

Northern Gateway

Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment Report





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Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

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EXECUTIVE SUMMARY

Northern Gateway Executive Summary

Northern Gateway	
Brief	Tetra Tech Ltd (Tetra Tech) was commissioned by Northern Gateway Development Joint Venture (NGDJV) to undertake a Geo-Environmental and Geotechnical Desk Study and Coal Mining Risk Assessment for the Northern Gateway Development Area to provide a preliminary assessment of the site's constraints for any future development.
The Site	The Project for Assessment boundary shown on Drawing No. B048805-TTE-00-XX-DR-U-0002 Site Boundary Plan is the area to which this desk study applies (the site) whilst the Proposed Scheme shows the area proposed for the first planning application. The site is approximately 570Ha in area and is centered upon SD 83733 07903 around Birch Industrial Park, Whittle Lane, Heywood OL10 2SX. The site currently comprises agricultural fields, farms, areas of residential properties, the South Heywood area, J3 of the M66 commercial units and a golf course with multiple small accesses across site.
Proposed Development	At the time of the assessment the anticipated development will be for a commercial land use.
Surrounding Site Information	The area to the north comprises Heywood Distribution Centre and Viridor Pilsworth South Landfill. To the east comprises agricultural farmland and the town of Hopwood. To the south comprises the M62 with agricultural farmland and the towns / villages of Simister, Bowlee and Langley beyond. To the west comprises the M66 with Pilsworth Industrial Park and town of Unsworth beyond.
Site Walkover	At the time of the site walkover November 2023 the agricultural fields across site were very wet and soft with water logged field accesses off the tracks and between fields. The Golf Club in Section F was closed due to the weather. Demolition works of Three Arrows Inn, Section A, were ongoing as well as road improvements to the junction between Moss Hall Road and Pilsworth Road on the northern boundary of Section A. A strong chemical odour was noted adjacent to Brightley Brook between Sections A and D. An odour anticipated to be associated with Pilsworth South Landfill was noted across sections A, D, E and G. No areas of obvious contamination were observed during the site walkover. Though evidence of earthworks/made ground was observed around site predominantly comprising spoil mounds though clear evidence of filled ground wasn't apparent.
Site History	The site has comprised agricultural land use from at least 1848 with farmsteads and multiple sand/sandstone, gravel quarries recorded across site which are likely to have been infilled. Barlows Coal Pits, north onsite in Section A, have been infilled. A former brickfield has been recorded to the centre southwest onsite (Section E) which is anticipated as having been infilled. There is an infilled sandpit to the centre south, Section C.

	Potential contaminative features previously onsite include Pilsworth Clough Woollen Mill and two recorded Bleach Works with associated reservoirs and tanks Sections D and E in addition to the infilled quarries. Birch Services and development of the M66 and M62 in the 1970s form the southern and western boundaries respectively with the development of Birch Industrial Park in the 1980s in Section A. Section H describes grassed fields from 1848 to present however, Google Earth and the Groundsure describes localized Landfilling between 2012 and 2018, under the EPR reference EA/EPR/KB3603LV/V003 and is indicated as still being active.
Geology	The geology is recorded by the British Geological Survey (BGS) maps as comprising: • Made Ground associated with infilled ponds, pits, quarries, motorway cuttings, and potential shallow or opencast workings. • The superficial strata across site primarily comprise Glacial Till: Ice contact deposits in the centre and northeast; with Glaciofluvial Deposits adjacent to the western and north-western boundaries. A linear section of Head deposits follows the line of Whittle Brook; Brightley Brook and Castle Brook. ◦ Peat deposits are described in Section F in the southwest by the BGS however, ground investigation has been undertaken to locate the Peat and recorded none as present. • Bedrock strata of both the Pennine Lower and Middle Coal Measures Formation comprise mudstone, siltstone and sandstone. Underlain by the Rossendale Formation of sandstone. • Coal Seams are recorded as outcropping / subcropping the site with: ◦ Arley Coal Section G ◦ Lower Foot Coal, Section H ◦ Lower Mountain Coal, Sections A, D and H ◦ Bassey Coal, Sections A and D; ◦ Subcrenatum Marine Band (6"); and ◦ Sand Rock Coal, Sections A and D. The site falls within a Coal Mining Reporting Area and Sections A, B, D, G and H recorded as being within Development High Risk Areas with respect to shallow mine workings, and as such a Coal Mining Risk Assessment has been undertaken.
Hydrogeology & Hydrology	The site does not fall within a Source Protection Zone and there are no Principal Aquifers recorded onsite. The superficial aquifer designations comprise: • Unproductive Aquifers of Peat and Glaciolacustrine deposits; • Secondary Undifferentiated Aquifer of Glacial Till, Glaciofluvial Sheet deposits, Head, Alluvium and River Terrace Deposits; and • Secondary A Aquifers of Glaciofluvial Ice contact deposits and Hummocky Glacial Deposits. The bedrock strata are described as Secondary A Aquifers. There are five named watercourses onsite comprising: • Brightley Brook, Section A, D and H • Pilsworth Clough, Section A, D and H • Whittle Brook, Sections C, D, E and F • Castle Brook, Section E and F • Hollins Brook, Section E • Unnamed watercourse, Section G

UXO Risk	A UXO desk study has been completed and describes the site as being Low risk for the site, with the recommended mitigation measures comprising a UXO awareness briefing for excavations.
Preliminary Coal Mining Risk Assessment	The Coal Mining Risk Assessment for the site concludes s that there is a High risk of shallow mine workings recorded by the cavities identified as part of the BGS borehole records associated with the Sand Rock Mine around Coal Pit Farm, Higher Barn Farm, Higher Fields, Meadowcroft Fold and Reservoir, as well as a High risk from potential mine entry collapse located around Higher Barn Farm and Coal Pits Farm, within Section A and D. Previous investigation works, referenced A117337 - South Heywood RCMRA v2 by WYG November 2020, investigated the coal underlying Section H and found it intact, therefore has not been considered further. The risk from Shallow mine workings in Section B and G is considered Moderate to Moderate/Low. Excavation of near surface mineworkings and grouting of deeper mineworkings can be expected to be required in Sections A and D. Structures over mineshafts should be avoided where possible (even if they are treated and capped prior to construction). If building over mineshafts is required, it will need justification and build over agreements will need to be sought from the Mining Remediation Authority (formerly the Coal Authority) and can be expected to require detailed design and consultation.
Preliminary Ground Contamination Assessment	High risk for ground gas associated with the infilled land, South Heywood landfill, mine shafts and mine workings. Moderate/Low risk to future site users and construction and maintenance workers from made ground on site Low risk to controlled waters (underlying aquifers) from made ground on site. Moderate/Low risk to the surface water courses from the potential made ground on site.
Preliminary Geotechnical Assessment	Foundations are likely to be variable across site and will be dependent on the proposed structure loadings as well as the strength and compressibility of superficial deposits, depth to bedrock and depth to mineworkings. Piled foundations can be expected to be required in some areas whilst shallow foundations may be suitable within shallow bedrock subject to depth, mine workings (see below) and design loads. Un-engineered made ground may be present in former quarries and presents a risk of different settlement. Un-engineered made ground in the landfill on the South Heywood site presents a risk of settlement to infrastructure which may be constructed in that area. This area is subject to a separate planning application and it is expected the geotechnical issues will be addressed as part of the development proposed for that site. There may be potential for geothermal heat generation associated with shallow mine workings and mine water though it is likely that grouting of shallow workings will be required for development stability, rendering them unsuitable for heat generation.

Recommendations

Several phases of intrusive ground investigation will be required across the site. It can be expected that more than one phase will be required in each part of the site as design progresses.

Boreholes will also need to be progressed deeper into the bedrock to assess the coal mining in the northwest of the site and refinement of the coal mining risk assessment will be needed. Geophysics, trial trenching and potentially boreholes will be needed to locate the mineshafts. Refinement of the Coal Mining Risk Assessment will be required following investigation to determine the nature, extent and condition of mine workings. Grouting of mineworkings and capping of mineshafts (where build over is justified and agreed with the Mining Remediation Authority) can be expected to be required.

Several phases of geotechnical ground investigation will be required to determine the parameters of the underlying soils and to obtain data for geotechnical design including foundations, earthworks, retaining structures, settlement assessment and pavement design and to provide information about groundwater levels.

Geo-environmental investigation and testing of the underlying soils will be required for areas including infilled ground and the former bleach works.

Ground gas and mine gas have been identified as a potential risk associated with the areas of infilled land, the former onsite landfill, potential mine workings and adjacent landfill. Gas monitoring will be required to provide a preliminary assessment of the ground gas risk.

