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

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Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

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Opencast mines
Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips
Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations
Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites
Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence
Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas
Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

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Mine water treatment schemes
Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining
Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing
Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders
Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices
Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices
Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

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The Coal Authority

Summary of findings

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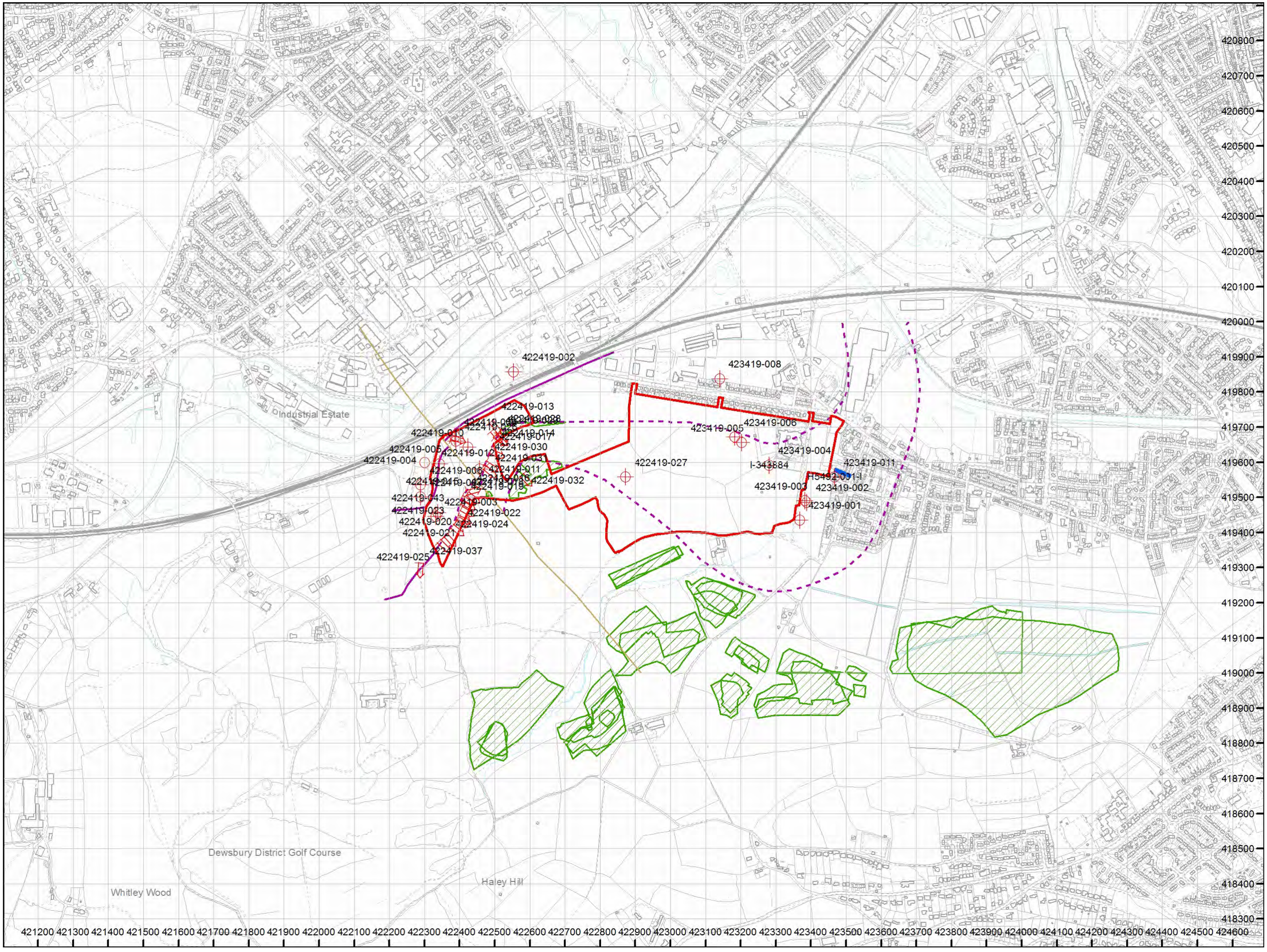
The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

- Approximate position of the enquiry boundary shown
- Disused mine shaft
- Disused adit
- Outcrop (Proven)
- Outcrop (Conjectured)
- Geological faults
- Unlicensed opencast site
- Remediated sites
- Coal claim



How to contact us
0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com

George Morton

From: George Morton
Sent: 18 December 2020 13:26
To: George Morton
Subject: FW: [External] mine waters query

From: John Leyland <JohnLeyland@coal.gov.uk>
Sent: 15 December 2020 17:45
To: George Morton <George.Morton@lithos.co.uk>
Cc: EnvironmentMail <EnvironmentMail@coal.gov.uk>; Rhiannon Marchi-Smith <RhiannonMarchi-Smith@coal.gov.uk>
Subject: RE: [External] mine waters query

George,

Many thanks for your enquiry. I have reviewed your Consultants mining report and the internal data sources on which it was based and can confirm that there are no Coal Authority mine water monitoring locations near to the site and that we are not aware of any specific mine water discharges in the area.

This does not mean that there are no mine water discharges in the area, just that they have not been reported which may indicate that they are not high flow, that they have not caused a nuisance to date or there is a general acceptance that there are mine water discharges in the area.

You have identified springs or water arising to the west of your site around the densely grouped mine entries in this area and I see that there are features marked on the OS mapping alluding to springs. It is likely that the water discharging here has interacted with mine workings and could therefore be described as mine water. This water is likely to contain elevated concentrations of minerals associated with the Coal Measures including iron which often presents as ochreous(orange) deposits around discharges. These constituents would be detected by standard metals analysis but they would also likely to occur in natural groundwater occurring in this area. It should be noted that “acid mine drainage” is rare in the UK and is related to specific conditions unlikely to be present at this site.

Please feel free to contact me directly to discuss this if required.

Regards

John

The Coal Authority

John Leyland BSc (Hons) MSc FGS
Hydrogeologist

DD: 01623 637 376
M : 07765 222 038
W : gov.uk/coalauthority

From: George Morton <George.Morton@lithos.co.uk>
Sent: 14 December 2020 15:48

To: thecoalauthority <thecoalauthority@coal.gov.uk>
Subject: [External] minewaters query

WARNING: This email originated outside of the Coal Authority. DO NOT CLICK any links or open any file attachments unless you recognise the sender and know the content is safe. Check the spelling of any email addresses carefully for anything unusual. If you are unsure please contact the ICT Service Desk for guidance.

Good afternoon.

We are currently undertaking a ground investigation at land off Ravensthorpe Road, Dewsbury. For reference please find attached a CA Consultants Mining Report which refers to our site boundary.

We are aware of several 'springs' where groundwaters issue from the ground which has been very heavily mined beneath this site. Most notably in places where there are very closely spaced mine entries (to the west). Therefore we are considering whether there could be the risk or 'contaminated' minewaters at this site.

Is the CA aware of any minewater contamination issues, reports, treatments etc in the immediate area, notably draining in to the River Calder which is located just to the north? If so are you able to advise on what information is available & the best way to make a search request/order?

Finally in the CA's experience are there any specific water quality tests which you would expect to see when dealing with mine water emissions from localised mine entries such as these?

Many thanks in advance for any advice.

Yours

George

George Morton
Senior Engineer
Lithos Consulting Ltd

Parkhill
Walton Road
Wetherby, LS22 5DZ

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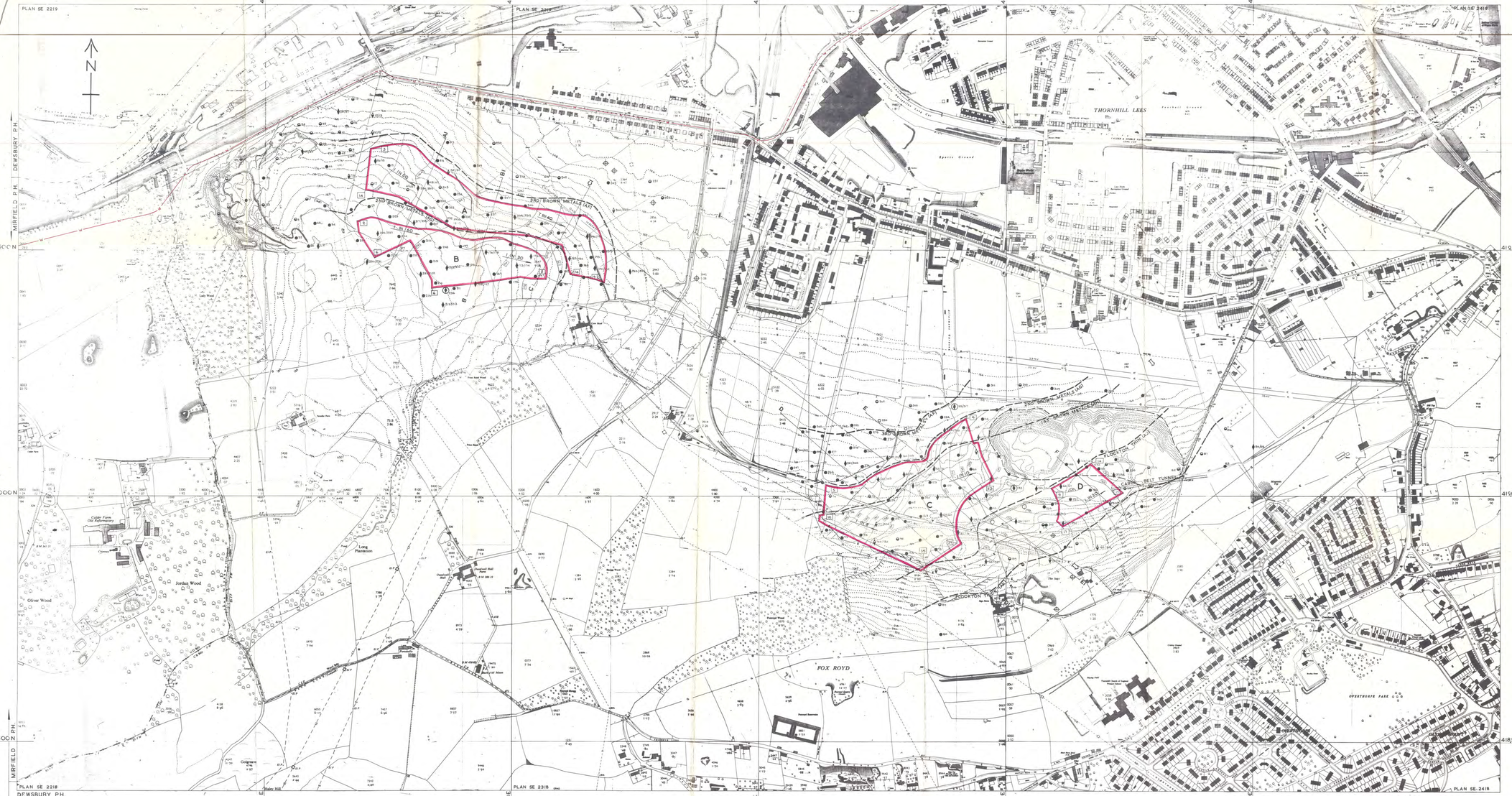

030240 RAVENSTHORPE (DEWSBURY C.B.)
LOCATION:– 2 MILES S.W. OF DEWSBURY.
PLAN SE :– 2219, 2319, 2418 (1967) 2218, 2318, (1961) 2419 (1955).
SCALE :– 1/2500

LEGEND

COLOUR	SYMBOL (OPEN / PARTLY STRATA TIMED / CORE)	DESCRIPTION
BLACK	○	BOREHOLE SHOWING NEITHER COAL NOR OLD WORKINGS
BLACK	● ◐ ◐	BOREHOLE SHOWING SOLID COAL ONLY
BLACK	◒ ◒	BOREHOLE SHOWING OLD WORKINGS OR GOB SLACK WITH OR WITHOUT SOLID COAL
BLACK	190	SURFACE CONTOUR ABOVE ORDNANCE DATUM (METRES)
YELLOW	⊕	SHAFTS
YELLOW	⇨	POSITION OF KNOWN OR SUSPECTED OLD ADITS
BLACK	A — A1	LINE OF GEOLOGICAL SECTION
BLACK		EDGE OF UPSTANDING TYP
BLACK		OUTCROP OF FLOOR OF COAL SEAM
BLACK	190	CONTOURS AT BASE OF COAL SEAM ABOVE DATUM (METRES)
BLACK	1 in 5th	DIRECTION AND RATE OF DIP
VARIOUS	A	PROPOSED WORKING, PERIMETER OF SEAM WITH SPOT DEPTHS IN METRES
		DEEP MINES OLD WORKINGS IN 1ST OR 2ND BROWN METALS
BLACK		SITE BOUNDARY (INSIDE EDGE OF SYMBOL TO BE TAKEN AS BOUNDARY)
BLACK		AUTHORISED LIMIT OF EXCAVATION
BLACK		OLD WORKING IN OLD HANDS

SEAM DETAILS

COLOUR	SEAM NAME	SEAM CODE	SEAM CONTOUR
RED	FLOCKTON THIN	AJ	(50)
GREEN	FIRST BROWN METALS	AH	
BROWN	SECOND BROWN METALS	AG	(100)
BLUE	THIRD BROWN METALS	AF	(150)

SERVICES

Y.E.B.	O/H LINE	E — E
Y.E.B.	U/G CABLE	UE — UE
P.O	O/H LINE	T — T
P.O.	U/G CABLE	UT — UT
N.E.G.B.	GAS MAIN	G — G
C.E.G.B.	O/H LINE	CE — CE
MID CALDER W.B.	WATER MAIN	W — W
WAKEFIELD AND DISTRICT W.B.	WATER MAIN	WW — WW
DEWSBURY C.B.	SEWER	S — S
N.C.B.	WATER MAIN	NW — NW
N.C.B.	GAS MAIN	NG — NG
N.C.B.	O/H LINE	NE — NE
N.C.B.	U/G CABLE	NUE — NUE
PROPOSED WATER MAIN		W — W

NB. A DATUM 100m B.O.D. HAS BEEN USED ON THIS PLAN

GEOLOGICAL PLAN

030240 RAVENSTHORPE

DRAWING No. 05/9517

	REVISIONS	DATE		REVISIONS	DATE
A	PLAN DRAWN	PS 31-11-72			
B	SERVICES ADDED	" 23-3-76			
C	GEOLOGICAL INFORMATION ADDED	ES 2-4-78			
D	SERVICES AMENDED	20-6-78			

NATIONAL COAL BOARD—OPENCAST EXECUTIVE
No. 5 (CENTRAL) REGION. NOTTINGHAM.

BASED UPON THE ORDNANCE SURVEY MAP WITH THE SANCTION OF THE CONTROLLER OF H.M. STATIONERY OFFICE.
CROWN COPYRIGHT RESERVED.
ORDNANCE DATUM REFERRED TO:– NEWLYN.

National Coal Board
Opencast Executive
No. 5 (Central) Region

Site Name: Ravensthorpe
Site number: 030240
Date: 17/7/73.

Part IV Summary of Analyses - probable as worked basis

Area	Seam Name & Index	Insitu thickness (m)	Moist. %	Ash %			Sulphur			Cal.Value(BTU/lb)			DAFCV (BTU/lb)	Recoverable Tonnage
				Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.		
A	3rd BROWN METALS (AF)	0.43	8.0	9.9	12.9	18.3	1.6	2.4	3.7	11000	11810	12260	14930	18843
B	2nd BROWN METALS (AG)	0.40	8.0	4.0	8.7	14.7	0.8	1.4	2.9	11270	12150	12830	14580	12313
C	1st BROWN METALS (AH)	0.85	8.0	5.9	12.1	14.6	0.8	3.2	4.4	11600	11980	12910	14990	38696
	2nd BROWN METALS (AG)	0.40	8.0	5.8	10.5	19.7	0.9	2.2	4.8	10820	12190	12900	14960	20526
D	FLOCKTON THIN (AJ)	0.77	8.0	9.1	12.4	15.3	1.1	1.8	3.1	11400	11830	12320	14860	8934
	WHOLE SITE		8.0	6.7	11.5	16.4	1.0	2.5	4.0	11270	12000	12720	14910	99312

Recoverable tonnage is calculated allowing a tolerance of 0.075m for each seam.
Ash percentages are derived from those given in Part II - air dried basis by adding an allowance for adventitious ash, and adjusting this figure for the estimated in situ moisture.
2% has been added to the 2nd Brown Metals and 3rd Brown Metals Seams, and 1.5% to the 1st Brown Metals & Flockton Thin Seams.
Calorific Values are derived from the Dry Ash Free CV by allowing for the corresponding ash and moisture percentages.