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THIRD PARTY DRAWINGS

NORM3018_EIA Project for Assessment - EIA Assessment Plan (including Parameter Plan)

DRAWINGS

B048805-TTE-00-XX-DR-U-0001-03 - Site Location Plan
B048805-TTE-00-XX-DR-U-0003-03 - Groundsure Section Plan
B048805-TTE-00-XX-DR-U-0004A-03 - Site Features Plan - Section A
B048805-TTE-00-XX-DR-U-0004B-03 - Site Features Plan - Section B
B048805-TTE-00-XX-DR-U-0004C-03 - Site Features Plan - Section C
B048805-TTE-00-XX-DR-U-0004D-03 - Site Features Plan - Section D
B048805-TTE-00-XX-DR-U-0004E-03 - Site Features Plan - Section E
B048805-TTE-00-XX-DR-U-0004F-03 - Site Features Plan - Section F
B048805-TTE-00-XX-DR-U-0004G-03 - Site Features Plan - Section G
B048805-TTE-00-XX-DR-U-0004H-01 - Site Features Plan - Section H
B048805-TTE-00-XX-DR-U-0005.1-04 - Coal Mining Features Plan
B048805-TTE-00-XX-DR-U-0005.2-03 - Mineral Extraction Plan
B048805-TTE-00-XX-DR-U-0006-04 - Geotechnical Constraints Plan
B048805-TTE-00-XX-DR-U-0007-04 - Geology Plan
B048805-TTE-00-XX-DR-U-0008-03 - Contamination Constraints Plan
B048805-TTE-00-XX-DR-U-0009-02 Flood Zones
B048805-TTE-00-XX-DR-U-0012-04 Historical Borehole Location Plan
B048805-TTE-00-XX-DR-U-0028-01 Peat Plan

APPENDICES

APPENDIX A – REPORT CONDITIONS
APPENDIX B – GROUNDSURE REPORT
APPENDIX C – HISTORICAL MAPS
APPENDIX D – CONSULTANTS MINING REPORT
APPENDIX E – BGS RECORDS
APPENDIX F – UNEXPLODED ORDNANCE
APPENDIX G – CIRIA C552 RISK METHODOLOGY.....

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
aOD	above Ordnance Datum
bgl	below ground level
BGS	British Geological Survey
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
C4SL	Category 4 Screening Levels
CIEH	Chartered Institute of Environmental Health
CLEA	Contaminated Land Exposure Assessment
CoC	Constituent of Concern
CSM	Conceptual Site Model
DEFRA	Department of Environment, Food and Rural Affairs
DQRA	Detailed Quantitative Risk Assessment
DTS	Desk Top Study
DRO	Diesel Range Organics
DWS	Drinking Water Standard
EA	Environment Agency (England)
EPH	Extractable Petroleum Hydrocarbons
EQS	Environmental Quality Standards
FOC	Fraction Organic Carbon
GPR	Ground Penetrating Radar
LOD	Limit Of Detection
LQM	Land Quality Management
NRW	Natural Resources Wales
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Poly Chlorinated Biphenyl
PPE	Personal Protective Equipment
ppm	parts per million
PRO	Petroleum Range Organics
SGV	Soil Guideline Values
SOM	Soil Organic Matter
SSV	Soil screening value
SVOC	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TSV	Tier 1 Screening Values
VOC	Volatile Organic Compounds
VPH	Volatile Petroleum Hydrocarbons

1.0 INTRODUCTION

1.1 INSTRUCTION

Tetra Tech Ltd (Tetra Tech) was commissioned by Northern Gateway Development Joint Venture (the Client) to undertake a Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment for the proposed Northern Gateway development.

The location and layout of the site is shown on the Turleys Drawing No. NORM3018_EIA Project for Assessment - EIA Assessment Plan (including Parameter Plan). 'The site' for the purposes of this report is the Project for Assessment boundary shown on the Site Boundary Plan.

1.2 BRIEF

The brief was to provide a Geo-environmental and Geotechnical Desk Study as well as a Coal Mining Risk Assessment report:

- To assess whether there was potential for ground contamination to be present which could significantly constrain the use of the site or give rise to the risk of significant environmental liability, and to undertake a desk study to assess contaminant linkages.
- To assess geotechnical risks which could significantly constrain the use of the site, or give rise to risk, and to undertake a desk study to assess these constraints.
- Undertake a preliminary coal mining risk assessment within the context of proposed commercial development.

The report has been prepared in general accordance and with reference to Environment Agency Land Contamination Risk Management, Version 3.

1.3 PROPOSED DEVELOPMENT

At the time of the assessment the anticipated development will be for a commercial land use.

The Project for Assessment boundary shown on Drawing No. B048805-TTE-00-XX-DR-U-0002 Site Boundary Plan is the area to which this desk study applies whilst the Proposed Scheme shows the area proposed for the first planning application.

It is expected that there will be more applications associated with the overall development.

1.4 RELATED ASSESSMENTS

Tetra Tech undertook a Geo-environmental High-Level Constraints assessment for the assessment of the site in 2020 on behalf of Northern Gateway Development Vehicle LLP for an area encompassed by the revised redline boundary detailed by drawing B048805-TTE-00-XX-DR-U-0002. The Historic report comprised:

- WYG 2020, Area GMA 1.1 Geo-environmental High-Level Constraints Review A104444-5.

WYG, (now Tetra Tech), previously undertook works which encompassed Section H as part of a separate planning application 16/01399/HYBR with the following reports relevant to the proposed works on the Northern Gateway scheme, have been reviewed.

- WYG Jul 2020, South Heywood Preliminary Desk Top Geotechnical and Geo-environmental Review, A117337
- WYG, Oct 2020, South Heywood Factual Ground Investigation Report, A117337

- WYG Nov 2020, South Heywood Refined Coal Mining Risk Assessment, A117337/RCMRA_V2

1.5 REPORT SCOPE

This report includes the following elements. These are separated into the main site and the offsite Junction 33 of the M66 which is covered separately in Section 9.0 of this report except for the assessment in Preliminary Coal Mining Risk Assessment in Section 6.0 which includes the offsite junction.

- A record of the site visit and visual inspection walkover.
- An historical site and area review, primarily referring to past editions of Ordnance Survey Maps.
- A discussion of the general expected ground and groundwater conditions within the topographical and area context referring to our own geological and hydrogeological maps library.
- Details of an Environmental database search (Groundsure) of key relevant agencies, including Local and Statutory Authorities such as the Environment Agency.
- A ground contamination assessment discussing the results of the research above not only concerning potential on-site conditions/constraints and contamination but also an overview of the potential for migration onto or off-site with respect to the surrounding neighboring sites.
- A review of information pertinent to the historic local coal mining including obtaining a Consultants Mining Report from the Mining Remediation Authority (MRA) (formerly the Coal Authority) and development of a Preliminary Coal Mining Risk Assessment plus preliminary comments of any geothermal heat potential from mine workings.
- A baseline UXO risk assessment using freely available databases to classify the site with regards to UXO risk;
- Development of a preliminary conceptual site model.
- Preliminary qualitative ground contamination risk assessment (compliant with CIRIA 552 (CIRIA, 2001) methodology).
- Initial consideration of ground engineering requirements and the development of a geotechnical risk register.

1.6 LIMITATIONS

The recommendations and opinions expressed in this report are based on information obtained as part of the desk study or provided by others. Information provided from other sources is taken in good faith and Tetra Tech cannot guarantee its accuracy.

This report is subject to the report conditions presented in Appendix A.

The information contained in this report is intended for the use of the Client (NGDJV) and Tetra Tech can take no responsibility for the use of this information by any third party or for uses other than that described in this report or detailed within the terms of our engagement.

2.0 SITE INFORMATION

2.1 LOCATION

The site is centered around Birch Industrial Park, Whittle Lane, Heywood OL10 2SX approximately 10km north of Manchester City Centre residing between the M62 and M66 south of Heywood. The site currently comprises agricultural fields, farms, areas of residential properties, commercial units and a golf course. There are multiple small access roads with areas of juvenile to mature vegetation across site.

The site is approximately 575 hectares (Ha) in area and is centered upon SD 83733 07903.

A site location plan is presented as drawing B048805-TTE-00-XX-DR-U-0001 and a Site Boundary Plan shown by drawing B048805-TTE-00-XX-DR-U-0002.

Due to the size of the dataset required for the development area, for the purpose of description and database information review, the site has been split into sections in line with the Groundsure reports, Sections A to H, and as detailed by drawing B048805-TTE-00-XX-DR-U-0003 Groundsure Section Plan.

2.2 GENERAL AREA CONTEXT

Table 2.1 describes the surrounding land uses for the redline boundary described on drawing B048805-TTE-00-XX-DR-U-0002 Site Boundary Plan.

Table 2-1 – Surrounding land uses

Direction	Description
North	Heywood Distribution Centre and Viridor Pilsworth South Landfill
East	Agricultural farmland and town of Hopwood
South	M62, Agricultural farmland and towns of Simister, Bowlee and Langley.
West	M66, Pilsworth Industrial Park and town of Unsworth

2.3 SITE DESCRIPTION

A site walkover inspection was undertaken by Tetra Tech on 27th November 2023. This section has been split as per the Groundsure dataset as shown by drawing B048805-TTE-00-XX-DR-U-0003 Groundsure Section Plan and is to be read in conjunction with the Site Features Plans B048805-TTE-00-XX-DR-U-0004A to B048805-TTE-00-XX-DR-U-0004H.

2.3.1 Site Description Summary

The site is predominantly comprised of open agricultural fields with small access roads and farm buildings and some areas are occupied by multiple tenants undertaking commercial activities including an industrial estate Birch Industrial Park, a motorway service station Birch Services on the southern boundary bounded by the M62 motorway and a golf course Pike Fold Golf Club located in the southwest of site bounded by the M66 motorway. The easternmost end of the site comprises the South Heywood area which is covered by a separate planning application.

2.4 SECTION A

2.4.1 Current Site Usage

Section A consists of the area around Coal Pit Farm, Birch Industrial Park and the junctions between Moss Hall Road and Whittle Lane as well as Pilsworth Road and Moss Hall Road. It comprises agricultural fields, some supporting livestock and mostly grassed at the time of the site visit.

2.4.2 Access and Boundaries

The fields are accessible off Moss Hall Road and Whittle Lane as well as Pilsworth Road via a mixture of locked gates and open access. Some of the areas around the junctions have grass verges with access from the road. The fields are typically fenced and locally lined with semi-mature to mature vegetation. Most of the field access points were waterlogged at the time of the site walkover.

The western limits comprise of fields of Section D to the southwest and Pilsworth Landfill to the northwest and by fields offsite to the east. To the north the boundary comprises Heywood Industrial Estate and to the southeast, Section B, comprising agricultural fields.

2.4.3 Topography

Topography has been determined using Google Earth Imagery and describes Section A rises to the northwest from 119m AOD to the south of Birch Industrial Park to approximately 125m AOD at Moss Hall Limited towards the centre of site before falling to approximately 112m AOD along Brightley Brook before rising to approximately 118m AOD at Moss Hall Road and Pilsworth Road junction.

2.4.4 Ground Cover and Vegetation

The site is predominantly covered by agricultural grassed fields, with hardstanding areas associated with Birch Industrial Park to the southwest. There are also roads around Moss Hall Road and Pilsworth Road junction and along Moss Hall Road south past Birch Industrial Park. Mature vegetation comprising trees and bushes is found on field boundaries and thick trees around the Moss Hall Road and Pilsworth Road Junction. Areas of hardstanding are around the farm and Moss Hall Limited.

Brightley Brook, flows below Moss Hall Road adjacent to Pilsworth Road in the north of section. The brook flows from the east to the west.

2.4.5 Tanks

No above ground storage tanks were observed for Section A, though storage of materials is likely associated with Coal Pit Farm.

2.4.6 Utilities

Two possible electrical substations are present along Moss Hall Road on the eastern side of the road adjacent to Heywood Industrial Park. A hydrant was recorded as being present on Moss Hall Road located to the north of Coal Pit Farm as part of the walkover. There is a high-pressure gas marker to the south of Coal Pit Farm along Moss Hall Road. There are telegraph poles across the agricultural fields.

2.4.7 Asbestos Containing Material

No obvious potential asbestos containing materials (ACM) were observed on the ground surface during the walkover. Given the age of some of the farm structures, it is possible that there is ACM within some of the farm buildings which may need to be assessed.

2.4.8 Evidence of Contamination

No areas of obvious contamination were observed during the site walkover. There is evidence of fill / made ground associated with the landfill to the northwest and a grassed mound to the east offsite which appears manmade. A strong chemical odour was recorded adjacent to Moss Hall Road and Pilsworth Road along Brightley Brook.

2.5 SECTION B

2.5.1 Current Site Usage

Section B consists of the easternmost portion of the study area including westbound and eastbound Birch Services, the M62 motorway east up to Junction 19, Stock Nook Farm, Lower Whittle Farm with residential and commercial properties along Manchester Road. There are agricultural fields with small access roads consisting of Dr Fold Lane in the section centre and Whittle Lane on the section's western boundary.

2.5.2 Access and Boundaries

Birch Services can be accessed via the M62 motorway, each side from its respective carriageway. Stock Nook and Lower Whittle Farm can be accessed via Dr Fold Lane, from Manchester Road, although gates are present preventing direct access to Lower Whittle Farm.

The western limits of Section B are bound by Whittle Lane and Section C. The route of the M62 to the northeast forms a finger that defines the bounds of the easternmost point of Section B at Junction 19 of the M62. Field boundaries form the northern bounds of this section. Section A bounds to the northwest comprising the continuation of agricultural fields and the presence of Birch Industrial Park.

2.5.3 Topography

Topography has been determined using Google Earth Imagery and describes Section B rises from 106m AOD around Birch Services to 122m AOD around M62 Junction 19, remaining at between 116-119m AOD in the areas of Stock Nook and Lower Whittle Farms before rising to 128m AOD on the western side next to Birch Industrial Park.

2.5.4 Ground Cover and Vegetation

The site is predominantly covered by agricultural grassed fields, with soft and hard landscaped areas associated with the gardens of the residential properties and the farm buildings. Hardstanding is present around the residential and commercial properties by Manchester Road and the M62 motorway and Birch Services. Mature vegetation comprising trees and bushes/hedgerows are recorded on field boundaries. Aerial imagery shows a small stream/watercourse and mature vegetation running from Stock Nook Farm to the northern point of Birch Services.

2.5.5 Tanks

It is anticipated that there are some above ground tanks associated with the farm buildings as well as some below ground tanks associated with the petrol filling stations at Birch Services though none were observed.

2.5.6 Utilities

No electricity substations were noted across Section B. Multiple overhead lines were noted crossing the site section. Above ground Calor Gas tanks were noted at several of the farmsteads.

2.5.7 Asbestos Containing Material

Potential asbestos containing materials (ACM) were observed as cement sheeting associated with some of the older farm structures around Stock Nook and Lower Whittle Farms. Assessment of the presence of potential ACM in buildings is not within the scope of this assessment.

2.5.8 Evidence of Contamination

No areas of obvious contamination were observed during the site walkover.

2.5.9 Anecdotal Information

A landowner recorded that Birch Industrial Estate used to be an RAF Base and reported that there is the potential for filled bomb craters associated with the firing testing having occurred onsite. Therefore, there is the potential for Unexploded Ordnance (UXO) to be present onsite.

2.6 SECTION C

2.6.1 Current Site Usage

Section C consists of Whittle Fold Small Holding, Whittle Croft Cottage, Broomhill Farm and former Whittle Sand and Gravel Pit. The section comprises primarily agricultural fields with small unnamed access roads off Whittle Lane and encompasses part of the M62 in the east.

2.6.2 Access and Boundaries

Section C can be accessed off Whittle Lane which runs along the eastern boundary with unnamed tracks to the western half of Section C. The western area is only accessible via open field access, breaks in vegetation and gates. It should be noted that a majority of access' into fields were waterlogged.

The western limits comprise Whittle Brook with Section F and Section E and agricultural fields beyond.

2.6.3 Topography

Topography has been determined using Google Earth Imagery and describes Section C undulates slopes primarily to the southwest from 128m AOD along Whittle Lane to approximately 93m AOD along Whittle Brook. There is a slight undulation from northwest to southeast across the centre of the site. The site rises from 102m AOD along the M62 rising to approximately 107m AOD along the centre of the site, with an unnamed tributary along the ridge, before sloping gradually to the northwest to 106m AOD before falling beyond.

2.6.4 Ground Cover and Vegetation

The site is predominantly covered by agricultural grassed fields with localized ponds which are overgrown with vegetation in the southeast. Mature vegetation comprising trees and bushes was recorded along the central watercourse as well as along Whittle Brook and are found on field boundaries. Areas of hardstanding have been observed around the farms and residential properties.

Whittle Brook flows along the western boundary from the southeast to the northwest. Whittle Brook is joined by an unnamed tributary which flows from the northeast to southwest.

2.6.5 Tanks

Gas tanks were noted around the farms and small holdings and given the remoteness of some of the farms it is likely that some of the structures will have septic tanks.

2.6.6 Utilities

No electricity substations were noted across site. Multiple overhead lines were noted as crossing the site section.

2.6.7 Asbestos Containing Material

Potential asbestos containing materials (ACM) were observed as cement sheeting associated with some of the older farm structures as well as smaller shelters and barns located in the fields. Assessment of the presence of potential ACM in buildings is not within the scope of this assessment.

2.6.8 Evidence of Contamination

No areas of obvious contamination were observed during the site walkover. It is recorded that a Sand and Gravel Pit was recorded though evidence of fill/ made ground was not observed as part of the walkover.

2.6.9 Anecdotal Information

A landowner recorded that Birch Industrial Estate used to be an RAF Base and reported that there is the potential for filled bomb craters associated with the firing testing having occurred onsite. Therefore, there is the potential for Unexploded Ordnance (UXO) to be present onsite.

2.7 SECTION D

2.7.1 Current Site Usage

Section D consists predominantly of the agricultural fields with small access roads and farm buildings of Higher Barn, operated by W&T Butterfield. On the northern boundary across Brightley Brook is an active Sewage treatment facility and to the northwest 200-300m from the Section boundary is the Pilsworth Landfill.

2.7.2 Access and Boundaries

The site is accessible primarily along small farm tracks and lanes accessed from Moss Hall Road which forms the boundary with Section A. Two tracks give access to the majority of the agricultural fields of this section from Higher Barn Farm.

The site is bounded to the north by Brightley Brook and fishing ponds/reservoirs, to the west by Whittle Brook and Section E, to the southeast by field boundaries and Section C and to the east by Section A along the line of Moss Hall Road.