National Coal Board

Opencast Executive

No 5 (Central) Region

Final Site Report

for

Ravensthorpe Site

030240

The following is supplied for information only. The Executive does not guarantee its accuracy in any respect, and tenderers should satisfy themselves as to the actual conditions. For this purpose tenderers are invited to inspect original records (e.g. bore logs) available at the office of the R.O.G.M.

Strata cores were taken from boreholes 133, 236, and 317 and are stored at Wentworth Core Shed.

1. LOCATION AND TOPOGRAPHY

1.1. Location

1.1.1. Two miles south of Dewsbury, West Riding of Yorkshire.

1.1.2. 6" O.S.Sheet S.E. 21 N.W.

1.1.3. National Grid Reference S.E.235191.

1.2. Topography

1.2.1. The site consists of two parts with a separation of about 600 metres.

1.2.2. The eastern part, containing coal areas C and D consists of a concave slope facing northwards from an east-west ridge. From a height of 208m A.O.D. at the top of the ridge, the slope is initially very steep, but becomes progressively less so towards the north where the ground level is 160m A.O.D. This natural slope has been modified in two ways :-

a) A cover of made ground forms terraces across the central part of the area.

b) These terraces merge in the north east, into two prominent spoil tips which have been built outwards from the general slope to stand some 30m above ground level along their northern edges.

1.2.3. The western part, containing coal areas A and B generally has more gentle slopes. The highest point, of about 82m A.O.D. is attained in the north-east and the lowest point is about 44 M.A.O.D. in the north-west.
The steepest slopes (up to 1 in 5) are found across the central part.

2. GEOLOGY

2.1. Succession of Strata

2.1.1. A generalised vertical section of the strata recorded on the site is shown on plan 05/9505.

2.1.2. The following is representative of the succession of strata within, and adjacent to the areas considered for working; the coal seams are identified by name and by seam code given in brackets:-

Coal Seam		Parting Variation	Description
	Measures	up to 14.40m	Mainly sandy mudstones
Flockton Thick (AK)			Coal Shale Coal Seatearth Coaly seatearth
	Measures	11.20m - 17.80m	Mainly sandy mudstones. Thin sandstone lenses may occur beneath the Flockton Thick.
Flockton Thin (AJ)			
	Measures	16.60m - 28.20m	Mainly sandy mudstones with subsidiary sandstone lenses. Coals up to 0.75m can occur outside the proposed coal working areas.

Coal Seam	Parting Variation	Description
First Brown Metals (AH)		
Measures	3.75m - 14.00m	Mainly mudstones with prominent sandstone horizon.
Second Brown Metals (AG)		
Measures	9.90m - 18.70m	Mustone or sandy mudstone with a sandstone Horizon at the top
Third Brown Metals (AF)		Coal
Measures	20 Metres	

Middleton Limited (MB)

2.1.3 The seams included in contract are shown underlined.

2.1.4 The predominent lithology is sandy mustone and mustone.

2.1.5. The prominent sandstone, occurring between the First and Second Brown Metals seams in area C, and variable sandstones above the Third Brown Metals in area D have been assessed quantitavely and volumes given by area on the S.S.C.

2.2. Unconsolidated Deposits

These comprise made ground and material described as weathered shale.

2.2.1. Over the eastern part of the site made ground is extensive such that there are few areas of original ground; it occurs in:-

(a) Two spoil tips, to the north east of coal area C, which together contain the greatest volume of made ground on the site; and in:-

(b) A terraced area near the disused Ingham's Colliery,

2.2.2. Over the western part no made ground was recorded within the two proposed coal working areas.

2.2.3. Over both eastern and western parts of the site, beneath the made ground or subsoil, there is a layer of 'weathered shale' which acts in the same way as drift deposits. Over the eastern part of the site the thickness of this varies from 3m - 10m while it is much thinner, 1m-2m thick over the western part of the site. There is a tendancy for this 'weathered Shale' to thicken northwards.

2.3. Structure

The geological structure of the site area has been interpreted by contouring on the Flockton Thin (Area D), Second Brown Metals (Areas B and C) and Third Brown Metals (Area A) where these form the pavement seams of their respective working areas, and have been differentiated by symbols on the Geological Plan 05/9517.

2.3.1. In areas A and B the seams dip at about 1 in 60 to the east south-east, although local rolls affect the degree and direction of this dip to a limited extent.

2.3.2. In the eastern part of the site dips are generally steeper. In area C the dip is to the east south east at about 1 in 8, becoming much gentler to the south. In the east of area C the direction of dip is east north-east and this continues through to area D with a dip of 1 in 30 - 1 in 8.

2.3.3. No faulting is known to affect the site. However, minor faulting, undetected in drilling may be present assoicated with the rolls described above.

2.4 Coal seams to be worked

2.4.1 Details of the seams, included in contract are given below:-

Seam Name and Index	Working Area	Range of Thickness (M)	Description	Average Thickness (M)	Remarks
Flockton Thin(AJ)D		0.72-0.84	Coal often shaly at the top	0.77	
		0.01-0.05	Seatearth	0.02	Excluded
		0.06-0.09	Inferior Coal	0.07	Exluded
		0.17-0.28	Seatearth with Coal bands		
		0.10-0.22	Inferior Coal	0.17	Excluded
		0.05-0.07	Coaly Seatearth	0.06	Excluded
		0.04-0.08	Inferior Coal	0.08	Excluded
First Brown Metals (AH)	C	0.62-0.92	Coal often shaly at the top	0.85	
		0.40-1.75	Seatearth with thin impersistent shaly coals	0.93	Excluded
Second Brown Metals (AG)	B	0.36-0.45	Coal	0.40	
		0.45-1.91	Seatearth with thin impersistent coal bands	1.06	Excluded
	C	0.33-0.49	Coal	0.40	
		0.60-1.98	Seatearth with thin impersistent shaly coals	1.06	Excluded
Third Brown Metals (AF)	D	0.32-0.52	Coal	0.44	
		0.01-0.07	Seatearth	0.04	Excluded
		0.09-0.16	Inferior Coal	0.13	Excluded

2.4.2. The in-situ thickness is the average thickness of contractual coal, being the average total coal thickness less excluded partings and inferior coal.

2.5 Partings within coal seams

There are no partings in the contractual seams and no allowances have been made for them in average seam thicknesses.

2.6 Overburden

2.6.1. Consists of soil, subsoil, weathered shale and superimposed made ground (wholly in the eastern part of the site), and variable thicknesses of stratified measures, mainly mudstones and sandy mudstones with subsidiary amounts of hard rock (See sections 2.1.2. and 2.1.5. and Geological Supplement 05/9505. For further details see sections 1.2, 2.1 and 2.2., and Geological Plan Supplement 05/9518 for details of distribution of unconsolidated deposits.)

2.7 Other Economic Materials

No other economic minerals are known to occur on the site.

3. WATER

3.1 No surface water occurs within the site.

3.2 No water was encountered during drilling.

4. OLD WORKINGS

4.1 Underground Old Workings

No abandoned mine plans of old workings are available for the the seams to be worked within the site area, except for area C (see section 4.1.2.), however, drilling has proved that certain seams in parts are affected by old wokings.

4.1.1. Details of underground old workings in the various seams, as indicated by drilling, are as follows.

(a) Area A

Third Brown Metals	Worked in small patches in the west of the area with a waste pack.

(b) Area B

Second Brown Metals	: None recorded

(c) Area C

First Brown Metals	: Worked in small patches in the west of area C leaving roof and floor usually but using a waste pack.
Second Brown Metals	: None recorded

(d) Area D

Flockton Thin	: None recorded

4.1.2. Although drilling records no old workings in the Second Brown Metals seam in area C, N.C.B. Deep Mines abandonment plan shows old workings in the 'Old Hards' seam, to the south of Ingham Colliery, this seam is usually correllated with the Second Brown Metals and as such indicates the possibility of old

workings in that seam, in area C, undetected by drilling. To cover this contingency, an old workings allowance (See section 8.7.3. (b) has been made.

4.1.3. Extensive underground workings are known to exist in the Middleton Little seam, some 20m below the Third Brown Metals and have been proved in drilling.

4.2. Opencast Workings

No opencast activity is known to have taken place in the area.

5 COLLIERIES

5.1 Thornhill Colliery 1 mile to the east.

5.1.2. Caphouse Colliery 2 miles to the south south east.

5.1.3. Shuttle Eye Colliery $2\frac{1}{2}$ miles to the south south west.

5.1.4. Denby Grange Colliery 3 miles south east.

5.2 Abandoned Collieries

5.2.1. The two shafts of Inghams Colliery are in the centre of the eastern part of the site. This pit is linked to Thornhill Colliery by a cable belt drift, the entrance of which is shown on the Geological plan 05/9517

5.2.2. Combs Colliery $\frac{1}{2}$ mile to the east

5.2.3. Quarry Wood No.2 $1\frac{1}{2}$ miles to the south west.

5.2.4. Whitley Temple Drift $1\frac{3}{4}$ miles to the south west.

5.2.5. The positions of all known shafts and adits occurring within and adjacent to the site boundary, are shown on the Geological Plan 05/9517.

5.2.6. (a) The following shafts and adits occur within the proposed site boundary and details of each, where known, are given below.

(i) No. 1 and No.2 shafts of Inghams Colliery are in process of being filled and are to be utilised to bleed off gas from old underground workings. They are located as:

No. 1 shaft 423974E/418949N
No. 2 shaft 424037E/418980N

See also sections 5.2.1. and 8.1.4.

(ii) The shafts at 423190E/419677N and 423205E/419662, occur to the north east of area A of which no details are known.

ACCESS

6.1. See Contract Documents

7. SPECIAL SEAMS

7.1 The Flockton Thick seam outcrops along the base of the steep ridge beyond the high wall of area D and has been excluded because of its occurrence on this ridge.

7.2 Thin coal seams (leaves of the Flockton Thin seam up to 0.17m thick) occur 0.02m - 0.28m below the main leaf of the Flockton thin seam; these are excluded because of poor quality.

7.3 Thin, impersistent coal and / or shaly coals may occur directly under lying the First and Second Brown Metals seams; these are intimately associated with seatearths and are invariably of very poor quality, hence they are excluded.

7.4 Coal, up to 0.16m thick, can occur directly beneath the Third Brown Metals but is of very poor quality and has been excluded.

7.5 A complex series of coal seams, impersistent in character and varying greatly in position and thickness, may develop in the parting between the Flockton Thin seam and the First Brown Metals, known, from Inghams shaft, as the Lobby coal. Due to their highly variable nature and a very uncertain degree of correllation, they have been excluded, although they may be encountered in the batters of area C.

8. ESTIMATES

8.1 Working Areas

8.1.1. There are four seperate working areas, lettered A,B,C and D, falling into an eastern (C and D) and a western (A and B) group. In areas C and B, the second Brown Metals is the pavement seam; in area A the pavement seam is the Third Brown Metals and in area D the Flockton Thin.

8.1.2. The seam working areas have been defined in part by stand offs and batters, in part by outcrop, and in part by economic considerations.

8.1.3. The batters used throughout are 1 horizontal to 1 vertical.

8.1.4. The required stand-offs and other limits are as follows:-

Working Area	North	East	South	West
A	Low wall of 2.5m cover line on the Third Brown Metals seam	Low wall of 2.5m cover line on the Third Brown Metals seam	High wall limiting ratio	From u/g electricity cable 15m
B	Low wall of 1.5m cover line on the Second Brown Metals seam	Low wall of 1.5m cover line on the Second Brown Metals seam	From u/g natural gas main 40m	From O.S. encl. boundaries 6445 and 7463 10m From o/h Electricity line 22m
C	Low wall of outcrop of roof of Second Brown Metals seam.	From base of upstanding tip 10m	High wall limiting ratio From Ingham Colliery shafts 50m	From o/h electricity line. From O.S. encl. boundaries 5300 10m
D	Low wall of outcrop of roof of Second Brown Metals seam	High wall limiting ratio	High wall limiting ratio	From Ingham Colliery shafts 50m

8.2 In Situ Thickness

8.2.1. The average in-situ thickness of contractual coal for each seam is the arithmetic average derived from acceptable cored borehole thicknesses rounded off to the nearest centimetre.

8.3 Recoverable Thickness

8.3.1. The recoverable thickness of contractual coal is the in-situ thickness less 0.15m (0.075m deducted from the top and bottom of each seperate contractual coal seam) tolerance allowance.

8.4 Washouts

8.4.1. No washouts were recorded from the drilling on the site and no allowance has been made in the estimates.

8.5 Partings

8.5.1. There are no partings recorded in any of the contractual coal to be dug and no allowance has been made in the estimates.

8.6 Faults

8.6.1. No faults have been indicated by the drilling and no faults are shown on the Geological Plan 05/9517; however:-

8.6.2. The seams are subject to rapid variations in direction and amount of dip and the possibility of small-scale faulting associated with these structural charges cannot be precluded

8.6.3. No allowances have been made for faulting in estimates.

8.7 Old Workings

8.7.1. On the basis of drilling information no old workings affect areas B and D, and no allowances have been made in the estimates.

8.7.2. In area A, drilling indicates old workings in the Third Brown Metals seam affecting a small area in the west. Where worked, the pack is entirely waste and no roof and floor has been left, hence, in the estimates the old workings have been allowed for by reduction of the working area of the seam by a percentage derived arithmetically from borchole data, and rounded up to the nearest 5%

8.7.3.

(a) In area C drilling encountered old workings in the First Brown Metals seam in the east of the area; boreholes showing both complete and partial old workings, i.e. old workings Voids packed with a non-recoverable waste material and old workings leaving solid coal roof support and/or solid coal floor. The roof and/or floor coal was present, however, in such minor amounts that it has been ignored for purposes of quantities and 'partial' old workings have been treated as 'complete' old workings. The allowance for old workings has been arrived at as in 8.7.2. above

(b) Although no old workings were encountered in the Second Brown Metals seam in area C in the drilling, there is a possibility that it may be affected by old workings (See section 4.1.2.) ; to cover this contingency an empirical 5% allowance has been taken (see above section); The area affected by these old workings is shown on the Geological Plan 05/9517.

8.8 Volumes of Coal

8.8.1. The volumes of in-situ and recoverable coal are the products of their respective thicknesses (as determined in 8.2 and 8.3) and their respective working areas defined on plan, reduced, where appropriate, by a percentage deduction to allow for old workings (as determined in 8.7.2.)

8.9 Conversion Factor

8.9.1. The conversion factor used throughout is:-

$1m^3$ coal = 1.31 tons coal

8.10 Vertical Excavation Volumes

8.10.1 These have been calculated by planimetry measurements of depth isopachs, drawn on the three pavement seams, and checked independantly.

8.10.2 Overlap Volumes of seams have been allowed for by measurement of overlap areas combined with average seam partings, floor to floor, and cross-checked by a similar method involving different measurements.

8.11 Hard Rock

8.11.1. For the purpose of estimates hard rock is defined as sandstone, not described as soft or shaly, over 1.00m in thickness and at a depth greater than 5.00m.

8.11.2. The occurrence and thickness of sandstone units are shown on the Generalised Vertical Section Plan 05/9505.

8.11.3 Estimates of hard rock, based on borehole occurrences, have been made and given as percentages of the vertical excavation (See section 2.1.5.)