2.7.3 Topography

Topography has been determined using Google Earth Imagery and describes the site undulates over hummocky agricultural fields and the topography gradually lowers towards Whittle Brook in the west. Site elevation ranges from approximately 127m AOD in the east at Higher Barn to 80m AOD in the northwest at Whittle Brook.

2.7.4 Ground Cover and Vegetation

The site is predominantly covered by agricultural fields with sporadic areas of soft landscaping and hedgerows some of which contain mature trees. The hardstanding includes areas of both tarmac and concrete and farm buildings, including Higher Barn Farm and Meadowcroft Fold.

2.7.5 Tanks

Given the remoteness of some of the farms it is likely that some of the structures will have gas and sceptic tanks.

2.7.6 Utilities

There is a High Pressure Gas Main noted across the north of the site and was recorded as passing beneath Whittle Lane to the east through the fields just south of Pilsworth Fishing Lake and is anticipated to run to Section E's Gas works. No Electricity substations were noted across site. Multiple overhead lines were noted as crossing the site.

2.7.7 Asbestos Containing Material

Potential asbestos containing materials (ACM) were observed as cement sheeting associated with some of the older farm structures around Higher Barn Farm and Meadowcroft Fold as well as smaller shelters and barns located in the fields. Assessment of the presence of potential ACM in buildings is not within the scope of this assessment.

2.7.8 Evidence of Contamination

No areas of obvious contamination were observed during the site walkover. No evidence of disposal of soils or evidence of fill/ made ground was observed.

2.7.9 Anecdotal Information

The tenant farmer's family indicated they had farmed the land for the last 100 years and before that recorded that there was a mining village located around Meadowcroft Fold in the 1800s with mining having been undertaken across site with shafts sunk onsite as well in the Pilsworth Fishing Lakes Car Park to the north. In the 1980s they said the site had been investigated by the National Coal Board (NCB) now (Mining Remediation Authority) to investigate the potential for Opencast mining. They noted that boreholes found workings with some boreholes collapsing leaving significant voids which were stoned and grouted up.

A landowner recorded that Birch Industrial Estate to the east used to be an RAF Base and reported that there is the potential for filled bomb craters associated with the firing testing having occurred onsite. Therefore, there is the potential for Unexploded Ordnance (UXO) to be present onsite.

2.8 SECTION E

2.8.1 Current Site Usage

Section E consists of Castle Brook Farm, Thurston Fold Farm, Brick House Farm, a Cadent Gas works and Unsworth Academy Playing fields. The section comprises primarily agricultural fields with small access roads consisting of Griffe Lane and Castle Road and several unnamed tracks connecting the site. At the time of the visit there was a small private residential estate of seven modern residential properties under development adjacent to Brick House Farm as well as some older residential properties associated with the farms.

2.8.2 Access and Boundaries

The eastern half of Section E can be accessed from Griffe Lane which leads to Unsworth Academy Playing Fields to the southwest, Brick House Farm and Thurston Fold Farm. Access to the northern and western areas can be gained from Castle Road which leads to Castle Brook Farm as well as the Cadent Gas works. There is also a possible radio tower in the fields west of Castle Road. The south-eastern areas are only accessible via open field access, breaks in vegetation and gates. The majority of accesses into fields were waterlogged.

The western limits are bound by the M66 and don't offer direct vehicular access. The eastern boundary comprises Whittle Brook with Section D's and Section C's agricultural fields beyond.

2.8.3 Topography

Topography has been determined using Google Earth Imagery and describes Section E undulates between approximately 103m AOD in the west to 91m AOD around Castle Brook at the centre of the section rising to 95m AOD around Thurston Fold Farm and Brick House Farm to 89m AOD by Whittle Brook on the eastern boundary.

2.8.4 Ground Cover and Vegetation

The site is predominantly covered by agricultural grassed fields, with landscaped areas associated with the residential properties as well as a quad/motorbike track which has been dug out in the fields to the southeast of Brick Farm. There are localized ponds which are overgrown with vegetation in the southeast. Mature vegetation comprising trees and bushes are recorded on the western boundary (M66) as well as along Whittle Brook and are found on field boundaries. Areas of hardstanding have been observed around the farms and private residential estate with a large area associated with the Unsworth Academy Playing fields. There is an unnamed track up to a possible radio tower.

Castle Brook water course flows northwards where it joins Whittle Brook and flows off site. Whittle Brook forms the eastern boundary and flows from the southeast to the northwest, where it combines with Brightley Brook to the north forming Hollins Brook as it flows to the northwest offsite.

2.8.5 Tanks

Gas tanks were noted adjacent to the barn at Unsworth Farm, given the remoteness of some of the farms it is likely that some of the structures will have gas and septic tanks.

2.8.6 Utilities

There is a Cadent gas works which receives the high-pressure gas main that passes below Griffe Lane in the northwest, through Brick House Farm. No Electricity substations were noted across site. Multiple overhead lines were noted as crossing the site.

2.8.7 Asbestos Containing Material

Potential asbestos containing materials (ACM) were observed as cement sheeting associated with some of the older farm structures around Unsworth and Brick House Farm as well as smaller shelters and barns located in the fields. Assessment of the presence of potential ACM in buildings is not within the scope of this assessment.

2.8.8 Evidence of Contamination

No areas of obvious contamination were observed during the site walkover. Evidence of fill/ made ground was observed associated with the playing fields which appeared to be levelled.

2.8.9 Anecdotal Information

A small hollow now filled with water, located within 100m east of Brick House Farm was described by a local landowner as a former clay pit, used for making the bricks of the original Brick House Farm.

A Landowner described the private houses constructed on Brick House Farmland as all having basement structures, though no evidence of stockpiled spoil was recorded.

A landowner recorded that Birch Industrial Estate used to be an RAF Base and reported that there is the potential for filled bomb craters associated with the firing testing having occurred onsite. Therefore, there is the potential for Unexploded Ordnance (UXO) to be present onsite.

2.9 SECTION F

2.9.1 Current Site Usage

Section F consists of Pike Fold Golf Club and agricultural fields, some supporting livestock and were mostly grassed at the time of the site visit. There are small access roads Hills Lane, Egypt Lane and Simon Lane as well as Egypt Farm and Unsworth Farm located within the section.

2.9.2 Access and Boundaries

The fields are accessible off Egypt Lane and Simon Lane as well as several unnamed lanes with vehicular access to the fields, as well as through fields, via open field access, breaks in vegetation and gates. The fields are typically fenced and locally lined with semi mature to mature vegetation. Pike Fold Golf Course is accessible from Hills Lane. It should be noted that the majority of access' into fields were waterlogged.

The southern/southeastern and western limits are bound by the M62 and M66 respectively which don't offer vehicular access. Section E bounds the north of site comprising agricultural fields and Whittle Brook is located on the northeastern boundary with Section C beyond with agricultural fields.

2.9.3 Topography

Topography has been determined using Google Earth Imagery and describes Section F typically undulates from west to east from approximately 99m AOD (M66) in the west before gradually falling to the northeast from 95m AOD to 93m AOD before rising around Simon Lane to approximately 97m AOD before falling to 93m AOD at Whittle Brook. There appears to be a potential manmade mound in the southwest rising to approximately 99m AOD, it is anticipated that the mound is a spoil mound associated with the M62 development.

2.9.4 Ground Cover and Vegetation

Section F is predominantly covered by agricultural grassed fields, with landscaped areas and water features associated with the golf course. Mature vegetation comprising trees and bushes are recorded on the western boundary (M66) though are found on field boundaries and in clumps around Egypt Farm. Areas of hardstanding were observed around the farms, stables and golf course.

Castle Brook water course separates the golf course with the agricultural fields to the south and flows from the east before flowing north through the golf course and into Section E. Whittle Brook forms the eastern boundary and flows from the southeast to the northwest.

2.9.5 Tanks

Above ground storage tanks were noted at the golf club filled with unknown contents, Calor gas tanks were observed as being present. There are likely to be some above ground tanks associated with the farm buildings.

2.9.6 Utilities

The High-Pressure Gas Main was recorded as passing through the golf course and was observed by the junction between Simon Lane and Egypt Lane. No Electricity substations were noted across site. Multiple overhead lines were noted as crossing the site.

2.9.7 Asbestos Containing Material

Potential asbestos containing materials (ACM) were observed as cement sheeting associated with some of the older farm structures around Unsworth Farm. Assessment of the presence of potential ACM in buildings is not within the scope of this assessment.

2.9.8 Evidence of Contamination

No areas of obvious contamination were observed during the site walkover. Evidence of fill/ made ground was observed associated with the golf course. Two potential spoil mounds were observed, a small pile of potential plainings was noted on the southern boundary within the agricultural fields, though could not be confirmed due to access. Further, a large spoil mound appears to be present in the southwest with possible boreholes, (small, fenced areas typically used for protecting boreholes), used for gas monitoring. Anticipated to be natural spoil tipped following motorway development.

2.9.9 Anecdotal Information

A landowner recorded that Birch Industrial Estate used to be an RAF Base and reported that there is the potential for filled bomb craters associated with the firing testing having occurred onsite. Therefore, there is the potential for Unexploded Ordnance (UXO) to be present onsite. However, a UXO risk assessment has been undertaken and the site has been assessed as Low risk as described in Section 4.10.

2.10 SECTION G

2.10.1 Current Site Usage

Section G comprises Pilsworth Road leading from Pilsworth Way, to the west, along Pilsworth Road passing beneath the M66 (6no. lanes of traffic plus a hard shoulder on both the north and southbound sides) leading past Pilsworth South landfill where it joins Section A on Pilsworth road to the west of the Moss Hall road turn off. The slip road' for Junction 3 are dual carriageways controlled by traffic lights turning east or west only. The Site features are described by drawing B048805-TTE-00-XX-DR-U-0004G Site Features Plan - Groundsure Section G.

2.10.2 Access and Boundaries

Section G can be accessed via the M66 motorway and from off Pilsworth Road but note this area comprises an active motorway and associated slip roads, as well as Pilsworth Industrial Park.

2.10.3 Topography

Topography has been determined using Google Earth Imagery and describes the motorway carriageways are at 98m AOD and rises from the west from 90m AOD at Pilsworth Way rising to 92m AOD beneath Junction 3 of the M66 before rising to 125m AOD in the east along. The motorway is linked to Pilsworth road by slip roads to account for the elevation changes.

2.10.4 Ground Cover and Vegetation

Section G comprises motorway and road infrastructure hardstanding with areas of mature vegetation present on the motorway embankment and along Pilsworth road to the east. To the west and some semi-mature vegetation along Pilsworth road to the west.

2.10.5 Tanks

No tanks were noted on the site walkover.

2.10.6 Utilities

Utility covers were noted in the footpaths along Pilsworth road and additional services are anticipated underlying the road ways.

2.10.7 Asbestos Containing Material

No potentially asbestos containing material was noted on the site walkover.

2.10.8 Evidence of Contamination

Littering was evident along Pilsworth road, though no significant quantities. Evidence of fill/ made ground was observed associated with the motorway infrastructure. Former Pilsworth North landfill and the currently operational Pilsworth South landfill are present to the immediate northeast and southeast of site respectively bisected by Pilsworth Road.

2.10.9 Anecdotal Information

No anecdotal evidence was obtained for this section of site.

2.11 SECTION H

2.11.1 Current Site Usage

Section H comprises Pilsworth Road leading from Moss Hall Way, to the west, to Hareshill Road / Queen Elizabeth Way in the east, with the main body of the site comprising unused grassland to the south. The Site features are described by drawing B048805-TTE-00-XX-DR-U-0004H Site Features Plan - Groundsure Section H.

2.11.2 Access and Boundaries

Section H can be accessed off Hareshill Road / Queen Elizabeth Way to the east. Heywood Distribution Park forms the northern and eastern boundaries with Groundsure A to the west and Groundsure Section B to the South as per drawing B048805-TTE-00-XX-DR-U-0003 Groundsure Section Plan.

2.11.3 Topography

Topography has been determined using Google Earth Imagery and describes the site as rising up southwards and westward from the north off Pilsworth Road, 119m AOD with Hareshill Road / Queen Elizabeth Way in the east at 128m AOD toward the centre of site at 129m AOD. The site falls to the southwest to 120m AOD along the unnamed watercourse which flows off to the northwest. This topography is likely associated with the historic landfill present onsite.

2.11.4 Ground Cover and Vegetation

Section H's northern and eastern boundaries comprise road infrastructure associated with Heywood Distribution Park to the north with undeveloped grassed areas across the remainder of site.

2.11.5 Tanks

No tanks were noted on the site walkover.

2.11.6 Utilities

Utility covers were noted in the footpaths along Pilsworth Road, Hareshill Road / Queen Elizabeth Way and additional services are anticipated underlying the roadways.

2.11.7 Asbestos Containing Material

No potentially asbestos containing material was noted on the site walkover.

2.11.8 Evidence of Contamination

Littering was evident along the roads, though no significant quantities. Evidence of fill/ made ground was observed across the section likely associated with the historic landuse.

2.11.9 Planning Application

The South Heywood site comprising Section H is covered by planning application number 16/01399/HYBR which is available on the RBC planning portal. Ground investigation and assessment has been completed relating to this application and the following reports are included on the portal with the application.

The reports reviewed comprise:

- Report Ground Investigation Junction 19 Link Road, Heywood, OL10 2TB, W15/41711-V1 dated October 2015;
- Phase 1 Geo-environmental Assessment, South Heywood Development Area, 11-094-R1 dated November 2016.

WYG, now Tetra Tech, has also previously investigated Section H as per the below reports:

- A117337_FR_V2 - Factual Ground Investigation Report dated October 2020
- A117337/RCMRA_V2 - South Heywood Revised Coal Mining Risk Assessment dated November 2020
- A117337_GCR_V2 Ground Contamination Report for Planning dated December 2020
- A117337_GI_V5 Ground Investigation Report (Whole Site) dated April 2021

3.0 SITE HISTORY

3.1 INTRODUCTION

The historical development of the site and surrounding area has been assessed using information available from extracts of historical Ordnance Survey (OS) maps for the site which are presented in Appendix C of this report.

In the context of the summary of historical development of the surrounding area, the descriptions are split based on the Groundsure Sections described on drawing B048805-TTE-00-XX-DR-U-0003 Groundsure Section Plan and limited to within approximately 250m of the outer redline boundary shown by drawing B048805-TTE-00-XX-DR-U-0002 site boundary plan, unless specified in the following section.

3.2 SITE HISTORY

3.2.1 Site Summary

The site's history describes primarily agricultural land use from at least 1848 with farmsteads and multiple sand/sandstone, gravel quarries recorded across site though are likely to have been infilled. There are coal pits recorded to the north onsite (Section A) only and are also anticipated to be infilled. A former brickfield has been recorded to the centre southwest onsite (Section E) which is anticipated as being infilled. There is an infilled sandpit to the centre south (Section C).

Potential contaminative features have been identified as being onsite include Pilsworth Clough Woollen Mill, two recorded Bleach Works with associated reservoirs and tanks located to the north of Section D and Northwest of Section E. There are numerous records of tanks, unspecified pits located across site and garages located.

Google Earth and a Groundsure reference indicate that landfilling took place on Section H between 2012 and 2018.

Birch Services and development on the M66 and M62 in the 1970s formed the southern and western boundaries with the Birch Industrial Park in the 1980s (Section B).

The potential contaminative sources identified as part of the site history and site walkover are shown on the contamination constraints drawing B048805-TTE-00-XX-DR-U-0007 Contamination Constraints Plan.

3.2.2 Site History

The following tables, Table 3.1 – 3.6, below provide a summary of each section's history following a review of available OS mapping coverage dating back to 1848 and historical aerial imagery for the site.

Table 3-1 – Section A

Feature	Map Years	Location	Notes (May impact other sections)
Open fields with numerous small holdings and farms	1848-Present	The number of fields within the site boundary remain relatively consistent across the map editions.	Higher Fields labelled as a small holding/farm throughout mapping
Old Sandstone Quarries	1848	Mapped either side of the Barlow Coal Pits on 1848 maps, likely infilled and in the east of site.	
Barlows Coal Pit	1848-Present	Labelled Coal Pits Farm from 2001 mapping	

Former brick field near Brick House	1894	Referenced as 'old' on 1894 mapping	
Birch Industrial Park	1981 – Present	Comprises industrial units including manufacturing and haulage businesses	Sections B, C and D
Sewage Works	1965 – Present	100m west of Section/site boundary along route of Brightley Brook	Section D

Table 3-2 – Section B

Feature	Map Years	Location	Notes (May impact other sections)
Open fields with numerous small holdings and farms	1848-Present	The number of fields within the site boundary remain relatively consistent across the map editions.	Doctors Moss/Stock Nook and Lower Whittle are predominant named small holdings / farms and both have a 'sand pit' adjacent in 1848 mapping
M62 Motorway and Birch Services	1974-Present	Developed along the central southeastern boundary line motorway – will have Petrol filling stations present including underground storage tanks	Section C Section F (Motorway only)
Garage	1965-Present	Located on Manchester Road	
Birch Mills	1848-1981	South-eastern boundary	Labelled as a Cotton Mill then Works in 1981.

Table 3-3 – Section C

Feature	Map Years	Location	Notes (May impact other sections)
Open fields with numerous small holdings and farms	1848-Present	The number of fields within the site boundary remain relatively consistent across the map editions.	Whittle Fold, Whittle Cottage and Broom Hill Farm are predominant named small holdings / farms and both have a 'pump' adjacent in 1848 mapping. Whittle Fold has 2 Sand Pits and a 'Well' adjacent. Whittle Fold Smallholding shown from 2001 mapping 150m southwest of Whittle Fold
Windpump	1915-1955	Mapped between Broom Hill and Whittle Fold.	

Small ponds	1848-1975	Numerous across Section area	One notable at location of Whittle Fold Smallholding – removed on 1981 map before construction
Whittle Sandpit/Quarry and associated Infilled Ground to immediate NW	1955-1965	Quarry/Sand pit located to east of Whittle Fold shown on	Only named on 1965 maps but earthworks shown in 1955. Area of infilled ground not shown by the mapping. Adjacent to Section B
Whittle Brook	1848 – present	Southwestern boundary	Sits between Section C, Section D, Section E and Section F.