8.11.4 In areas A and B a nominal allowance of 2.5% has been made to cover the possible occurrence of sandstones undetected in drilling.

8.12 The provisional estimates on the above bases are as shown On the S.S.C.

8.13 Depths of Working

8.13.1 The maximum, minimum and average depths (in metres) are listed below to the nearest half-metre, the average depth being the Total Excavation Volume' (= Vertical Excavation Volume') divided by the Total Area.

Working Area	Maximum	Minimum	Average
A	14.5	3.0	8.5
B	6.0	2.0	3.5
C	39.0	4.5	18.5
D	16.5	9.0	13.5

9. PUBLIC SERVICES

9.1 The following public services are peripheral to the proposed coal working areas and the appropriate stand offs andbatters have been taken from them (sections 8.1.3. and 8.1.4):-

9.1.1. An underground electricity cable immediately to the West of coal area A.

9.1.2. An undeground N.E.G.B. 18" high pressure gas main immediately to the South of coal area B.

9.1.3. An overhead Y.E.B. 33kV electricity line to the West of coal area B.

9.1.4. An overhead C.E.G.B. 132 kV electricity line to the west of coal area C.

9.2. The following public services occur within the proposed site boundary or adjacent to it:-

9.2.1 A 20" diameter Wakefield and District Water Board water main occurs

within the site boundary in the extreme north west of the site.

9.2.2. (a) An 18" diameter N.E.G.B. high pressure underground gas main runs east to west to the north of area C and to the south of area B (from which the appropriate stand-off has been applied)

(b) A methane gas pipeline (N.E.G.B.) affects the extreme south east of the eastern part of the site.

(c) A disused gas main, running NW-SE, crosses the north east corner of coal area A.

9.2.3. (a) A 66kV C.E.G.B. overhead electricity line passes to the west of areas A and B.

(b) A 132kV C.E.G.B. overhead electricity line passes between the western and eastern areas of the site (from which the appropriate stand - off has been applied)

9.2.4. (a) Two 66kV Y.E.B. overhead electricity lines pass to the west of areas A and B.

(b) A 33kV Y.E.B. overhead electricity line passes to the west (from which the appropriate stand off has been applied) and south of coal area B, and continues south-eastwards to skirt the eastern part of the site.

(c) 11 Kv and Low Voltage overhead and underground Y.E.B. electricity lines occur to the south and west of coal area C.

9.2.5. G.P.O. (Dewsbury Exchange) overhead and underground telephone lines occur within coal area C.

9.2.6. (a) 9" and 10" diameter Mid Calder Water Board mains skirt the eastern 'boundary' of the eastern part of the site.

(b) A 6" Mid Calder W.B. Colliery supply main opproaches coal area C from the South.

9.3 Services in part comprising sections 9.2.4.(C) and 9.2.5 will need diversion.

10 POSSIBLE EXTENSIONS

Details of possible extensions is restricted to within the present site boundary.

10.1 High wall extensions are possible on areas A and D depending on old workings and other economic considerations. Inghams' pit shafts and old workings in the Second and First Brown Metals effectively confine area C to its present extent and electricity and gas services restrict area B.

10.2 Lateral (i.e. strike) extentions are possible eastwards of areas C and D at present limited by the upstanding tip.

10.3 Any extensions in depth, within the present coal working areas depend on old workings and other economic considerations and, due to the general thinness of the seams and their large seperation. Working of seams below the present pavement seams is considered unlikely.

11. REMARKS (including factors affecting stability

Attention is drawn to the following:-

11.1 Ground Slope

11.1.1. The western part of the site has gentle slopes nowhere exceeding 1 in 5.

11.1.2. The eastern part of the site lies on a steep, natural, north facing slope, with even steeper slopes loccally, on the flanks of terraces and mounds of superimposed spoil material (See section 1.2.2.)

11.2 Structural dips

11.2.1. Dips are usually gentle or moderate but can become steep locally on the flanks of small rolls (See section 2.3.)

11.3 Faults

11.3.1. Major faulting does not occur, although small scale faulting, undetected by drilling is not precluded, particularly associated with local steepening of dip.

11.4 Water

11.4.1 No water was encountered during drilling.

11.5 Made Ground

11.5.1. Thickness of made ground varies considerably from nil in the western part to 10m., assoicated with the terraces in the eastern part of the site.
(See section 2.2.)

11.6 Old Workings

11.6.1. Old workings in the Third and First Brown Metals seams affect small parts of areas A and C (See sections 4.1 and 8.7)
No cavities have been proved in these workings.

11.6.2. There is a probability that the Second Brown Metals seam in area C may also be worked but they are not proved by drilling.

11.6.3. One old shaft only (in the South of area C) is known to occur within the coal working areas but shafts are present within the site boundary. (for details of the shafts see section 5.2.5.)

Date: April 1973

E.J. Anderson

Regional Opencast Manager (Development)

NATIONAL COAL BOARD

OPENCAST EXECUTIVE

NO. 5(CENTRAL) REGION

BOREHOLE SCHEDULE

FOR

RAVENSTHORPE SITE

030240

A datum of 100m BCD has been used in this Schedule.

Abbreviations :-

B	Base depth & level
E	Easting
MUG	Made up Ground
N	Northing
OW	Old Workings
R	Rockhead Level
S	Surface Level
SHY	Shaly
SST	Sandstone
TRS	Coal Traces

Seam Coding :-

AK	Flockton Thick
AJ	Flockton Thin
1AH	Unnamed Seam
AH	1st Brown Metals
AG	2nd Brown Metals
AF	3rd Brown Metals
1AE	Unnamed Seam
AE	Middleton Little
1CD	Unnamed Seam
ACD	Thorncliffe
AB	Wheatley Lime

REGION CENTRAL PAGE
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
1	422607E	186.20S						
	419509N	185.45R				0.75	0.75	MU
		180.25	5.95	0.45	AG			
		163.78	22.42	0.72	AF			
		158.50	27.70	0.25	1AE			
		149.80				36.40	0.50	SO
		145.60	40.60	0.35	AE			
		129.00	57.20	0.70	ACD			
		121.50	64.70	0.70	AB			
		116.20B				70.00B		
2	422607E	186.20S						
	419509N	185.45R				0.75	0.75	MU
		180.27	5.93	*0.43	AG			
		180.19	6.01	*0.02	AG			
		180.04	6.16	*0.03	AG			
		163.98	22.22	*0.51	AF			
		163.78	22.42	*0.16	AF			
		158.52	27.68	*0.22	1AE			
		149.80				36.40	0.50	SO
		145.81	40.39	*0.16	AE			
		145.71	40.49	*0.10	O.W. AE			
		145.62	40.58	*0.09	AE			
		132.20	54.00	****	O.W.			
		132.20B				54.00B		
3	422621E	183.30S						
	419589N	179.30R				4.00	4.00	MU
		171.80				11.50	3.50	SS
		164.10	19.20	0.70	AF			
		158.10	25.20	0.20	1AE			
		146.90	36.40	0.90	AE			
		137.90				45.40	1.90	SS
		130.60	52.70	0.20	1CD			
		122.40	60.90	0.70	ACD			
		121.80B				61.50B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE		DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
4	422584E	182.40S							
	419604N	182.40R					0.0		
		180.40	2.00	0.50		AG			
		172.20					10.20	3.20	SS1
		164.10	18.30	0.70		AE			
		158.80	23.60	0.20		1AE			
		145.80	36.60	2.50	O.W.	AE			
		144.90B					37.50B		
5	422561E	182.60S							
	419563N	181.60R					1.00	1.00	MU
		180.40	2.20	0.20		AG			
		171.80					10.80	5.20	SS
		164.80	17.80	0.70		AE			
		158.80	23.80	0.20		1AE			
		146.30	36.30	0.50	O.W.	AE			
		145.80	36.80	0.50		AE			
		136.10					46.50	3.00	SO
		134.60B					48.00B		
6	422675E	182.90S							
	419584N	182.60R					0.30		
		174.70					8.20	1.30	SS
		165.30	17.60	0.60		AE			
		158.60	24.30	0.20		1AE			
		145.85	37.05	1.05		AE			
		128.82	54.08	0.18		1CD			
		117.20					65.70	2.70	SS
		112.90B					70.00B		
7	422669E	177.70S							
	419651N	177.40R					0.30		
		166.30	11.40	0.65		AE			
		159.66	18.04	0.24		1AE			

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
		146.20	31.50	1.40	O.W.AE		
		145.70B				32.00B	
8	422669E	177.70S					
	419651N	177.40R				0.30	
		166.44	11.26	*0.46	AF		
		166.31	11.39	*0.09	AF		
		159.69	18.01	*0.24	1AE		
		158.70B				19.00B	
9	422671E	171.60S					
	419705N	171.30R				0.30	
		168.25	3.35	0.65	AF		
		161.16	10.44	0.24	1AE		
		147.40	24.20	1.30	AE		
		139.10				32.50	4.00 SS
		132.60				39.00	4.30 SO
		131.10	40.50	0.90	O.W.ACD		
		123.40	48.20	0.70	AB		
		122.60B				49.00B	
10	422675E	162.80S					
	419761N	162.50R				0.30	
		157.80				5.00	2.70 SS
		148.60	14.20	1.00	O.W.AE		
		139.00				23.80	4.00 SS
		133.80				29.00	3.00 SS
		132.30				30.50	1.50 SO
		131.80	31.00	0.50	O.W.ACD		
		130.80B				32.00B	
11	422677E	157.90S					
	419808N	157.60R				0.30	
		149.50	8.40	3.10	O.W.AE		

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
		141.20				16.70	3.60 SST
		134.40				23.50	5.50 SST
		133.40	24.50	1.00	O.W.ACD		
		125.95	31.95	0.70	AB		
		125.40B				32.50B	
12	422717E	161.20S					
	419775N	160.90R				0.30	
		148.50	12.70	0.90	AE		
		139.70				21.50	3.40 SST
		133.20				28.00	4.20 SST
		132.00	29.20	0.70	ACD		
		124.50	36.70	0.70	AB		
		123.70B				37.50B	
13	422717E	161.20S					
	419775N	160.90R				0.30	
		149.40	11.80	*0.12	AE		
		149.05	12.15	*0.35	O.W.AE		
		148.94	12.26	*0.11	SLA AE		
		148.55	12.65	0.39	O.W.AE		
		148.50	12.70	*0.05	AE		
		139.70				21.50	3.40 SST
		133.20				28.00	4.20 SST
		132.20	29.00	1.00	O.W.		
		131.70B				29.50B	
14	422717E	166.10S					
	419740N	165.80R				0.30	
		161.70	4.40	0.16	1AE		
		147.80	18.30	1.10	AE		
		139.00				27.10	3.20 SST
		132.30				33.80	4.40 SST
		131.20	34.90	1.10	O.W.ACD		
		********B				********B	

REGION CENTRAL PAGE

SITE NAME & NO. RAVENSTHORPE 030240

COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	COAL SEAM THICKNESS	COAL SEAM CODE	DRIFT/SANDSTONE BASE DEPTH	DRIFT/SANDSTONE THICKNESS
15	422717E	166.10S					
	419740N	165.80R				0.30	
		161.93	4.17	*0.03	1AE		
		161.71	4.39	*0.15	1AE		
		161.10	5.00	0.01	O.W.		
		147.80	18.30	2.50	O.W.AE		
		147.10B				19.00B	
16	422722E	174.80S					
	419683N	174.50R				0.30	
		167.45	7.35	0.65	AE		
		160.32	14.48	0.18	1AE		
		146.80	28.00	1.10	AE		
		137.80				37.00	3.50 SS
		130.80				44.00	4.60 SS
		130.10	44.70	0.70	ACD		
		122.50	52.30	0.70	AB		
		121.80B				53.00B	
17	422716E	178.50S					
	419635N	178.20R				0.30	
		166.40	12.10	0.65	AE		
		159.30	19.20	0.20	1AE		
		146.10	32.40	1.90	O.W.AE		
		146.00	32.50	0.10	AE		
		145.50B				33.00B	
18	422722E	174.80S					
	419683N	174.50R				0.30	
		167.45	7.35	0.65	AE		
		160.30	14.50	0.20	1AE		
		147.22	27.58	*0.69	AE		
		147.19	27.61	*0.03	SHY AE		
		147.15	27.65	*0.01	SHY AE		

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		146.82	27.98	*0.33	AE			
		145.90B				28.90B		
19	422711E	182.60S						
	419590N	181.70R				0.30		
		180.50	1.50	0.50	AG			
		174.50				7.50	3.00	SST
		165.40	16.60	0.65	AF			
		164.50B				17.50B		
20	422758E	176.90S						
	419636N	176.60R				0.30		
		165.25	11.65	0.65	AF			
		164.40B				12.50B		
21	422750E	175.10S						
	419673N	174.80R				0.30		
		166.25	8.85	0.65	AF			
		165.60B				9.50B		
22	422563E	184.40S						
	419526N	181.40R				3.00	3.00	MUG
		181.20	3.20	0.20	AG			
		171.60				12.80	2.90	SST
		165.55	18.85	0.65	AF			
		164.90B				19.50B		
23	422612E	170.20S						
	419715N	169.90R				0.30		
		162.20	8.00	0.20	1AE			
		147.20	23.00	2.00	D.W.AE			

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	COAL SEAM THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	DRIFT/SANDSTONE THICKNESS
		146.70B				23.50B	
24	422568E	163.90S					
	419755N	163.60R				0.30	
		150.20	13.70	1.20	O.W.AE		
		149.40B				14.50B	
25	422612E	163.70S					
	419758N	163.40R				0.30	
		150.20	13.50	1.20	O.W.AE		
		149.70B				14.00B	
26	422648E	160.40S					
	419783N	160.10R				0.30	
		150.60	9.80	1.10	AE		
		149.90B				10.50B	
27	422648E	160.40S					
	419783N	160.10R				0.30	
		150.94	9.46	*0.72	AE		
		150.63	9.77	*0.26	AE		
		150.59	9.81	*0.04	SHY AE		
		150.20B				10.20B	
28	422532E	166.30S					
	419736N	165.70R				0.60	
		164.10	2.20	0.20	1AE		
		150.20	16.10	1.00	O.W.AE		
		149.90	16.40	0.30	AE		
		149.30B				17.00B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL - SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
29	422574E	171.40S					
	419701N	168.40R				3.00	3.00 MUG
		162.50	8.90	0.25	1AE		
		148.55	22.85	1.15	AE		
		147.90B				23.50B	
30	422574E	171.40S					
	419701N	168.40R				3.00	3.00 MUG
		162.50	8.90	*0.25	1AE		
		148.97	22.43	*0.73	AE		
		148.61	22.79	*0.29	AE		
		147.70B				23.70B	
31	422523E	173.20S					
	419686N	172.20R				1.00	
		162.37	10.83	0.23	1AE		
		148.80	24.40	1.40	D.W.AE		
		148.20B				25.00B	
32	422496E	173.00S					
	419648N	171.50R				1.50	1.50 MUG
		169.52	3.48	0.68	AE		
		162.37	10.63	0.23	1AE		
		149.00	24.00	1.20	AE		
		148.50B				24.50B	
33	422495E	174.00S					
	419593N	173.00R				1.00	1.00 MUG
		168.85	5.15	0.65	AE		
		161.88	12.12	0.22	1AE		
		148.80	25.20	2.20	D.W.AE		

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		148.00B				26.00B	
34	422516E 419547N	178.90S 178.30R				0.60	0.60 MUG
		167.10	11.80	1.80	O.W.AE		
		166.40B				12.50B	
35	422460E 419602N	168.50S 167.50R				1.00	1.00 MUG
		163.26	5.24	0.24	1AE		
		149.70	18.80	1.10	AE		
		149.00B				19.50B	
36	422441E 419559N	167.60S 166.60R				1.00	1.00 MUG
		164.86	2.74	0.24	1AE		
		155.25	12.35	0.35	O.W.AE		
		154.60B				13.00B	
37	422402E 419575N	164.10S 163.10R				1.00	1.00 MUG
		154.30	9.80	2.00	O.W.AE		
		153.60B				10.50B	
38	422423E 419588N	163.30S 161.30R				2.00	2.00 MUG
		151.80	11.50	1.50	O.W.AE		
		151.30B				12.00B	