Table 3-4 – Section D

Feature	Map Years	Location	Notes (May impact other sections)
Open fields with numerous small holdings and farms including: Higher Barn; Meadow Croft Fold; and unknown structure	1851	Higher Barn is present as of today's location. Meadow Croft Fold is present as of today's location however, fewer structures are present. Unknown Structure recorded to the north adjacent to Burlow Coal Pit	
Sandstone Old Quarry	1851	Located to the north onsite and appears to be replaced by the Pilsworth Clough Mill in 1891	Section A
Sand Pit	1851 – 1891	Located to the north onsite and appears to be replaced by the reservoir (shown today) in 1891.	
Brightley Brook	1851 – present	Located to the north onsite and present as of today's location	Section A
Unnamed Brook	1851 – present	Adjacent to Burlow's Coal Pits and is culverted below an unnamed road (Moss Hall Road)	Section A

Ponds	1851 – present	One located to the east onsite, no longer annotated from 1891. Three ponds located around Meadow Croft Fold no longer annotated from 1890 – 1891. One pond located on the southern boundary no longer recorded from 1907. One pond recorded to the northwest adjacent to the reservoir no longer recorded from 1974. One pond located to the west adjacent to Whittle Brook recorded to present. A second pond is shown to the west on the 2010 plan only.	
Reservoir	1891 – present.	One reservoir is recorded to the northwest onsite adjacent to the Pilsworth reservoir and is no longer recorded from 1908. One reservoir is recorded to the north onsite and is recorded to present.	
Windpump	1928 – 1965	Windpump located adjacent Meadow croft farm described as disused from 1955.	
Pilsworth Clough Mill later works with tanks and settling tanks	1890 – 1992	Recorded as being disused from 1939, described as being used for Dying and Finishing from 1956.	Section A
Whittle Brook	1848 – present	Western boundary	Sits between Section C, Section D, Section E and Section F.

Table 3-5 – Section E

Feature	Map Years	Location	Notes (May impact other sections)
Open fields with numerous small holdings and farms	1848-Present	The number of fields within the site boundary remain relatively consistent across the map editions.	
Castle House, Thruston Fold, Brick House, Roe Fold, Roe Barn, Grundy Fold Farm and Nell Field.	1848 – Present	Northern boundary East adjacent to Whittle fold Centre south Western boundary Centre southern boundary Just beyond western boundary and replaces Roe Fold from 1915 and referred to as Castle Brook Farm from 1965. Centre site	

Ponds	1848 – present	Four ponds located around Brick House Two ponds located to the southwest One pond located adjacent to Roe Fold. Two ponds located around Thurston Fold becoming four ponds between 1928 to 1955. One pond located adjacent Hollins Brook to the northwest.	
Old Brick Field	1915 – 2001	Adjacent to Brick House and shows four pits.	
Settlement ponds	1907 – 1974	Replaces the pond located adjacent Hollins Brook to the northwest in 1907 and no longer recorded from 1981.	
Windpump and tanks	1907 – 1965	Located around Roe Barn. Windpump no longer recorded from 1955. Tank no longer recorded 1965.	Section F
Playing fields	1981 – 2023	Not recorded on the 2023 maps however was observed as being present as part of the walkover.	
Castle Brook	1848 – Present	Runs through the centre of site where it joins Whittle Brook in the north onsite before flowing into Hollins Brook to the north.	Section F

Table 3-6 – Section F

Feature	Map Years	Location	Notes (May impact other sections)
Open fields with numerous small holdings and farms	1848-Present	The number of fields within the site boundary remain relatively consistent across the map editions.	
Back of the Moss Pike Fold Golf Club	1848 – Present	Back of the Moss is recorded up until 2010 when it is referred to as a Golf Club, significant earthworks are likely to have been undertaken, with development of ponds to the south of The Hills and eastern side of Castle Brook.	
The Hills	1848 – Present	Adjacent to the Golf club in the west of site.	

Lower Egypt Higher Egypt (Later Egypt Farm)	1848 – Present	On the southern boundary. Referred to as Egypt Farm from 1890.	
Unsworth Moss	1848 – Present	Located to the east onsite and shows continual expansion from the first maps with additional structures shown on every plan.	
Moss Side	1848 – Present	Located to the northeast and appears to go relatively unchanged.	
Ponds	1848 – Present	Three ponds are located to the west of Back of the Moors. Seven ponds to the south off Egypt Lane, four are recorded to the southwest from 1891 with none recorded from 2023. Six ponds are located to along the centre of the site following a track. One pond is recorded to the south of Moss Side. Multiple ponds are recorded with the development of the Golf Course from 2010.	
Castle Brook	1848 – Present	Castle Brook rises to the east of The Hills. Two unnamed drains flow into Castle Brook to the south.	
Egypt Lane	1848 – Present	Passes from east to west in the southwest onsite.	
Sand Pits	1848 – 1890	Two sand pits are recorded to the southeast adjacent to Sand Field Farm (offsite) One sand pit is recorded to the centre east off the unnamed track and south of Moss Side and west of Unsworth Moss.	Adjacent to Section C
Whittle Brook	1848 – Present	Runs along the eastern boundary.	Adjacent to Section C

Table 3-7 – Section G

Feature	Map Years	Location	Notes
Open fields with numerous small holdings and farms	1848-1981	The number of fields within the site boundary remain relatively consistent across the map editions.	Pilsworth Road runs across site as present.
Frog Hall	1848-1928	Adjacent to western section boundary	

Unnamed Watercourse	1848 – present	Across the centre north flowing east to west.	Appears to have been culverted over as part of the construction of the M66 between 1977 and 1980.
Reservoir	1891- Present	100m northwest of site	
Hummocks	1910- 1968	Central area of site. Labelled as Refuse Tip 1968.	
Industrial Estate including works and depot	1974- Present	Southwest of section area	Expanded to the northwest between 1980 and 1983. Further expansion southwest in 2001.
M66 Motorway	1981- Present	Running directly through section area north-south.	
Pilsworth Landfills north and south	2000- Present	To the east of section area	

Table 3-8 – Section H

Feature	Map Years	Location	Notes
Open fields with numerous small holdings and farms	1848- Present	Across site	Pilsworth present along northern boundary with several small holdings present, though the structures no longer recorded from 1955.
Brightley Beck	1848 – Present	Crosses western section	Flows north to south through the site boundary Before flowing westwards following Pilsworth Road.
Open fields	1848 – Present	Across site	Lane running through site east/west toward off site (west) sandstone quarry known as footpath 1890. Google Earth shows earthworks taking place in 2013 which appear to have been completed in 2019, anticipated to be the landfill.
4no. Ponds	1848 – 2010	Southern area	From 1890 only 1no. pond is shown.
Earthworks possible landfill	2012 – 2018	Across the north	Landfilling operation
Pilsworth Road	1848 – Present	Northern boundary	
Hareshill Road	1848 – Present	Eastern boundary	Known as Hares Hill Lane up until 1923
Queen Elizabeth Way	2022	Eastern Boundary	Splits the original Hareshill Road
Pond	1923 - 1955	North along Hareshill Road boundary	
Three Lane Ends	1848 – 2022	Adjacent to western section boundary	Several structures are recorded on western boundary up until 1965 when just the public house remains. (No longer present onsite following walkover).
Sewage Works	1965 – Present	50m west of western extent	

3.2.3 Surrounding History

Potentially contaminative land uses within 250m of the site boundary are summarised in Table 3.7 below.

Table 3-9 – Summary of History of Surrounding Land within 250m

Feature	Map Years	Location Relative to which Section Boundary	Notes (May impact other sections)
Development of the M62 Motorway	1974 – Present	Southern boundary of Section F, Section C and Section B.	Importing of made ground materials and possible hydrocarbon spillages from vehicles
Development of M66 Motorway	1981 – Present	West of Section E and Section F.	Importing of made ground materials and possible hydrocarbon spillages from vehicles
Infilling of multiple sand pits and quarries	1848 – 1894 and 1956 -1978	South of Section F and Section C.	Assumed infilled with unknown materials
Heywood Industrial Park development	1966 – Present	200m north of Section A	
Pilsworth Landfill	Unclear from mapping – aerial imagery suggests usage from early 2000s	100m north of Section E and Section D	
Reservoir (Now Pilsworth Fishery)	1851 – Present	Northern Boundary of Section A and Section E	
Quarry	1891 – 1965	Northern Boundary of Section A	
Pumping Station	1891 – 2001	Northern Boundary of Section A	
Chimney	1965 – 2001	Northern Boundary of Section A	
Morris' Mill then Pilsworth Bleachworks and later Works Later Pilsworth Cottages and Garic depot	1848 – Present	Approx 150m northwest of Section A Approximately 50m north of Section E	
Birch Industrial Park	1891 – Present	Sits between Section A, Section B, Section C and Section D.	Comprises industrial units including manufacturing and haulage businesses
Sewage Works	1956 – Present	Section A	
Sand pit	1848 – 1891	100m north of Section E	
Tanks and Windpump	1915 – 1965	Approximately 50m south of Section F.	