REGION			CENTRAL				030240		
SITE NAME & NO.			RAVENSTHORPE				DRIFT/SANDSTONE		
			COAL SEAM						
BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
39	422419E	161.10S							
	419645N	160.00R					1.10	1.10	MUG
		152.65	8.45	0.40	O.W.	AE			
		152.10B					9.00B		
40	422452E	165.20S							
	419685N	163.20R					2.00	2.00	MUG
		151.00	14.20	1.70	O.W.	AE			
		150.20B					15.00B		
41	422649E	165.90S							
	419740N	165.60R					0.30		
		162.90	3.00	0.20		1AE			
		148.65	17.25	2.15	O.W.	AE			
		147.90B					18.00B		
42	422650E	172.20S							
	419698N	171.90R					0.30		
		168.05	4.15	0.65		AE			
		167.20B					5.00B		
43	422593E	166.60S							
	419739N	166.30R					0.30		
		164.90	1.70	0.20		1AE			
		150.90	15.70	1.14	O.W.	AE			
		150.10B					16.50B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
44	422624E 419670N	175.50S 175.20R				0.30		
		167.35	8.15	0.65	AF			
		166.50B				9.00B		
45	422600E 419554N	184.60S 180.60R				4.00	4.00	MUG
		178.85	5.75	*0.07	TRS			
		178.73	5.87	*0.02	TRS			
		178.58	6.02	*0.15	SHY AG			
		178.19	6.41	*0.05	SHY AG			
		177.86	6.74	*0.05	SHY AG			
		175.37				9.23	0.47	SOF
		173.82				10.78	0.58	SOF
		172.27				12.33	0.49	SST
		171.40				13.20	0.87	SOF
		171.17				13.43	0.23	BKN
		163.63	20.97	*0.51	AF			
		163.43	21.17	*0.14	AF			
		162.50B				22.10B		
46	422788E 419624N	176.70S 176.40R				0.30		
		164.55	12.15	0.65	AF			
		163.70B				13.00B		
47	422788E 419624N	176.70S 176.40R				0.30		
		164.70	12.00	4.50	O.W.AF			
		164.20B				12.50B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
48	422829E	171.90S					
	419640N	171.60R				0.30	
		163.00	8.90	0.65	AF		
		156.40	15.50	0.20	1AE		
		143.60	28.30	1.10	AE		
		142.50B				29.00B	
49	422829E	171.90S					
	419640N	171.60R				0.30	
		163.42	8.48	*0.23	AF		
		163.15	8.75	*0.26	AF		
		162.99	8.91	*0.10	AF		
		162.40B				9.50B	
50	422871E	166.80S					
	419659N	166.50R				0.30	
		163.80	3.00	0.65	AF		
		156.60	10.20	0.20	1AE		
		147.00				19.80	1.70 SST
		142.68	24.12	1.00	AE		
		141.80B				25.00B	
51	422871E	166.80S					
	419659N	166.50R				0.30	
		163.80	3.00	0.65	AF		
		156.60	10.20	0.20	1AE		
		147.00				19.80	1.70 SST
		143.66	23.14	0.05	D.W.AE		
		143.04	23.76	*0.62	AE		
		142.68	24.12	*0.33	AE		
		142.20B				24.60B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	COAL SEAM THICKNESS	COAL SEAM CODE	DRIFT/SANDSTONE BASE DEPTH	DRIFT/SANDSTONE THICKNESS	
52	422849E	166.01S						
	419682N	165.71R				0.30	0.30	MU(
		163.66	2.35	0.65	AE			
		157.11	8.90	0.20	1AE			
		145.91				20.10	3.10	SS'
		142.91	23.10	1.10	AE			
		142.01B				24.00B		
53	422869E	161.00S						
	419720N	160.00R				1.00	1.00	MU(
		157.70	3.30	0.20	1AE			
		146.10				14.90	1.90	SS1
		143.40	17.60	1.10	AE			
		142.50B				18.50B		
54	422629E	184.70S						
	419551N	183.70R				1.00	1.00	MU(
		180.44	4.26	0.46	AG			
		165.70				19.00	10.50	SS1
		164.25	20.45	0.65	AF			
		163.70B				21.00B		
55	422587E	186.50S						
	419509N	185.50R				1.00	1.00	MU(
		183.40				3.10	0.60	SOF
		181.35	5.15	0.45	AG			
		165.65	20.85	0.65	AF			
		165.00B				21.50B		
56	424075E	188.76S						
	418940N	188.46R				0.30	0.30	MU(

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
		174.66	14.10	1.60	O.W.AJ			
		173.76B				15.00B		
57	4241615	186.48S						
	418965N	185.48R				1.00	1.00	MUG
		171.98				14.50	9.30	SHY
		171.18	15.30	0.60	AJ			
		170.78	15.70	0.20	AJ			
		145.28	41.20	0.70	AH			
		136.48				50.00	6.00	SST
		136.48B				50.00B		
58	4242395	182.26S						
	419014N	178.76R				3.50	3.50	MUG
		166.66				15.60	4.60	SST
		165.86	16.40	0.80	AJ			
		165.46	16.80	0.10	AJ			
		151.76	30.50	0.90				
		151.16	31.10	0.40				
		147.16	35.10	0.60				
		137.26				45.00	4.00	SST
		134.26	48.00	1.50	O.W.AH			
		127.26B				55.00B		
59	4238535	167.19S						
	419053N	165.19R				2.00	2.00	MUG
		160.79	6.40	0.80	AH			
		157.99				9.20	2.20	SST
		153.79	13.40	0.30	AG			
		140.59	26.60	0.60	AF			
		135.59	31.60	0.10	1AE			
		116.19B				51.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
60	423793E 419043N	167.69S						
		165.69R				2.00	2.00	MUD
		162.89	4.80	0.35	AG			
		156.69				11.00	1.80	SST
		149.04	18.65	0.65	AF			
		144.89	22.80	0.10	1AE			
		137.69B				30.00B		
61	423794E 419043N	167.69S						
		165.69R				2.00	2.00	MUD
		162.90	4.79	*0.33	AG			
		156.69				11.00	1.80	SST
		149.05	18.64	*0.66	AF			
		144.89	22.80	*0.10	1AE			
		139.69B				28.00B		
62	423805E 418986N	175.24S						
		171.24R				4.00	4.00	MUD
		161.44	13.80	0.80	AH			
		154.79	20.45	0.35	AG			
		154.44	20.80	0.10	AG			
		142.04	33.20	0.60	AF			
		140.24B				35.00B		
63	423868E 418962N	175.65S						
		174.65R				1.00	1.00	MUD
		170.65				5.00	0.50	SST
		166.75				8.90	3.90	SHY
		166.45	9.20	0.30	1AH			
		162.10	13.55	1.05	AH			
		161.76	13.89	0.23	AH			
		161.50	14.15	0.15	AH			
		159.05				16.60	2.00	SST
		154.79	20.86	0.51	AG			

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		154.35	21.30	0.14	AG			
		154.15	21.50	0.15	SHY AG			
		150.65				25.00	3.00	SST
		141.20	34.45	0.65	AF			
		140.65B				35.00B		
64	423869E	175.65S						
	418962N	174.65R				1.00	1.00	MUG
		170.72				4.93	0.52	SST
		170.67	4.98	*0.05	1AH			
		170.63				5.02	0.04	SST
		170.29				5.36	0.30	SST
		170.11	5.54	*0.08	SHY 1AH			
		169.95				5.70	0.16	SST
		169.92	5.73	*0.03	1AH			
		169.56				6.09	0.28	SST
		169.51	6.14	*0.05	1AH			
		169.12				6.53	0.39	SST
		169.01	6.64	*0.11	1AH			
		168.92				6.73	0.09	SST
		168.75	6.90	*0.17	1AH			
		168.12				7.53	0.53	SOF
		167.75	7.90	*0.37	1AH			
		167.32	8.33	*0.39	1AH			
		167.22				8.43	0.07	SOF
		166.92				8.73	0.30	SST
		166.84	8.81	*0.08	1AH			
		166.77	8.88	*0.06	1AH			
		166.38	9.27	*0.36	1AH			
		163.09	12.56	*0.06	SHY AH			
		162.26	13.39	*0.83	AH			
		162.10	13.55	*0.13	AH			
		161.76	13.89	*0.23	SHY AH			
		161.50	14.15	*0.15	AH			
		159.05				16.60	2.00	SST
		154.89	20.76	*0.41	AG			
		154.79	20.86	*0.04	SHY AG			
		154.58	21.07	*0.03	SHY AG			
		154.34	21.31	*0.14	AG			
		154.15	21.50	*0.14	SHY AG			
		154.04	21.61	*0.06	AG			
		153.15				22.50	0.54	SST
		153.15B				22.50B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
65	423969E	177.193						
	418974N	176.19B				1.00	1.00	MU
		163.39				13.80	0.80	SS
		162.79	14.40	0.60	1AH			
		161.84				15.35	0.95	SS
		161.34	15.85	0.50	1AH			
		156.74	20.45	0.65	AH			
		154.29	22.90	1.00	AH			
		146.54	30.25	0.35	AG			
		146.04	31.15	0.15	AG			
		132.19	45.00	0.90	AF			
		131.19B				46.00B		
66	424111E	179.41S						
	419017N	174.41R				5.00		
		169.41				10.00	0.50	SOF
		169.01				10.40	0.40	SST
		167.66	11.75	0.95	AJ			
		167.26	12.15	0.15	AJ			
		156.06	23.35	0.20				
		155.46	23.95	0.60	TRS			
		152.86	26.55	2.60	SHY 1AH			
		152.41				27.00	0.45	SST
		151.86	27.55	0.55	1AH			
		147.41	32.00	0.85	AH			
		146.36	33.05	0.70	AH			
		129.41B				50.00B		
67	424112E	179.41S						
	419017N	174.41R				5.00	5.00	MUG
		169.13				10.28	0.78	SOF
		167.77	11.64	*0.84	AJ			
		167.66	11.75	*0.06	AJ			
		167.26	12.15	*0.13	AJ			
		156.03	23.38	*0.22				
		155.93				23.48	0.10	SST
		155.82	23.59	*0.08	SHY			

REGION CENTRAL
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COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		155.63				23.78	0.19 SST
		155.51	23.90	*0.12			
		155.45				23.96	0.06 SST
		155.08	24.33	*0.37	1AH		
		154.44	24.97	*0.60	1AH		
		154.14	25.27	*0.25	1AH		
		153.71	25.70	*0.38	1AH		
		152.86	26.55	*0.47	1AH		
		151.85	27.56	*0.58	1AH		
		148.22	31.19	*0.03			
		147.40	32.01	*0.80	AH		
		147.14	32.27	*0.06	AH		
		146.35	33.06	*0.70	AH		
		145.61B				33.80B	
68	424186E	180.46S					
	419053N	170.26R				10.20	10.20 MUC
		164.66	15.80	0.60	AJ		
		164.26	16.20	0.10	AJ		
		142.26	38.20	0.90	1AH		
		141.46	39.00	0.40	1AH		
		136.66	43.80	0.60	AH		
		130.46B				50.00B	
69	423927E	168.89S					
	419054N	166.89R				2.00	2.00 MUC
		153.69	15.20	0.80	AH		
		149.69				19.20	2.20 SST
		146.04	22.85	0.35	AG		
		145.19	23.70	0.10	AG		
		131.89	37.00	0.60	AF		
		130.89B				38.00B	
70	423854E	167.19S					
	419052N	165.19R				2.00	2.00 MU
		162.27				4.92	0.92 SO
		161.55	5.64	0.72	O.W.		

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		160.71	6.48	*0.84	AH		
		160.53	6.66	*0.05	AH		
		157.99				9.20	2.20 SST
		153.67	13.52	*0.41	AG		
		153.50	13.69	*0.04	AG		
		153.36	13.83	*0.04	AG		
		153.16	14.03	*0.15	AG		
		152.77	14.42	*0.35	SHY AG		
		140.54	26.65	*0.66	AF		
		139.19B				28.00B	
71	423862E	174.85S					
	418996N	170.85R				4.00	4.00 MUG
		164.85				10.00	4.00 SST
		160.25	14.60	0.90	AH		
		159.60	15.25	0.15	AH		
		157.65				17.20	1.20 SST
		153.40	21.45	0.35	AG		
		152.85	22.00	0.10	AG		
		140.60	34.25	0.65	AF		
		139.85B				35.00B	
72	423860E	186.09S					
	418918N	178.59R				7.50	7.50 MUG
		175.09				11.00	1.00 SST
		166.29	19.80	0.30	TRS 1AH		
		161.99	24.10	1.10	AH		
		155.44	30.65	0.45	AG		
		154.94	31.15	0.15	AG		
		154.09B				32.00B	
73	423856E	186.45S					
	418891N	184.45R				2.00	2.00 MUG
		175.45				11.00	1.00 SST
		174.15				12.30	1.30 SOFT
		160.55	25.90	0.90	AH		
		154.20	32.25	0.35	AG		

REGION
SITE NAME & NO.

CENTRAL
RAVENSTHORPE
COAL - SEAM

030240
DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	COAL BASE DEPTH	COAL THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	DRIFT/SANDSTONE THICKNESS	
		153.75	32.70	0.10	AG			
		141.25	45.20	0.60	AF			
		140.45B				46.00B		
74	424033E	201.11S				2.50	2.50	MUG
	41886N	198.61R						
		197.71	3.40	0.20	AK			
		191.91				9.20	5.20	SST
		186.11				15.00	1.10	SST
		179.11	22.00	2.50	O.W.AJ			
		151.11B				50.00B		
75	424088E	202.34S				1.00	1.00	MUC
	41886N	201.34R						
		195.44	6.90	0.40	AK			
		193.94				8.40	0.90	SST
		177.74	24.60	0.60	AJ			
		177.14	25.20	0.40	AJ			
		168.34B				34.00B		
76	424089E	202.34S				1.00	1.00	MUC
	41886N	201.34R						
		195.44	6.90	*0.41	AK			
		195.14	7.20	*0.05	AK			
		179.13				23.21	0.21	SS
		177.10	25.24	*1.10	O.W.AJ			
		176.97	25.37	*0.13	O.W.AJ			
		147.44	54.90	0.70	AH			
		146.34B				56.00B		
77	424142E	202.26S				2.00	2.00	MU
	41890N	200.26R						
		191.96	10.30	0.40	AK			
		190.26				12.00	1.20	SS

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
		173.76	28.50	1.20	D.W.AJ			
		173.26B				29.00B		
78	423857E	195.16S						
	418848N	194.86R				0.30		
		190.31				4.85	4.55	SO
		188.81	6.35	0.80	AJ			
		188.41	6.75	0.25	AJ			
		160.21	34.85	1.10	AH			
		158.76				36.40	0.40	SS
		154.86	40.30	0.35	AG			
		154.16B				41.00B		
79	423858E	195.16S						
	418848N	194.86R				0.30		
		190.56				4.60	4.30	SO
		190.32				4.84	0.24	SO
		189.56	5.60	*0.05	SHY AJ			
		188.85	6.31	*0.71	AJ			
		188.76	6.40	*0.07	AJ			
		188.58	6.59	*0.03	SHY AJ			
		188.36	6.80	*0.22	AJ			
		160.94	34.22	0.49	D.W.AH			
		158.52	36.64	*0.42	D.W.AH			
		154.85	40.31	*0.34	AG			
		153.66B				41.50B		
80	424211E	184.04S						
	418983N	183.74R				0.30	0.30	MUD
		169.04				15.00	0.80	SST
		166.99	17.05	0.85	AJ			
		166.59	17.45	0.10	AJ			
		155.34				28.70	2.70	SST
		154.84	29.20	0.50				
		154.64	29.40	0.10				
		154.44				29.60	0.20	SST
		153.84	30.20	0.60	1AH			

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		149.74	34.30	0.70	1AH		
		145.59	38.45	0.05			
		140.04				44.00	1.80 SST
		136.04	48.00	0.50	AH		
		135.14	48.90	0.60	AH		
		130.04B				54.00B	
81	424212E	184.04S					
	418983N	183.74B				0.30	0.30 MUG
		169.04				15.00	0.80 SST
		167.78	16.26	*0.05	SHY AJ		
		167.09	16.95	*0.69	AJ		
		166.99	17.05	*0.07	AJ		
		166.61	17.43	*0.10	AJ		
		155.31				28.73	0.73 SST
		154.84	29.20	*0.47			
		154.66	29.38	*0.10			
		154.43				29.61	0.23 SST
		153.85	30.19	*0.58	1AH		
		150.35	33.69	*0.04	SHY		
		149.66	34.38	*0.69	1AH		
		149.46	34.58	*0.07	SHY 1AH		
		148.69	35.35	*0.06	SHY 1AH		
		145.79	38.25	*0.07			
		140.04				44.00	1.80 SST
		135.42	48.62	0.98	O.W.AH		
		134.04B				50.00B	
82	424349E	186.57S					
	419054N	183.57B				3.00	3.00 MU
		177.07				9.50	1.10 SS
		163.37				23.20	1.70 SS
		158.57	28.00	0.80	AJ		
		150.57				36.00	0.60 SS
		146.87	39.70	0.70	1AH		
		144.57	42.00	1.50	TRS		
		140.97	45.60	0.60	1AH		
		133.97				52.60	1.10 SS
		130.87	55.70	1.20	O.W.AH		
		130.57B				56.00B	

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
83	424443E	195.21S					
	419061N	194.91R				0.30	
		192.61	2.60	0.10	1AL		
		190.81	4.40	0.70	AL		
		186.11				9.10	2.10 SST
		173.81	21.40	0.40	AK		
		173.31	21.90	0.30	AK		
		171.91	23.30	0.40	AK		
		157.81				37.40	1.40 SST
		152.61	42.60	0.80	AJ		
		150.21B				45.00B	
84	424499E	194.26S					
	419099N	193.96R				0.30	
		189.96	4.30	0.10	1AL		
		188.21	6.05	0.65	AL		
		183.66				10.60	2.60 SST
		171.46	22.30	0.50	AK		
		171.06	23.20	0.25	AK		
		169.51	24.75	0.40	AK		
		152.26				42.00	1.20 SST
		149.96	44.30	0.85	AJ		
		149.56	44.70	0.15	AJ		
		148.76B				45.50B	
85	424500E	194.26S					
	419099N	193.96R				0.30	
		189.96	4.30	0.10	1AL		
		188.17	6.09	*0.66	AL		
		183.66				10.60	2.60 SST
		171.47	22.79	*0.49	CAN AK		
		171.08	23.18	*0.23	AK		
		169.53	24.73	*0.39	AK		
		150.04	44.22	*0.77	AJ		
		149.95	44.31	*0.06	AJ		
		149.71	44.55	*0.03	AJ		
		149.51	44.75	*0.19	AJ		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	COAL SEAM THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	DRIFT/SANDSTONE THICKNESS	
		148.96B				45.30B		
86	424444E	181.26S						
	419137N	181.06R				0.30		
		175.36	6.00	5.70	O.W.AK			
		174.06	7.30	0.40	AK			
		172.76				8.60	0.60	SST
		156.66				24.70	2.20	SST
		155.36	26.00	0.60	AJ			
		154.81	26.55	0.15	AJ			
		141.36				40.00	1.00	SST
		133.36				48.00	5.00	SST
		128.86	52.50	1.00	O.W.AH			
		127.46	53.90	0.40	AH			
		122.56	58.80	0.40	AG			
		121.36B				60.00B		
87	424397E	183.61S						
	419086N	183.41R				0.20		
		175.66	7.95	0.45	AK			
		174.21				9.30	0.60	SST
		162.81				20.80	0.80	SST
		156.81	26.80	0.80	O.W.AJ			
		156.46	27.15	0.15	AJ			
		142.51				41.10	0.90	SST
		134.41				49.20	5.20	SST
		130.21	53.40	0.90	O.W.AH			
		128.81	54.80	0.40	AH			
		123.71	59.90	0.40	AG			
		121.61B				62.00B		
88	423867E	217.30S						
	418719N	217.00R				0.30		
		208.30	9.00	0.40	AK			
		207.90	9.40	0.25	AK			
		206.70	10.60	0.40	AK			
		199.80				17.50	6.30	SST

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		188.10	29.20	0.50	AJ			
		187.70	29.60	0.35	AJ			
		186.30B				31.00B		
89	423864E	208.32S						
	418778N	208.02R				0.30		
		204.07	4.25	0.55	AK			
		199.52				8.80	4.00	SST
		183.82	24.50	1.00	D.W.AJ			
		183.47	24.85	0.15	AJ			
		182.32B				26.00B		
90	423739E	167.90S						
	419060N	166.90R				1.00	1.00	MUG
		150.75	17.15	0.65	AE			
		146.30	21.60	0.10	1AE			
		140.50				27.40	3.40	SST
		137.90B				30.00B		
91	423695E	170.23S						
	419038N	169.23R				1.00	1.00	MUG
		152.28	17.95	0.65	AE			
		147.63	22.60	0.10	1AE			
		142.23				28.00	3.00	SST
		136.43				33.80	2.80	SST
		131.23	39.00	1.50	D.W.AE			
		130.23B				40.00B		
92	423696E	170.23S						
	419038N	169.23R				1.00	1.00	MUG
		152.44	17.79	*0.47	AE			
		152.25	17.98	*0.14	AE			
		150.93B				19.30B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
93	423723E	173.16G				1.20	1.20 MUG
	419000N	171.96R					
		165.56	7.60	0.40	AG		
		151.41	21.75	0.65	AF		
		146.36	26.80	0.10	1AE		
		141.16				32.00	2.90 SST
		135.36				37.80	2.50 SST
		130.16	43.00	1.30	O.W.AE		
		129.16B				44.00B	
94	423645E	174.40S					
	418999N	173.20R				1.20	1.20 MUG
		166.80	7.60	0.40	AG		
		162.70				11.70	0.20 SST
		152.55	21.45	0.65	AF		
		148.30	26.10	0.10	1AE		
		142.30				32.10	3.10 SST
		136.40				38.00	3.00 SST
		131.40	43.00	2.00	O.W.AE		
		130.40B				44.00B	
95	423671E	177.82S					
	418967N	175.32R				2.50	2.50 MUG
		174.62	3.20	0.70	AH		
		167.62	10.20	0.45	AG		
		153.47	24.35	0.65	AF		
		148.62	29.20	0.15	1AE		
		142.72				35.10	2.10 SST
		137.32				40.50	2.50 SST
		132.22	45.60	1.60	O.W.AE		
		131.32B				46.50B	
96	423672E	177.82S					
	418967N	175.47R				2.35	2.35 MU

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
		174.62	3.20	0.85	AH			
		167.67	10.15	*0.38	AG			
		166.91	10.91	*0.08	SHY AG			
		153.65	24.17	*0.47	AF			
		153.45	24.37	*0.17	AF			
		148.58	29.24	*0.18	1AE			
		147.82B				30.00B		
97	423737E	177.45S						
	418942N	176.45R				1.00	1.00	MUC
		171.65				5.80	1.80	SST
		166.55	10.90	0.70	1AH			
		163.95	13.50	0.90	AH			
		160.95				16.50	2.40	SST
		157.35	20.10	0.40	AG			
		144.20	33.25	0.65	AF			
		139.65	37.80	0.10	1AE			
		134.55				42.90	2.90	SST
		129.45				48.00	2.10	SST
		123.25	54.20	1.20	O.W.AE			
		122.45B				55.00B		
98	423779E	185.07S						
	418914N	180.07R				5.00	5.00	MUC
		176.07				9.00	4.00	SHY
		161.07	24.00	0.20	AH			
		160.07	25.00	1.00	O.W.AH			
		159.92	25.15	0.15	AH			
		157.97				27.10	1.10	SST
		154.37	30.70	0.40	AG			
		142.42	42.65	0.65	AF			
		141.57B				43.50B		
99	423668E	184.85S						
	418916N	179.75R				5.10	5.10	MUC
		173.35				11.50	5.00	SST
		167.45	17.40	0.40	AH			

REGION CENTRAL
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BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
		161.20	23.65	0.45	AG		
		150.20	34.65	0.65	AF		
		148.85B				36.00B	
100	423733E	184.11S					
	418908N	183.91R				0.20	
		162.06	22.05	0.05	AH		
		160.66	23.45	1.40	O.W.AH		
		160.56	23.55	0.10	AH		
		154.16	29.95	0.45	AG		
		142.46	41.65	0.65	AF		
		141.61B				42.50B	
101	423668E	171.79S					
	419027N	169.79R				2.00	2.00 MU
		152.54	19.25	0.65	AF		
		151.79B				20.00B	
102	423741E	169.12S					
	419033N	168.72R				0.40	0.40 MU
		164.56	4.56	0.36	AG		
		149.72	19.40	0.60	AF		
		148.62B				20.50B	
103	423740E	169.12S					
	419033N	168.72R				0.40	0.40 MU
		164.58	4.54	*0.36	AG		
		164.42	4.70	*0.04	SHY		
		164.12	5.00	*0.10	SHY		
		164.12B				5.00B	

REGION CENTRAL
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COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
104	423786E	165.07S							
	419081N	164.07R					1.00	1.00	MUG
		149.57	15.50	0.60	SHY	AF			
		148.57B					16.50B		
105	423789E	165.07S							
	419081N	164.07R					1.00	1.00	MUG
		149.76	15.31	*0.40		AF			
		149.07B					16.00B		
106	423819E	163.77S							
	419114N	161.37R					2.40	2.40	MUG
		149.17	14.60	0.60		AF			
		148.27B					15.50B		
107	423827E	164.26S							
	419080N	163.71R					0.65	0.65	MUG
		148.26	16.10	0.60		AF			
		147.36B					17.00B		
108	423874E	163.46S							
	419108N	162.81R					0.65	******	MUG
		151.26	12.20	0.40		AG			
		136.96	26.50	0.65		AF			
		135.96B					27.50B		
109	423902E	165.57S							
	419083N	164.37R					1.20	1.20	MUG

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		158.42	7.15	0.05	1AH			
		156.07	9.50	1.00	AH			
		152.57				13.00	1.10	SST
		148.07	17.50	0.40	AG			
		134.22	31.35	0.65	AF			
		133.57B				32.00B		
110	423971E	170.94S						
	419036N	168.44R				2.50	2.50	MUC
		161.94				9.00	1.50	SST
		152.14	18.80	0.80	AH			
		148.44				22.50	1.70	SST
		144.34	26.60	0.40	AG			
		143.84	27.10	0.10	AG			
		142.14				28.80	1.00	SST
		130.39	40.55	0.75	AF			
		129.44B				41.50B		
111	423970S	170.94S						
	419036N	168.44R				2.50	2.50	MUC
		161.94				9.00	1.50	SST
		152.90	18.04	*0.03	SHY AH			
		152.14	18.80	*0.76	AH			
		151.95	18.99	*0.03	SHY AH			
		148.44				22.50	1.70	SST
		144.35	26.59	*0.40	AG			
		144.23	26.71	*0.04				
		144.07	26.87	*0.04	AG			
		143.84	27.10	*0.12	AG			
		142.84				28.10	0.20	SST
		130.57	40.37	*0.57	AF			
		130.39	40.55	*0.14	AF			
		128.94				42.00	0.45	SST
		128.94B				42.00B		
112	424005S	171.32S						
	419044N	169.82R				1.50	1.50	MUC

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		151.02	20.30	0.80	AH			
		147.32				24.00	1.60	SST
		143.12	28.20	0.40	AG			
		142.62	28.70	0.10	AG			
		140.82				30.50	1.00	SST
		129.17	42.15	0.75	AF			
		128.32B				43.00B		
113	423985E	169.72S						
	419081N	165.52R				4.20	4.20	MUD
		157.22				12.50	0.60	SST
		151.72	18.00	0.80	AH			
		147.72				22.00	1.60	SST
		144.02	25.70	0.40	AG			
		143.57	26.15	0.10	AG			
		141.87				27.85	0.85	SST
		129.87	39.85	0.75	AF			
		129.22B				40.50B		
114	423950E	160.90S						
	419156N	160.70R				0.20		
		151.90				9.00	1.00	SST
		148.00	12.90	0.40	AG			
		147.55	13.35	0.10	AG			
		145.20				15.70	1.70	SST
		134.90	26.00	0.70	AF			
		133.90B				27.00B		
115	423894E	158.26S						
	419182N	158.06R				0.20		
		141.41	16.85	0.70	AF			
		140.26B				18.00B		

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
116	423912E	161.23S						
	419139N	161.03R				0.20		
		152.73				8.50	1.50	SST
		148.98	12.25	0.40	AG			
		148.53	12.70	0.15	AG			
		146.13				15.10	1.60	SST
		135.73	25.50	0.70	AF			
		134.73B				26.50B		
117	423944E	163.31S						
	419118N	163.11R				0.20		
		150.31				13.00	2.00	SST
		146.21	17.10	0.40	AG			
		145.76	17.55	0.15	AG			
		144.31				19.00	0.75	SST
		133.61	29.70	0.70	AF			
		132.81B				30.50B		
118	423943E	163.31S						
	419118N	163.11R				0.20		
		150.31				13.00	2.00	SST
		146.21	17.10	*0.40	AG			
		146.11	17.20	*0.05	SHY			
		145.78	17.53	*0.14	SHY AG			
		144.81*				18.50	0.27	SST
		144.31				19.00	0.50	SST
		133.78	29.53	*0.54	AF			
		133.62	29.69	*0.10	AF			
		133.01B				30.30B		
119	423960E	171.70S						
	419002N	169.20R				2.50	2.50	MU
		162.20				9.50	1.10	SST
		160.20	11.50	0.60	IAH			

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	COAL BASE DEPTH	COAL THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	DRIFT/SANDSTONE THICKNESS	
		157.90	13.80	0.40	1AH			
		153.60	18.10	0.70	AH			
		150.40				21.30	1.30	SST
		146.10	25.60	0.40	AG			
		145.70	26.00	0.10	AG			
		143.90				27.80	0.80	SST
		131.40	40.30	0.70	AF			
		130.70B				41.00B		
120	423926E	171.70S						
	418996N	171.40R				0.30	0.30	MUG
		160.30	11.40	1.50	AH			
		159.70	12.00	0.30	AH			
		154.10				17.60	1.00	SST
		150.10	21.60	0.40	AG			
		149.60	22.10	0.10	AG			
		136.20	35.50	0.70	AF			
		135.20B				36.50B		
121	423905E	171.07S						
	419016N	169.07R				2.00	2.00	MUG
		161.07				10.00	0.50	SST
		156.82	14.25	0.75	AH			
		155.12				15.95	0.45	SST
		150.67	20.40	0.40	AG			
		150.17	20.90	0.10	AG			
		148.67				22.40	0.90	SST
		136.52	34.55	0.75	AF			
		135.57B				35.50B		
122	423814E	170.90S						
	419021N	168.90R				2.00	2.00	MUG
		159.30	11.60	0.80	AH			
		156.30				14.60	1.50	SST
		152.20	18.70	0.40	AG			
		151.70	19.20	0.10	AG			
		150.40				20.50	1.00	SST