4.0 GEOLOGY, HYDROGEOLOGY, HYDROLOGY AND RADON

4.1 INTRODUCTION

Details of the geology underlying the site have been obtained from the following sources and are shown on drawing B048805-TTE-00-XX-DR-U-0007.

Geology Plan:

- BGS 1:50000 Map, Sheet No. 85 Manchester Bedrock and Superficial Deposits
- Mining Remediation Authority Interactive Viewer, accessed March 2024
- BGS website and Geindex (British Geological Survey, 2021), accessed March 2024.
- Environmental database – Groundsure Reports GSIP-2023-14200-16018_RR_A_1 to GSIP-2023-14200-16018_RR_F_1, presented in Appendix B.
- Environmental database – Groundsure Reports GS-4ZE-CGA-ZND-GJC to GS-QZX-I9X-A2Y-GPY, presented in Appendix B.
- BR211 Indicative Radon Mapping (Scivyer, 2015).
- MAGIC MAP online interactive mapper.
- Consultants Coal Mining Report
- BGS Borehole Data
- CCG-C-23-14270 Ground Investigation at Unsworth Farm November 2023

4.2 GEOLOGY

Below is a summary of the BGS recorded geology, based on the sources listed in Section 4.1, which is also shown on drawing B048805-TTE-00-XX-DR-U-0007 Geology Plan.

4.2.1 Made Ground

Infilled ground is present to the south onsite likely associated with the infilling of former sand quarries. Significant infilled ground is likely to be present beyond the northern boundary of the site associated with Pilsworth Landfill Site. Worked Ground is present around the Birch Industrial Park as well as on the southern and western boundaries associated with the development of the M62 and M66 respectively.

Made Ground is not recorded by the BGS GeoIndex nor the Groundsure report GS-QZX-I9X-A2Y-GPY, however a record is held for a licenced waste site for Harehill Equestrian Centre (at the South Heywood part of the site) held between March 2012 and February 2022 and operated by P Casey Enviro Ltd, transferred to Russells South Heywood limited in 2021. Described as deposit of waste to land as a recovery operation. The waste management licence number was 103489 with an annual tonnage of 306000. The Groundsure does not indicate the licence has expired though no works were observed as part of the site walkover undertaken in November 2023.

4.2.2 Superficial Geology

Superficial strata are found across site and primarily comprise Glacial Till. The following superficial deposits are also identified in some areas:

- Glacial Till across the majority of the site
- Peat deposits are recorded by the BGS in the southwest in Section F however, ground investigation has been undertaken to locate the Peat and recorded none as present as described in 4.5.
- Ice contact deposits (mainly sand with some gravel) in the centre and northeast.

- Glaciofluvial Deposits (sand and gravel with lenses of clay and stony clay) adjacent to the north western boundary and adjacent to the M66.
- A linear section of Head deposits (rock fragments and pebbles within a clay and sand matrix) follows the Brooks; Whittle Brook; Brightley Brook and Castle Brook.
- Morainic deposits (poorly sorted sand, gravel and silty clay with a hummocky topography) to the northwest.

There are glacial features onsite that can be attributed to glaciation and may account for the numerous small pond features such as Kettle Holes and drumlins.

The exploratory holes indicate the superficial strata in the north as being approximately 5m thick with the hydrogeology and becomes progressively thicker to the south onsite approximately 15m thick around Broomhill Farm and a minimum of 5m thick to the south.

4.2.3 Bedrock Geology

The bedrock geology comprises primarily Pennine Lower Coal Measures – mudstone, siltstone and sandstone to the centre and east onsite. To the west onsite comprises primarily Pennine Middle Coal Measures – mudstone, siltstone and sandstone.

To the north, the bedrock comprises the Rossendale Formation of Rough Rock (oldest in the succession) and Rossendale Formation (undifferentiated). The succession is becoming progressively younger in a south westerly direction.

In the area around Higher Barn Farm and in the centre of Section H, the Lower Coal Measures are expected to be near surface as no superficial deposits are shown on the BGS map.

4.2.4 Geological Features

There are multiple faults across the site which are primarily running from northwest to southeast and primarily downthrows to the southwest. Ashton Moss Fault strikes through the Pennine Lower Coal Measures northwest to southeast with a downthrow on the southwest side.

There are four coal seams recorded within the main development site:

- Arley Coal approximately 0.90 – 2.00m thick subcropping in Section G and underlying at depth Section B, Junction 19 of the M62.
- Lower Mountain Coal Seam approximately 1.30m thick, subcropping in Sections A, D and H;
- Lower Foot Coal Approximately 0.80m thick, subcropping in Section H.
- Bassey Coal Seam approximately 1.20m thick, outcropping in Sections A and D;
- Subcrenatum Marine Band (6") 0.15m thick subcropping in Sections A and D; and
- Sand Rock Coal Seam approximately 0.70m thick, subcropping in Sections A and D.

Glacial features have been recorded onsite and comprise Kettle Holes and Drumlins.

4.3 COAL MINING

The entire site, (Sections A – H), falls within a Coal Mining Reporting Area with Sections A, B, D, G and H located within a Development High Risk Area with respect to shallow coal.

The coal mining risk has been assessed in line with CIRIA C758D Abandoned Mine Works Manual in section 6.0 of this report.

Drawing B048805-TTE-00-XX-DR-U-0005.1 is the Coal Mining Features Plan shows the areas of higher coal mining risk which have been assessed in Section 6.0 of this report.

4.4 MINERAL MINING AND GROUND WORKINGS

The below Tables 4.1 to 4.9, summarise the likely Mineral Mined and Ground Workings relevant to the sections A – H Plan and limited to within approximately 250m of the outer redline boundary. Their locations are shown on drawing B048805-TTE-00-XX-DR-U-0005.2 Mineral Extraction Plan.

Table 4-1 – Mineral Mining and Ground Workings Section A

Feature	Location	Notes
Three Lane Ends Darn Hill, Heywood, Lancashire	North	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site Status description: Site which, at date of entry, has ceased to extract minerals. Sandstone – Ceased
Coal Pits	North	1851 – 1981, Mapping
Unspecified Pit	North	1928 – 1981, Mapping
Old Sandstone Quarry	Northwest	1851, Mapping
Ponds (17 records)	Across site	1851 – 1908, Mapping

Table 4-2 – Mineral Mining and Ground Workings Section B

Feature	Location	Notes
Lower Whittle Quarries Hopwood, Heywood, Lancashire	West	Sand extraction via Quarry and Sand Pit
Lower Whittle Sand Pit Hopwood, Heywood, Lancashire	West	Sand extraction via Sand Pit.
Doctor's Moss Siddall Moor, Heywood, Lancashire	Onsite	Sand extraction via Sand Pit.
Cuttings	Southern boundary	1975 – 1982, Mapping
Pond	Across Site	1890 – 1965, Mapping
Unspecified Ground Workings	Across the south	1909 – 1981
Unspecified Pit	Across the south	1909 – 1982

Brick yard	Southeast	1851
Sand Pit	Southwest	1851
Unspecified Ground Workings	Across the south	1909 – 1981
Unspecified Old Quarries	Southwest	1890
Reservoirs	Located to the south	1890 – 1955
Surface Mineral working	Whittle Lane Sand Pit	Planning Status Date – 09/07/1947 Sand
Surface Mineral working	Manchester Road	Commodity: Sand

Table 4-3 – Mineral Mining and Ground Workings Section C

Feature	Location	Notes
Whittle Sand Pit Birch, Rochdale, Lancashire	East	Sand extraction via Sand Pit.
Whittle Fold Sand Quarry Birch, Middleton, Lancashire	East	Sand extraction via It may be termed Quarry.
Cuttings	Southern boundary	1974 – 1981, Mapping
Pond	Across Site	1891 – 1938, Mapping
Unspecified Pit	Across the south	1909 – 1965
Refuse Heap	East	1955
Sand Pit	East	1851
Sand Quarry	East	1851
Surface Mineral working	Whittle Fold Farm	Planning Status Date – 18/05/1967 Sand and gravel
Surface Mineral working	Whittle Fold	Commodity: Sand

Table 4-4 – Mineral Mining and Ground Workings Section D

Feature	Location	Notes
Three Lane Ends Darn Hill, Heywood, Lancashire	North	A surface mineral working. Potentially as a Quarry or Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sandstone – Ceased Sand – Ceased
Reservoir	Northern Boundary	1851 – 1981, Mapping
Pond	Across Site	1891 – 1981, Mapping
Unspecified Pit	North	1928 – 1981, Mapping
Water Body	North	1955, Mapping
Sand Pit	North	1851, Mapping
Filter Tanks/Beds	North	1908 – 1955, Mapping

Table 4-5 – Mineral Mining and Ground Workings Section E

Feature	Location	Notes
Cuttings	Western Boundary	1981, Mapping
Pond	Across Site	1915 – 1981, Mapping
Unspecified Pit	North	1891 – 1974, Mapping
Unspecified Ground Workings	West	1891 – 1974, Mapping
Settling Tanks	North	1974, Mapping
Old Brick Field	Southeast	1891, Mapping