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
		139.00	31.90	0.70	AF			
		137.90B				33.00B		
123	423946E	169.80S						
	419028N	167.80R				2.00	2.00	MU
		160.60	9.20	0.70	AH			
		158.10				11.70	1.70	SS
		153.90	15.90	0.40	AG			
		153.30	16.50	0.10	AG			
		140.80	29.00	0.70	AF			
		139.80B				30.00B		
124	423760E	174.44S						
	418989N	171.94R				2.50	2.50	MU
		168.64	5.80	0.10	AH			
		167.24				7.20	0.70	SS
		163.04	11.40	0.40	AG			
		162.34	12.10	0.10	AG			
		159.84				14.60	1.80	SS
		149.34	25.10	0.70	AF			
		148.44B				26.00B		
125	423688E	173.45S						
	419007N	172.25R				1.20	1.20	MU
		166.35	7.10	0.40	AG			
		165.75	7.70	0.10	AG			
		152.65	20.80	0.70	AF			
		151.95B				21.50B		
126	423769E	177.46S						
	418954N	175.96R				1.50	1.50	MU
		166.46				11.00	3.60	SS
		163.26	14.20	1.70	AH			
		162.56	14.90	0.20	AH			

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		161.26				16.20	0.70	SST
		156.46	21.00	0.40	AG			
		155.66	21.60	0.10	AG			
		153.46				24.00	1.75	SST
		142.51	34.95	0.75	AF			
		141.46B				36.00B		
127	423794E	178.28S						
	418948N	174.58R				3.70	3.70	MUC
		170.78				7.50	0.58	BKM
		168.04				10.24	0.35	SST
		167.00				11.28	0.25	SST
		166.67				11.61	0.19	SST
		165.83				12.45	0.08	SST
		164.08	14.20	*0.03	SHY			
		163.97	14.31	*0.02	SHY			
		162.87	15.41	*0.02	SHY			
		162.58	15.70	*0.15	AH			
		161.82	16.46	*0.76	AH			
		161.35	16.93	*0.12	SHY AH			
		159.87				18.41	0.89	SST
		159.14				19.14	0.17	BKM
		158.70				19.58	0.17	SST
		156.47				21.81	0.16	BKM
		154.55	23.73	*0.23	SHY AG			
		152.01				26.27	0.21	SST
		142.67	35.61	*0.54	AF			
		142.58B				35.70B		
128	423704E	181.77S						
	418920N	179.47R				2.30	2.30	MUC
		175.87				5.90	2.00	SST
		168.17	13.60	0.80	AH			
		164.17				17.60	1.10	SST
		161.47	20.30	0.40	AG			
		160.97	20.80	0.10	AG			
		158.97				22.80	1.25	SST
		147.47	34.30	0.70	AF			
		146.77B				35.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
129	423825E	185.82S						
	418910N	180.32B				5.50	5.50	MUC
		178.52				7.30	1.80	SST
		173.82				12.00	2.20	SST
		162.62	23.20	0.80	AH			
		161.17	24.65	0.35	AH			
		159.82				26.00	0.60	SST
		154.92	30.90	0.40	AG			
		154.42	31.40	0.10	AG			
		152.57				33.25	1.25	SST
		141.12	44.70	0.70	AF			
		140.32B				45.50B		
130	423901E	184.52S						
	418927N	179.02B				5.50	5.50	MUC
		174.62				9.90	0.90	SST
		170.12	14.40	0.60	1AH			
		166.12	18.40	0.70	1AH			
		160.82	23.70	0.70	AH			
		157.52				27.00	1.70	SST
		154.42	30.10	0.40	AG			
		153.92	30.60	0.10	AG			
		151.12				33.40	1.80	SST
		140.42	44.10	0.60	AF			
		139.52B				45.00B		
131	423902E	184.52S						
	418927N	179.02B				5.50	5.50	MU
		174.62				9.90	0.90	SST
		170.72				13.80	0.44	BK
		170.14	14.38	*0.58	1AH			
		166.09	18.43	*0.75	1AH			
		160.69	23.83	*0.82	AH			
		160.62	23.90	*0.07	CAN AH			
		160.55	23.97	*0.03	SHY AH			
		159.95	24.57	*0.15	SHY AH			
		157.52				27.00	1.70	SS

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		154.44	30.08	*0.39	AG			
		153.83	30.69	*0.12	AG			
		140.35	44.17	*0.65	AF			
		139.42B				45.10B		
132	423928E	176.80S						
	418952N	175.80R				1.00	1.00	MUC
		166.70	10.10	0.75	1AH			
		166.30				10.50	0.40	SST
		165.70	11.10	0.60	1AH			
		160.90	15.90	0.90	AH			
		157.90	18.90	1.10	AH			
		152.50	24.30	0.40	AG			
		151.90	24.90	0.10	AG			
		148.70				28.10	2.10	SST
		138.65	38.15	0.65	AF			
		137.80B				39.00B		
133	424016E	175.86S						
	419016N	173.21R				2.65	2.65	MUC
		167.69				8.17	0.17	SOI
		160.58				15.28	1.28	SST
		159.88				15.98	0.63	SST
		159.78	16.08	*0.10	1AH			
		159.74				16.12	0.04	SST
		158.86	17.00	*0.38	1AH			
		158.82	17.04	0.04	1AH			
		158.53	17.33	*0.29	1AH			
		158.43	17.43	*0.06	1AH			
		157.91	17.95	*0.20	1AH			
		157.35	18.51	*0.51	1AH			
		156.79	19.07	0.56	TRS			
		152.89	22.97	*0.59	AH			
		152.86	23.00	0.03	AH			
		152.78	23.08	*0.08	AH			
		152.62	23.24	*0.05	AH			
		152.33				23.53	0.09	SS
		150.39				25.47	0.30	SST
		149.36				26.50	0.69	BK
		149.09				26.77	0.27	SO

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
		148.67				27.19	0.42	SST
		145.51	30.35	*0.40	AG			
		144.60	31.26	*0.11	AG			
		144.39	31.47	*0.15	SHY AG			
		144.30	31.56	*0.07	SHY AG			
		140.86				35.00	2.21	SST
		139.95				35.91	0.23	SST
		130.63	45.23	*0.56	AF			
		130.48	45.38	*0.12	AF			
		130.06B				45.80B		
134	423961E	171.70S						
	419002N	169.20R				2.50	2.50	MUD
		162.20				9.50	1.10	SST
		160.80				10.90	0.40	BKD
		160.63	11.07	*0.17	SHY 1AH			
		160.23	11.47	*0.40	1AH			
		160.10	11.60	*0.11	1AH			
		158.33				13.37	1.60	BK
		158.20				13.50	0.13	SST
		157.72	13.98	*0.48	1AH			
		156.48				15.22	0.11	SST
		155.90B				15.80B		
135	424062E	177.86S						
	419015N	171.86R				6.00	6.00	MUD
		160.21	17.65	0.65	1AH			
		159.56				18.30	0.65	SST
		158.86	19.00	0.70	1AH			
		157.16	20.70	0.70	1AH			
		152.56	25.30	0.80	1AH			
		150.36	27.50	0.60	AH			
		146.06				31.80	2.80	SST
		142.46	35.40	0.40	AG			
		141.86	36.00	0.10	AG			
		139.86				38.00	1.00	SST
		128.56	49.30	0.70	AF			
		127.86B				50.00B		

REGION CENTRAL
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BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
136	424169E 419011N	180.76S 176.76R				4.00	4.00	MUC
		170.26				10.50	1.00	SST
		169.36	11.40	0.90	AJ			
		168.26B				12.50B		
137	4242155 419042N	181.34S 175.34R				6.00	6.00	MUC
		163.94				17.40	0.20	SST
		163.04	18.30	0.90	AJ			
		161.84B				19.50B		
138	424216E 419042N	181.34S 175.34R				6.00	6.00	MUC
		163.95				17.39	0.21	SOF
		163.15	18.19	*0.80	AJ			
		163.06	18.28	*0.07	AJ			
		162.84B				18.50B		
139	424290E 419021N	186.88S 181.38R				5.50	5.50	MUC
		177.38				9.50	3.50	SST
		163.18	23.70	0.70	D.W.AJ			
		163.08	23.80	0.10	AJ			
		150.28	36.60	0.40	1AH			
		149.33	37.55	0.65	1AH			
		145.88	41.00	0.50	AG			
		142.88B				44.00B		
140	4242215 419073N	181.74S 170.74R				11.00	11.00	MUC

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
		164.24	17.50	1.00	AJ			
		163.24B				18.50B		
141	424193E	181.26S						
	419091N	167.26R				14.00	14.00	MU(
		141.26	40.00	0.80	AH			
		140.96	40.30	0.10	AH			
		140.26B				41.00B		
142	424146E	180.36S						
	419070N	169.36R				11.00	11.00	MU(
		143.06	37.30	0.80	AH			
		142.76	37.60	0.10	AH			
		141.86B				38.50B		
143	424299E	190.93S						
	418992N	190.73R				0.20		
		180.93	10.00	0.50	AK			
		179.93				11.00	0.80	SS'
		165.43				25.50	5.40	SS'
		144.43	46.50	0.70	AJ			
		142.93B				48.00B		
144	424273E	191.88S						
	418978N	191.68R				0.20		
		182.78	9.10	0.30	CAN AK			
		181.43	10.45	0.45	AK			
		163.18	28.70	0.50	AJ			
		147.68	44.20	0.40	AH			
		144.53	47.35	0.55	AG			
		143.88B				48.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
145	4241478	180.36S						
	419070N	169.36R				11.00	11.00	MUC
		143.85	36.51	*0.02	SHY AH			
		143.11	37.25	*C.74	AH			
		141.06				39.30	0.60	SS
		135.96	44.40	0.40	AG			
		135.26	45.10	0.10	AG			
		132.96				47.40	1.40	BKI
		132.36B				48.00B		
146	4242028	180.72S						
	419064N	170.62R				10.10	10.10	MU
		164.32	16.40	0.90	AJ			
		163.97	16.75	0.15	AJ			
		149.72				31.00	1.00	SS
		142.22				38.50	0.80	SS
		134.97	45.75	0.75				
		133.22				47.50	1.00	SS
		124.02	56.70	0.40				
		108.72				72.00	0.50	BK
		108.02				72.70	0.70	SS
		107.77	72.95	0.25	O.W.AE			
		106.72B				74.00B		
147	4241418	179.88S						
	419042N	171.88R				8.00	8.00	MU
		166.88	13.00	0.80	AJ			
		137.78	42.10	0.60	AH			
		136.88B				43.00B		
148	4241188	179.71S						
	419064N	169.21R				10.50	10.50	MU
		144.06	35.65	0.65	AH			
		143.21B				36.50B		

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
149	4239295E	176.80S						
	4189521	175.70R				1.10	1.10	MU
		167.39	9.41	*0.05	1AH			
		167.22	9.58	*0.15	1AH			
		166.85	9.95	*0.28	1AH			
		166.37				10.43	0.48	BK
		165.77	11.03	*0.60	1AH			
		161.93	14.87	*0.37	AH			
		161.32				15.48	0.20	SH
		160.51	16.29	*0.37	AH			
		159.79	17.01	*0.15	AH			
		152.48	24.32	*0.45	AG			
		152.14	24.66	*0.03	AG			
		151.89	24.91	*0.15	SHY AG			
		151.69	25.11	*0.12	SHY AG			
		151.54	25.26	*0.12	SHY AG			
		148.70				28.10	2.10	SS
		138.61	38.19	*0.68	AF			
		137.60B				39.20B		
150	4240639E	177.86S						
	4190159N	171.86R				6.00	6.00	MU
		160.24	17.62	*0.58	1AH			
		160.16	17.70	*0.07	SHY 1AH			
		159.76				18.10	0.40	SS
		159.66	18.20	*0.10	1AH			
		159.58				18.28	0.08	SS
		159.55	18.31	*0.03	SHY 1AH			
		159.02	18.84	*0.53	1AH			
		158.71	19.15	*0.12	1AH			
		158.38				19.48	0.27	SS
		158.30	19.56	*0.03	1AH			
		158.10				19.76	0.20	SS
		157.99	19.87	*0.11	SHY 1AH			
		157.46	20.40	*0.53	1AH			
		157.04	20.82	*0.37	1AH			
		153.50	24.36	*0.05	SHY 1AH			
		153.36	24.50	*0.14	1AH			
		152.56	25.30	*0.78	1AH			
		152.36	25.50	*0.05	1AH			

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
		150.38	27.48	*0.62		AH			
		149.78	28.08	*0.11	SHY	AH			
		146.21					31.65	2.65	SS
		142.33	35.53	*0.49		AG			
		141.68	36.18	*0.13		AG			
		139.66					38.20	1.20	SS
		128.65	49.21	*0.67		AF			
		127.86B					50.00B		
151	4238128	170.88S							
	419022N	168.48R					2.40	2.40	MU
		161.73	9.15	0.85		AH			
		159.18					11.70	1.10	SS
		154.88	16.00	0.40		AG			
		154.33	16.55	0.10		AG			
		143.03	27.85	0.65		AF			
		141.88B					29.00B		
152	4238138	170.88S							
	419022N	168.48R					2.40	2.40	MU
		162.48	8.40	*0.08	SHY	AH			
		161.74	9.14	*0.74		AH			
		159.18					11.70	1.10	SS
		154.91	15.97	*0.36		AG			
		154.89	15.99	*0.02	SHY	AG			
		154.87	16.01	*0.02		AG			
		154.32	16.56	*0.12		AG			
		143.22	27.66	*0.47		AF			
		143.06	27.82	*0.11		AF			
		141.98B					28.90B		
153	4237758	171.77S							
	419012N	170.27R					1.50	1.50	MU
		164.27					7.50	1.30	SS
		160.77	11.00	0.40		AG			
		160.22	11.55	0.10		AG			
		148.92	22.85	0.65		AF			

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
		147.77B					24.00B		
154	423734E 418908N	184.85S 184.65B					0.20		
		161.35	23.50	1.50	D.h.	AH	28.61	0.11	SST
		156.24							
		154.96	29.89	*0.39		AG			
		154.43	30.42	*0.13	SHY	AG			
		143.39	41.46	*0.45		AF			
		143.22	41.63	*0.16		AF			
		142.05B					42.80B		
155	423768E 418886N	187.58S 187.38B					0.20		
		168.58					19.00	3.00	SST
		164.43	23.15	0.75		AH	27.00	1.50	SST
		160.58							
		156.58	31.00	0.40		AG			
		156.01	31.57	0.12		AG			
		144.53	43.05	0.65		AF			
		143.58B					44.00B		
156	423798E 418883N	189.21S 185.71B					3.50	3.50	MUG
		182.71					6.50	1.00	SST
		172.71					16.50	2.50	SST
		170.61					18.60	1.10	SST
		165.16	24.05	0.75		AH	27.90	1.70	SST
		161.31							
		157.01	32.20	0.40		AG			
		156.49	32.72	0.12		AG			
		144.16	45.05	0.65		AF			
		143.21B					46.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
157	423894E	190.22S						
	418875N	187.72R				2.50	2.50	MU
		159.22	31.00	0.40	AH			
		158.77	31.45	C.05	AH			
		153.82	36.40	0.40	AG			
		153.22	37.00	0.10	AG			
		151.32				38.90	1.10	SS
		140.57	49.65	0.65	AF			
		139.72B				50.50B		
158	423959E	194.70S						
	418865N	192.90R				1.80	1.80	MU
		185.20	9.50	0.80	AJ			
		184.80	9.90	0.10	AJ			
		183.70B				11.00B		
159	424CC6E	199.96S						
	418872N	192.76R				7.20	7.20	MU
		189.96				10.00	1.25	SO
		189.10				10.86	0.86	SC
		188.53				11.43	0.57	BK
		187.32				12.64	0.90	SS
		185.06				14.90	1.60	BK
		183.80				16.16	0.20	SS
		182.28	17.68	0.74	O.W.AJ			
		182.22	17.74	0.06	O.W.AJ			
		182.00	17.96	*0.22	AJ			
		181.96B				18.00B		
160	4238633	174.84S						
	418996N	170.84R				4.00	4.00	MU
		165.17				9.67	3.67	SS
		164.54	10.30	*0.63	1AH			
		161.14	13.70	*0.05	SHY AH			

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
		161.04	13.80	*0.10		AH			
		161.01	13.93	*0.03	CAN	AH			
		160.37	14.47	*0.64		AH			
		159.71	15.13	*0.21		AH			
		157.64					17.20	1.20	SST
		153.36	21.48	*0.33	SHY	AG			
		152.53	22.31	*0.28		AG			
		140.65	34.19	*0.64		AF			
		139.84B					35.00B		
161	4239795E	159.23S							
	4191760N	143.98R					15.25		
		134.49	24.75	0.65		AF			
		133.23B					26.00B		
162	4240068E	160.06S							
	4191760N	158.86R					1.20	1.20	MU
		144.06	16.00	0.40		AG			
		132.71	27.35	0.65		AF			
		132.06B					28.00B		
163	4238275E	175.34S							
	4189591N	174.54R					0.80	0.80	MU
		165.69	9.65	0.15		1AH			
		161.84	13.50	0.80		AH			
		157.94					17.40	2.40	SS
		155.34	20.00	0.40		AG			
		154.74	20.60	0.10		AG			
		152.84					22.50	1.20	SS
		142.19	33.15	0.65		AF			
		141.34B					34.00B		
164	4241175E	202.19S							
	4188959N	195.69R					6.50	6.50	MU

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
169	422963E	178.95S					
	419452N	178.65R				0.30	
		174.05	4.90	0.40	AG		
		159.50	19.45	0.65	AF		
		153.45	25.50	0.15	IAF		
		152.95B				26.00B	
170	422948E	178.66S					
	419496N	178.36R				0.30	
		177.96				0.70	0.40 SST
		175.21	3.45	0.45	AG		
		174.01	4.65	0.15	AG		
		160.11	18.55	0.65	AF		
		159.16B				19.50B	
171	422932E	174.53S					
	419538N	174.23R				0.30	
		160.38	14.15	0.65	AF		
		159.53B				15.00B	
172	422996E	176.48S					
	419512N	176.18R				0.30	
		174.28	2.20	0.40	AG		
		168.98				7.50	4.00 SST
		159.13	17.35	0.65	AF		
		158.48B				18.00B	
173	423010E	176.18S					
	419470N	175.88R				0.30	
		172.68	3.50	0.50	AG		
		167.53				8.65	3.65 SST

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE		DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		157.68	18.50	0.65		AF			
		156.68B					19.50B		
174	423010E	176.18S							
	419470N	175.88R					0.30		
		172.68	3.50	0.50		AG			
		167.53					8.65	3.65	SST
		157.67	18.51	*0.65		AF			
		156.68B					19.50B		
175	422997E	176.77S							
	419436N	176.47R					0.30		
		172.17	4.60	0.60		AG			
		167.57					9.20	3.60	SST
		157.57	19.20	0.65		AF			
		156.77B					20.00B		
176	422949E	178.66S							
	419496N	178.36R					0.30		
		177.96					0.70	0.40	SOF
		174.98	3.68	1.08		AG			
		174.24	4.42	*0.04		AG			
		174.05	4.61	*0.15	SHY	AG			
		160.28	18.38	0.48		AF			
		160.07	18.59	0.16		AF			
		159.16B					19.50B		
177	423047E	174.32S							
	419447N	174.02R					0.30		
		171.67	2.65	0.45		AG			
		156.42	17.90	0.60		AF			
		155.32B					19.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
178	423037E 419488N	174.44S 174.14R				0.30	
		172.34	2.10	0.35	AG		
		156.89	17.55	0.60	AF		
		155.94B				18.50B	
179	423038E 419488N	174.44S 174.14R				0.30	
		172.35	2.09	*0.36	AG		
		157.10	17.34	*0.40	AF		
		156.89	17.55	*0.14	AF		
		156.09B				18.35B	
180	423028E 419530N	173.25S 172.95R				0.30	
		172.40	0.85	0.30	AG		
		169.25				4.00	2.00 SS
		159.20	14.05	0.60	AF		
		152.75	20.50	0.15	1AE		
		141.65				31.60	6.60 SS
		138.35	34.90	0.80	AE		
		137.25B				36.00B	
181	423096E 419431N	170.14S 169.84R				0.30	
		156.14	14.00	0.60	AF		
		155.14B				15.00B	
182	423097E 419457N	170.66S 170.36R				0.30	
		169.66	1.00	0.40	AG		

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
		166.96				3.70	1.95 SST
		155.01	15.65	0.65	AF		
		154.16B				16.50B	
183	423114E	168.73S					
	419484N	168.43R				0.30	
		166.03				2.70	1.20 SST
		154.63	14.10	0.70	AF		
		153.73B				15.00B	
184	423115E	168.73S					
	419484N	168.43R				0.30	
		166.03				2.70	1.20 SST
		154.83	13.90	*0.49	AF		
		154.65	14.08	*0.15	AF		
		153.73B				15.00B	
185	423090E	170.24S					
	419507N	169.94R				0.30	
		168.84	1.40	0.40	AG		
		166.44				3.80	1.20 SST
		155.39	14.85	0.65	AF		
		154.24B				16.00B	
186	423092E	167.60S					
	419534N	167.30R				0.30	
		156.50	11.10	0.60	AF		
		155.60B				12.00B	
187	423125E	166.59S					
	419508N	166.29R				0.30	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		154.29	12.30	0.60	AF		
		153.09B				13.50B	
							0.30
188	423137E	166.48S					
	419470N	166.18R					
		154.28	12.20	0.60	AF		
		153.48B				13.00B	
							0.30
189	423144E	165.72S					
	419445N	165.42R					
		155.77	9.95	0.60	AF		
		154.72B				11.00B	
							0.30
190	423178E	162.59S					
	419431N	162.29R					
		152.09	10.50	0.15	IAE		
		150.59B				12.00B	
							0.30
191	423166E	163.20S					
	419464N	162.90R					
		155.65	7.55	0.60	AF		
		154.70B				8.50B	
							0.30
192	423167E	163.20S					
	419464N	162.90R					
		155.79	7.41	*0.46	AF		
		155.63	7.57	*0.12	AF		
		154.80B				8.40B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE		DRIFT/SANDSTONE BASE DEPTH	THICKNESS
193	423157E 419486N	163.85S 163.55R					0.30	
		154.80	9.05	0.60		AF		
		153.85B					10.00B	
194	423150E 419528N	162.21S 161.91R					0.30	
		154.26	7.95	0.65		AF		
		153.21B					9.00B	
195	423151E 419528N	162.21S 161.91R					0.30	
		154.40	7.81	*0.52		AF		
		154.29	7.92	*0.10	SHY	AF		
		153.61B					8.60B	
196	422926E 419432N	180.54S 180.24R					0.30	
		176.14	4.40	0.45		AG		
		174.99	5.55	0.15	SHY	AG		
		161.24	19.30	0.60		AF		
		160.54B					20.00B	
197	422927E 419432N	180.54S 180.24R					0.30	
		176.19	4.35	*0.40		AG		
		176.14	4.40	*0.03	SHY	AG		
		175.01	5.53	*0.23	SHY	AG		
		161.40	19.14	*0.44		AF		
		161.24	19.30	*0.13		AF		
		160.94B					19.60B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE		DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
198	422910E 419473N	179.90S 179.60R					0.30		
		176.50	3.40	0.40		AG			
		175.35	4.55	0.15	SHY	AG			
		161.90	18.00	0.60		AF			
		160.90B					19.00B		
199	422855E 419508N	177.86S 177.56R					0.30		
		175.46	2.40	0.40		AG			
		174.01	3.85	0.15	SHY	AG			
		160.86	17.00	0.60		AF			
		159.86B					18.00B		
200	422882E 419544N	175.95S 175.65R					0.30		
		161.85	14.10	0.65		AF			
		160.95B					15.00B		
201	422883E 419544N	175.95S 175.65R					0.30		
		161.83	14.12	0.65	O.W.	AF			
		160.95B					15.00B		
202	422867E 419587N	173.03S 172.73R					0.30		
		170.28					2.75	0.75	SST
		161.53	11.50	0.60		AF			
		160.53B					12.50B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
203	422854E	170.49S							
	419628N	170.19R					0.30		
		162.59	7.90	0.50	O.W.	AF			
		161.49B					9.00B		
204	422809E	174.74S							
	419627N	174.44R					0.30		
		172.94					1.80	0.70	SST
		164.04	10.70	0.40		AF			
		163.24B					11.50B		
205	422810E	174.74S							
	419627N	174.44R					0.30		
		172.94					1.80	0.70	SST
		164.10	10.64	*0.28		AF			
		163.98	10.76	*0.09		AF			
		163.24B					11.50B		
206	422825E	176.52S							
	419587N	176.22R					0.30		
		172.62					3.90	0.60	SST
		163.57	12.95	0.60		AF			
		162.52B					14.00B		
207	422835E	178.14S							
	419553N	177.84R					0.30		
		176.64	1.50	0.40		AG			
		161.69	16.45	0.60		AF			
		161.14B					17.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE		DRIFT/SANDSTONE BASE DEPTH	THICKNESS
208	422854E 419506N	179.85S 179.55R					0.30	
		177.05	2.80	0.40		AG		
		175.95	3.90	0.20	SHY	AG		
		162.05	17.80	0.60		AF		
		161.35B					18.50B	
209	422868E 419464N	180.51S 180.21R					0.30	
		176.46	4.05	0.40		AG		
		161.86	18.65	0.55		AF		
		161.01B					19.50B	
210	422869E 419464N	180.51S 180.21R					0.30	
		175.73	4.78	*0.18		AG		
		161.84	18.67	*0.55		AF		
		161.10B					19.41B	
211	422882E 419423N	181.66S 181.36R					0.30	
		177.36	4.30	0.40		AG		
		176.01	5.65	0.15	SHY	AG		
		162.96	18.70	0.60		AF		
		162.16B					19.50B	
212	422859E 419391N	182.30S 182.00R					0.30	
		178.30					4.00	1.30 SST
		176.70	5.60	0.45		AG		
		176.50	5.80	0.10	SHY	AG		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS
		175.75	6.55	0.15	SHY	AG		
		162.15	20.15	0.60		AF		
		161.30B					21.00B	
213	422860E	182.30S						
	419391N	182.00R					0.30	
							4.00	1.30 SST
		178.30						
		176.72	5.58	*0.45		AG		
		176.53	5.77	*0.07	SHY	AG		
		175.74	6.56	*0.14	SHY	AG		
		162.18	20.12	*0.58		AF		
		161.88B					20.42B	
214	422845E	182.19S						
	419434N	181.89R					0.30	
		176.94	5.25	0.45		AG		
		175.84	6.35	0.15	SHY	AG		
		162.34	19.85	0.60		AF		
		161.69B					20.50B	
215	422833E	181.23S						
	419478N	180.93R					0.30	
		176.78	4.45	0.45		AG		
		175.58	5.65	0.15	SHY	AG		
		162.03	19.20	0.60		AF		
		161.23B					20.00B	
216	422820E	180.51S						
	419518N	180.21R					0.30	
		177.06	3.45	0.45		AG		
		175.66	4.85	0.15	SHY	AG		
		162.41	18.10	0.65		AF		
		161.51B					19.00B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS
217	422801E	179.88S						
	419556N	179.58R					0.30	
		178.83	1.05	0.45		AG		
		177.73	2.15	0.15	SHY	AG		
		163.33	16.55	0.70		AF		
		162.38B					17.50B	
218	422802E	179.88S						
	419556N	179.58R					0.30	
		178.83	1.05	0.45		AG		
		177.73	2.15	0.15	SHY	AG		
		163.54	16.34	*0.51		AF		
		163.34	16.54	*0.15		AF		
		162.98B					16.90B	
219	422783E	178.46S						
	419596N	178.16R					0.30	
		164.21	14.25	0.65		AF		
		163.46B					15.00B	
220	422819E	183.46S						
	419410N	183.16R					0.30	
		176.81	6.65	0.45		AG		
		175.81	7.65	0.15	SHY	AG		
		161.86	21.60	0.60		AF		
		160.96B					22.50B	
221	422814E	182.61S						
	419452N	182.31R					0.30	
		178.01					4.60	0.50 SOF
		177.71	4.90	0.30		AG		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
		177.21	5.40	0.35		AG			
		175.46	7.15	0.15	SHY	AG			
		161.71	20.90	0.55		AF			
		160.61B					22.00B		
222	4228195	182.61S							
	419452N	182.31R					0.30		
		178.00					4.61	0.51	SST
		177.89	4.72	*0.11		AG			
		177.70	4.91	*0.13		AG			
		177.65	4.96	*0.05	SHY				
		177.56					5.05	0.09	SST
		177.14	5.47	*0.35		AG			
		175.46	7.15	0.15	SHY	AG			
		161.86	20.75	*0.43		AF			
		161.72	20.89	*0.10		AF			
		161.11B					21.50B		
223	4227935	182.47S							
	419489N	182.17R					0.30		
		176.77	5.70	0.40		AG			
		175.82	6.65	0.15	SHY	AG			
		159.97	22.50	0.60		AF			
		158.97B					23.50B		
224	4227715	182.37S							
	419528N	182.07R					0.30		
		179.97	2.40	0.40		AG			
		178.52	3.85	0.15	SHY	AG			
		164.97	17.40	0.60		AF			
		164.37B					18.00B		
225	4227525	181.25S							
	419568N	180.95R					0.30		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
		179.90	1.35	0.45		AG			
		178.70	2.55	0.15	SHY	AG			
		164.30	16.95	0.55		AF			
		163.25B					18.00B		
226	422728E	183.35S							
	419534N	183.05R					0.30		
		181.20	2.15	0.35		AG			
		180.15	3.20	0.15	SHY	AG			
		165.30	18.05	0.50		AF			
		164.35B					19.00B		
227	422729E	183.35S							
	419534N	183.05R					0.30		
		181.20	2.15	0.35		AG			
		180.15	3.20	0.15	SHY	AG			
		165.32	18.03	*0.52		AF			
		164.85B					18.50B		
228	422750E	184.43S							
	419489N	184.13R					0.30		
		179.68	4.75	0.45		AG			
		178.43	6.00	0.10	SHY	AG			
		164.23	20.20	0.60		AF			
		163.43B					21.00B		
229	422687E	184.33S							
	419520N	184.03R					0.30		
		181.13					3.20	0.40	SST
		178.73	5.60	0.50		AG			
		177.38	6.95	0.15	SHY	AG			
		176.23					8.10	0.60	SST
		163.48	20.85	0.60		AF			
		162.33B					22.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE		DRIFT/SANDSTONE BASE DEPTH	THICKNESS
230	422707E 419477N	186.44S 186.14R					0.30	
		179.69	6.75	0.40		AG		
		178.49	7.95	0.10	SHY	AG		
		173.54	12.90	0.90		AF		
		164.29	22.15	0.60		AF		
		163.44B					23.00B	
231	422708E 419477N	186.44S 186.14R					0.30	
		179.72	6.72	*0.38		AG		
		179.44	7.00	*0.06		AG		
		178.52	7.92	*0.08	SHY	AG		
		173.54					12.90	0.90 SST
		164.50	21.94	*0.41		AF		
		164.31	22.13	*0.13		AF		
		163.94B					22.50B	
232	422866E 419560N	175.67S 175.37R					0.30	
		161.97	13.70	0.60		AF		
		161.17B					14.50B	
233	422849E 419600N	173.50S 173.20R					0.30	
		162.35	11.15	0.60		AF		
		161.50B					12.00B	
234	422883E 419614N	169.07S 168.77R					0.30	
		163.22	5.85	0.60		AF		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		162.07B				7.00B		
235	422898E	172.67S						
	419568N	172.57R				0.30		
		161.27	11.60	0.60	AF			
		160.37B				12.50B		
236	422864E	182.13S						
	419420N	181.83R				0.30		
		179.53				2.60	0.45	SOF
		177.77				4.36	0.36	SST
		176.90	5.23	*0.41	AG			
		175.67	6.46	*0.04				
		175.31	6.82	*0.07	SHY AG			
		165.45				16.68	0.08	FE
		162.46	19.67	*0.45	AF			
		162.31	19.82	*0.10	AF			
		161.13B				21.00B		
237	422949E	169.73S						
	419572N	169.43R				0.30		
		161.53	8.20	0.60	AF			
		160.73B				9.00B		
238	423003E	168.88S						
	419567N	168.58R				0.30		
		160.78	8.10	0.60	AF			
		159.88B				9.00B		
239	423004E	168.88S						
	419567N	168.58R				0.30		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
		160.82	8.06	*0.56	AF		
		160.18B				8.70B	
240	423058E	168.05S					
	419554N	167.75R				0.30	
		158.85	9.20	0.60	AF		
		158.05B				10.00B	
241	423136E	159.54S					
	419571N	159.24R				0.30	
		155.94	3.60	0.60	AF		
		148.69	10.85	0.15	IAE		
		148.04B				11.50B	
242	423093E	152.58S					
	419648N	152.28R				0.30	
		142.08				10.50	4.50 SST
		137.88	14.70	1.70	D.W.AE		
		137.08B				15.50B	
243	423192E	149.08S					
	419639N	148.78R				0.30	
		137.68				11.40	3.30 SST
		133.48	15.60	1.10	AE		
		133.08B				16.00B	
244	423204E	151.91S					
	419582N	151.61R				0.30	
		146.41	5.50	0.20	IAE		
		135.91				16.00	3.40 SST
		132.61	19.30	1.00	AE		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		131.91B				20.00B	
245	423205E	151.91S					
	419582N	151.61R				0.30	
		146.41	5.50	0.20	1AE		
		135.91				16.00	3.40 SST
		132.88	19.03	*0.66	SHY AE		
		122.76	19.15	0.12	O.W. AE		
		131.91B				20.00B	
246	423026E	163.97S					
	419591N	163.67R				0.30	
		160.97	3.00	0.60	AE		
		153.07	10.90	0.20	1AE		
		152.47B				11.50B	
247	422978E	162.86S					
	419608N	162.56R				0.30	
		161.36	1.50	0.60	AE		
		153.46	9.40	0.20	1AE		
		152.86B				10.00B	
248	423009E	154.83S					
	419650N	154.53R				0.30	
		143.13				11.70	4.20 SST
		139.23	15.60	1.10	O.W.AE		
		138.83B				16.00B	
249	422923E	158.67S					
	419672N	158.37R				0.30	
		155.87	2.80	0.20	1AE		

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		155.17B				3.50B	
250	422963E 419719N	152.66S 152.36B				0.30	
		144.56				8.10	3.40 SST
		141.26	11.40	1.90	O.W.AE		
		140.66B				12.00B	
251	423277E 419640N	147.40S 147.10B				0.30	
		135.90				11.50	3.90 SST
		132.90	14.50	3.00	O.W.AE		
		132.40B				15.00B	
252	423303E 419608N	148.80S 148.50B				0.30	
		136.30				12.50	1.30 SST
		132.80	16.00	3.50	O.W.AE		
		132.30B				16.50B	
253	423237E 419458N	157.58S 157.28B				0.30	
		150.53	7.05	0.15	1AE		
		138.98				18.60	4.10 SST
		134.58	23.00	1.10	AE		
		134.43	23.15	0.05	AE		
		133.58B				24.00B	
254	423238E 419458N	157.58S 157.28B				0.30	
		150.53	7.05	0.15	1AE		

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
		138.98				18.60	4.10 SST
		134.64	22.94	*1.05	AE		
		134.45	23.13	*0.07	AE		
		133.58				24.00	0.31 SST
		133.58B				24.00B	
255	422183E	159.76S					
	419498N	159.46R				0.30	
		156.11	3.65	0.55	AF		
		149.01	10.75	0.15	1AE		
		148.26B				11.50B	
256	424076E	184.21S					
	418979N	183.91R				0.30	
		170.86				13.35	5.35 SST
		170.11	14.10	0.75	AJ		
		157.41	26.80	0.30	TRS		
		156.31				27.90	1.10 SST
		155.81	28.40	0.50	1AH		
		151.91	32.30	0.80	AH		
		151.21B				33.00B	
257	424128E	180.14S					
	418994N	177.64R				2.50	2.50 MUG
		170.84	9.30	0.80	AJ		
		170.14B				10.00B	
258	424243E	182.33S					
	419050N	173.33R				9.00	9.00 MUG
		160.23	22.10	0.80	AJ		
		153.58	28.75	0.35	1AH		
		153.23				29.10	0.35 SST
		152.73	29.60	0.50	SHY 1AH		
		151.83B				30.50B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS	
259	424115E 418944N	187.73S 187.53R				0.20		
		175.63				12.10	2.60	SST
		174.83	12.90	0.80	AJ			
		174.38	13.35	0.25	AJ			
		173.73B				14.00B		
260	423960E 418932N	184.42S 182.42R				2.00	2.00	MUG
		178.82				5.60	3.60	SOF
		178.02	6.40	0.80	AJ			
		177.57	6.85	0.30	AJ			
		176.92B				7.50B		
261	424020E 418948N	184.92S 181.92R				3.00	3.00	MUG
		176.92				8.00	2.00	SHY
		174.22	10.70	0.80	AJ			
		173.82	11.10	0.20	AJ			
		172.92B				12.00B		
262	424021E 418948N	184.92S 181.92R				3.00	3.00	MUG
		176.92				8.00	2.00	SHY
		174.20	10.72	*0.82	AJ			
		173.81	11.11	*0.18	AJ			
		173.71	11.21	*0.04				
		172.92B				12.00B		
263	424161E 419058N	180.05S 170.55R				9.50	9.50	MUG

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		167.25	12.80	0.80	AJ			
		166.80	13.25	0.25	AJ			
		144.65				35.40	2.80	SST
		142.05	38.00	0.80	AH			
		141.75	38.30	0.10	AH			
		141.05B				39.00B		
264	423831E	174.93S						
	418997N	171.43R				3.50	3.50	MUG
		167.73				7.20	2.20	SOF
		160.93	14.00	0.80	AH			
		155.93				19.00	1.90	SST
		154.53	20.40	0.40	AG			
		153.93	21.00	0.10	AG			
		151.93				23.00	1.30	SST
		141.88	33.05	0.85	AF			
		140.93B				34.00B		
265	424296E	188.01S						
	419057N	176.01R				12.00	12.00	MUG
		164.71				23.30	4.30	SST
		163.81	24.20	0.90	D.W.AJ			
		163.01B				25.00B		
266	423634E	169.12S						
	419048N	162.12R				7.00		
		153.32	15.80	0.60	AF			
		152.62B				16.50B		
267	423675E	166.27S						
	419066N	159.27R				7.00		
		152.22	14.05	0.60	AF			
		147.67	18.60	0.15	1AE			
		136.27				30.00	2.30	SST

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
		136.27B				30.00B	
268	423676E	166.27S					
	419066N	159.27B				7.00	
		152.38	13.89	*0.46	AF		
		152.21	14.06	*0.13	AF		
		147.64	18.63	*0.16	IAF		
		147.27B				19.00B	
269	423714E	163.78S					
	419093N	158.28B				5.50	
		151.13	12.65	0.65	AF		
		150.28B				13.50B	
270	423753E	161.33S					
	419117N	155.73B				5.60	
		152.13	9.20	0.60	AF		
		151.33B				10.00B	
271	423795E	159.57S					
	419138N	152.07B				7.50	
		144.57B				15.00B	
272	423758E	165.48S					
	419078N	155.28B				10.20	
		150.63	14.85	0.60	AF		
		149.98B				15.50B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
273	423759E 419078N	165.48S 155.28R				10.20	
		150.61 149.78B	14.87	*0.61	AF	15.70B	
274	423707E 419061N	167.01S 158.81R				8.20	
		151.21 150.51B	15.80	0.65	AF	16.50B	
275	423659E 419033N	170.54S 165.94R				4.60	
		152.69 151.54B	17.85	0.65	AF	19.00B	
276	423660E 419033N	170.54S 165.94R				4.60	
		152.84 152.67 151.74B	17.70 17.87	*0.48 *0.13	AF AF	18.80B	
277	423643E 419090N	165.00S 159.00R				6.00	
		153.80 153.00B	11.20	0.60	AF	12.00B	
278	423685E 419099N	163.53S 158.03R				5.50	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	COAL BASE DEPTH	COAL THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	DRIFT/SANDSTONE THICKNESS
		152.53	11.00	0.60	AF		
		151.53B				12.00B	
279	423724E	160.92S				7.40	
	419130N	153.52R					
		152.72	8.20	0.60	AF		
		151.92B				9.00B	
280	423742E	159.20S				9.50	
	419154N	149.70R					
		147.20B				12.00B	
281	423687E	160.39S				7.00	
	419146N	153.39R					
		148.79	11.60	0.10	1AE		
		143.39B				17.00B	
282	423668E	162.11S				8.40	
	419125N	153.71R					
		153.51	8.60	0.20	AF		
		148.66	13.45	0.15	1AE		
		147.61B				14.50B	
283	423759E	160.10S				5.80	
	419136N	154.30R					
		135.00				25.10	1.60 SST
		130.40	29.70	1.20	O.W.AE		
		130.25	29.85	0.15	AE		
		129.10B				31.00B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE		BASE DEPTH	THICKNESS	
289	423960E 418865N	194.70S 193.70R					1.00	1.00	MUG
							4.50	0.80	SST
		190.20							
		185.24	9.46	*0.73		AJ			
		185.15	9.55	*0.07		AJ			
		184.96	9.74	*0.02		AJ			
		184.80	9.90	*0.14		AJ			
		184.67	10.03	*0.03		AJ			
		184.50B					10.20B		
290	424116E 418944N	187.73S 184.73R					3.00		
							11.60	2.10	SST
		176.13							
		174.83	12.90	*0.80		AJ			
		174.74	12.99	*0.07		AJ			
		174.36	13.37	*0.15	SHY	AJ			
		173.93B					13.80B		
291	424093E 418983N	187.34S 183.24R					4.10	4.10	MUG
							11.70	1.20	SST
		175.64							
		173.94	13.40	0.90		AJ			
		173.64	13.70	0.10		AJ			
		172.64B					14.70B		
292	424162E 419058N	180.05S 170.55R					9.50	9.50	MUG
		162.55B					17.50B		
293	424106E 418962N	183.65S 179.15R					4.50	4.50	MUG

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
		169.65				14.00	1.50	SST
		168.45	15.20	0.80	AJ			
		168.05	15.60	0.10	AJ			
		167.15B				16.50B		
294	423939E	166.24S						
	419090N	163.14B				3.10	3.10	MUG
		153.24	13.00	0.90	AH			
		151.14				15.10	1.10	SST
		145.54	20.70	0.40	AG			
		143.24				23.00	0.70	SST
		131.44	34.80	0.65	AF			
		130.74B				35.50B		
295	423940E	166.24S						
	419090N	163.14B				3.10	3.10	MUG
		154.06	12.18	*0.08	SHY AH			
		153.22	13.02	*0.94	AH			
		152.24B				14.00B		
296	423607E	167.92S						
	419062N	161.12B				6.80		
		154.72	13.20	0.60	AF			
		149.72	18.20	0.20	IAE			
		148.92B				19.00B		
297	423567E	168.22S						
	419058N	163.02B				5.20		
		156.62	11.60	0.60	AF			
		151.62	16.60	0.20	IAE			
		150.72B				17.50B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
298	423612E 419090N	165.68S 158.48B				7.20	
		155.53	10.15	0.65	AE		
		150.58	15.10	0.15	1AE		
		149.68B				16.00B	
299	423627E 419123N	162.94S 155.74B				7.20	
		154.94	8.00	0.65	AE		
		149.49	13.45	0.15	1AE		
		148.94B				14.00B	
300	423576E 419094N	165.10S 158.90B				6.20	
		156.30	8.80	0.60	AE		
		151.45	13.65	0.15	1AE		
		150.60B				14.50B	
301	423588E 419132N	162.33S 155.93B				6.40	
		155.23	7.10	0.60	AE		
		150.33	12.00	0.15	1AE		
		149.33B				13.00B	
302	423611E 419142N	161.62S 153.12B				8.50	
		152.52	9.10	0.10	1AE		
		151.62B				10.00B	

REGION
SITE NAME & NO. CENTRAL RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL - SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
303	423824E	158.87S					
	419156N	147.87R				11.00	
		147.02				11.85	0.85 SST
		143.07	15.80	0.20	1AE		
		141.87B				17.00B	
304	423822E	158.19S					
	419170N	147.19R				11.00	
		146.84				11.35	0.35 SST
		143.04	15.15	0.15	1AE		
		141.19B				17.00B	
305	423805E	157.26S					
	419184N	145.76R				11.50	
		129.26	28.00	2.00	O.W.AE		
		128.26B				29.00B	
306	423737E	157.51S					
	419192N	147.71R				9.80	
		145.51				12.00	2.20 SST
		130.01	27.50	3.50	O.W.AE		
		129.01B				28.50B	
307	424274E	159.71S					
	419205N	152.21R				7.50	
		151.71				8.00	0.50 SST
		137.31	22.40	0.90	AH		
		133.41				26.30	1.30 SST
		129.81	29.90	0.40	AG		
		116.91	42.80	0.70	AF		
		115.71B				44.00B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS
308	424200E 419219N	157.15S 142.55R				14.60	
		135.95	21.20	0.50	AG		
		123.35	33.80	0.65	AF		
		122.15B				35.00B	
309	424092E 419220N	156.20S 137.70R				18.50	
		129.50	26.70	0.40	AG		
		105.20B				51.00B	
310	424028E 419226N	154.95S 143.45R				11.50	
		133.85	21.10	0.60	AF		
		126.95	28.00	0.20	1AE		
		106.95	48.00	9.00	O.W.AE		
		104.95B				50.00B	
311	423963E 419226N	154.53S 139.83R				14.70	
		135.53	19.00	0.60	AF		
		134.53B				20.00B	
312	423577E 419094N	165.10S 161.30R				3.80	
		156.48	8.62	*0.45	AF		
		155.30B				9.80B	

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240

BH. NO.	GRID REF.	LEVEL	COAL SEAM BASE DEPTH	THICKNESS	CODE	DRIFT/SANDSTONE BASE DEPTH	THICKNESS	
313	423628E 419027N	171.78S 170.88R				0.90	******	MUG
		166.98	4.80	0.40	AG			
		153.68	18.10	0.60	AF			
		152.78B				19.00B		
314	423625E 418968N	177.68S 177.38R				0.30		
		173.28	4.40	0.20	AH			
		167.18	10.50	0.40	AG			
		153.63	24.05	0.65	AF			
		152.68B				25.00B		
315	423635E 418932N	182.76S 182.46R				0.30		
		178.66				4.10	0.60	SST
		173.76	9.00	1.00	AH			
		167.36	15.40	0.40	AG			
		153.51	28.85	0.65	AF			
		152.76B				30.00B		
316	424080E 418940N	188.96S 187.96R				1.00	******	MUG
		175.96				13.00	2.00	SST
		175.16	13.80	0.80	AJ			
		169.36				19.60	0.60	SST
		155.46				33.50	10.80	SST
		155.06	33.90	0.40	AH			
		150.46	38.50	0.10				
		146.16				42.80	1.10	SST
		142.16	46.80	0.40	AG			
		128.86	60.10	0.60	AF			
		127.96B				61.00B		

REGION CENTRAL
SITE NAME & NO. RAVENSTHORPE 030240
COAL SEAM DRIFT/SANDSTONE

BH. NO.	GRID REF.	LEVEL	BASE DEPTH	THICKNESS	CODE	BASE DEPTH	THICKNESS
317	423895E 419182N	158.26S 142.36R				15.90	
		142.09	16.17	*0.02	SHY AF		
		141.40	16.86	*0.69	AF		
		140.46B				17.80B	