Table 4-6 – Mineral Mining and Ground Workings Section F

Feature	Location	Notes
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Unsworth Moss Sand Pit Bowlee, Middleton, Lancashire	Southeast	A surface mineral working possible Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
The Hills Gravel Pit Whitefield, Bury, Lancashire	Southeast	A surface mineral working. Former Sand and Gravel Pit. Site which, at date of entry, has ceased to extract minerals. Sand and Gravel – Ceased
Cuttings	West and southeast	1974 – 1981, Mapping
Pond	Across Site	1907 – 1981, Mapping
Unspecified Pit	North	1891 – 1965, Mapping
Unspecified Ground Workings	West	1932 – 1938, Mapping
Sand Pit	Southeast	1851, Mapping
Refuse heap	Onsite	1955, Mapping
Unspecified heap	Onsite	1932, Mapping
Gravel Pit	Southeast	1915 – 1923, Mapping
Surface Mineral working	Cowl Gate – Southwest	Planning Status Date – refused 5/04/1968. Sandstone
Surface Mineral working	Sandfield Farm – Southwest	Planning Status Date – Valid 17/08/1969 Sand and Gravel

Table 4-7 – Mining and Ground Workings Section G

Feature	Location	Notes
Cuttings	Across Site	1981, Mapping
Pond	Northwest	1955, Mapping
Unspecified Pit	North	1891 – 1965, Mapping
Unspecified Ground Workings	West	1932 - 1938, Mapping
Sand Pit	Southeast	1851, Mapping
Refuse heap	Onsite	1955, Mapping
Unspecified heap	Onsite	1932, Mapping
Gravel Pit	Southeast	1915 – 1923, Mapping

Surface Mineral working	Cowl Gate	Planning Status Date – refused 05/04/1968 Sandstone
Surface Mineral working	Sandfield Farm	Planning Status Date – Valid 17/08/1969 Sand and Gravel

Table 4-8 – Mining and Ground Workings Section H

Feature	Location	Notes
4no. Ponds	South	1938 - 1981
Pond	East offsite	1851
Old Sandstone Quarry	Southwest offsite	1851
Vein Mineral	Onsite	Underground mine workings are uncommon, although the geology is similar to that worked elsewhere. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.
Pond	East offsite	

Table 4-9 – Mineral Mining and Ground Workings within 250m of Redline Boundary

Feature	Distance to potential Impacted Section	Notes
Pilsworth Sand Quarry	227m northwest Section A	A surface mineral working as a Quarry/ Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Pilsworth South Quarry Pilsworth, Bury, Lancashire	172m west of Section A	A surface mineral working as a Quarry/ Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Doctor's Moss Siddal Moor, Heywood, Lancashire	91m East of Section A	A surface mineral working as a Quarry/ Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Sewage Works	50m northwest of Section A	1974, Mapping
Filter tanks	227m – 248m west of Section A	1928 – 1955, Mapping
Old Sandstone Quarry	93m northeast of Section A	1851, Mapping

Sandpit	91m east of Section A	1851, Mapping
Hollins Sand Pit Hollins, Bury, Lancashire	179m northwest of section E	A surface mineral working as a Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Cold Gate Sand Pit	90m southwest of Section F	A surface mineral working as a Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Three Land Ends Darn Hill, Heywood, Lancashire	101m northeast of Section A 197m – 222m west of Section A	A surface mineral working as a Quarry/ Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased Sandstone – Ceased
Manchester Road Sandpit Birch, Middleton, Lancashire	14m southeast of Section B	A surface mineral working as a Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Whittle Fold Sand Quarry Birch, Middleton, Lancashire	85m – 112m southwest of Section B	A surface mineral working as a Quarry/ Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Whittle Sandpit Birch, Rochdale, Lancashire	166m southwest of section B	A surface mineral working as a Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Cow field Hopwood, Heywood, Lancashire	179m northeast of section B	A surface mineral working as a Clay Pit. Site which, at date of entry, has ceased to extract minerals. Clay and Shale – Ceased
Whittle Fold Sand Pit Whitefield, Bury, Lancashire	109m south of section C 23m east of Section F	A surface mineral working as a Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Sandfield Sand Pit Bowlee, Middleton, Lancashire	211m south of Section C 87m east of Section F	A surface mineral working as a Sand Pit. Site which, at date of entry, has ceased to extract minerals. Sand – Ceased
Sandfield Farm	184m south of section C	Surface Mineral Working for Sand and Gravel, Valid and 17/08/1969
Pilsworth Clough Heywood, Lancashire	54m north of section D	A surface mineral working as a Quarry. Site which, at date of entry, has ceased to extract minerals.

4.5 HISTORICAL BOREHOLE LOGS

BGS logs have been referred to for information with boreholes onsite in Table 4-10 below. BGS borehole records are publicly available and have been used for information only.

The MRA were contacted regarding some abandonment plans which when reviewed described BGS borehole records for Pilsworth Opencast prospecting holes and were undertaken on Section A, B and Section D. All available historical boreholes have been overlaid onto B048805-TTE-00-XX-DR-U-0012 (Historical Borehole Location Plan).

Table 4-10– Available boreholes in relation to each Section

Section	Location On Site	Summary
Section A	North	<u>Heywood 1 Borehole – 1619m deep</u>
		- Unknown strata to 5.10m bgl - Rough Rock Sandstone to 16.60m bgl - Two bands of Coal (unknown thickness) – anticipated to be the Sand Rock Coal and Subcrenatum Marine Band (SMB). - Rough Rock Sandstone to 35.70m bgl - Upper Haslingdon Flags Sandstone to 54.50m bgl - Mudstone Siltstone to 76.20m bgl - G. Cumbriense Marine Band 73.50m bgl - Coal at 76.20m bgl - Lower Haslingdon Flags primarily Sandstone with mudstone bands to 171.60m bgl - Varying thickness' of sandstone, shales and mudstone beds to 1619m bgl
		6no. Pilsworth East Extension boreholes recorded as being confidential.
		Pilsworth Opencast Prospecting records describe variable depths of superficial strata becoming progressively thicker to the southeast. The superficial strata are typically 2.00m to 2.80m thick around Coal Pits and Higher Fields becoming 19.30m thick east of Birch Industrial Park underlain by mudstone and sandstone bands. Two coal seams were recorded on the NCB Drillers logs anticipated to be and locally recorded as the Sand Rock Coal and SMB (referred to as the 6" Coal on the driller's logs) and were recorded at variable depths though were consistent within local fault lines between 4.60m and 14.14m bgl (SMB) and 10.70 to 21.70m bgl (Sand Rock). Unnamed coal seams anticipated to be the SMB and Sand Rock were recorded as deep as 68.85m bgl becoming progressively deeper to the south. Potential workings were recorded around Coal Pits Farm between 10.83 and 13.80m below ground.

		Mine workings were recorded as being as deep as 20m bgl around Higher Fields by the BGS records.
Section B	West, Broom Hill Farm Boreholes	Topsoil: 0.50m bgl Brown SAND with clay partings: 2.50m bgl Orange brown SAND with clay partings: 4.00m bgl Red brown clayey SAND: 5.50m bgl Brown clayey SAND: 7.00m bgl Red brown clayey SAND: 8.50m bgl Orange brown silty SAND: 10.00m bgl Red brown clayey SAND: 11.50m bgl Dark grey stiff silty CLAY: 14.50m bgl Pilsworth Opencast Prospecting records describe the superficial strata as being up to 23.05m adjacent to Stock Nook Farm and underlain by mudstone and sandstone bands.
	East, Manchester Smart Motorway M60	Confidential
Section C	North, Broom Hill Farm Boreholes	Topsoil: 0.50m bgl Orange brown SAND: 1.20m bgl Brown silty SAND: 2.50m bgl Brown silty SAND: 6.00m bgl Purple brown firm silty CLAY: 6.50m bgl Brown silty SAND: 8.50m bgl Brown silty SAND: 12.00m bgl Grey brown soft CLAY: 14.50m bgl Groundwater present between 2.50 – 3.50m bgl
	East, Birch Services	Topsoil: 0.15m bgl Stiff dark brown sandy gravelly CLAY with silty sand bands: 0.50m bgl Stiff dark brown sandy CLAY: 4.00m bgl
Section D	East, Broom Hill Farm Boreholes	Topsoil: 0.40m bgl Orange brown SAND with clay partings: 1.50m bgl Brown Silty SAND: 2.50m bgl Black brown slightly clayey very silty SAND: 5.50m bgl Dark brown silty clayey SAND: 7.20m bgl Dark grey stiff silty CLAY: 11.00m bgl Pilsworth Opencast Prospecting records describe shallow workings in the Sand Rock Coal Seam to the west of Coal Pits Farm between 3.20m and 5.50m bgl. Further they describe mine workings between 7.90m and 20.55m around Higher Barn Farm. Boreholes 267 and 257 describe deep superficial strata in an area where superficial strata is typically between 1.50 and 6.90m deep and as such are potential shafts. (See Section 6.0).
Section E	Northwest, M66 Bury, Easterly bypass 27.27A	BH27/27A are recorded as being present onsite with the log shown as part of a section though no clear strata nor depths are recorded.
Section F	Pike Fold Golf Club	Hardcore Fill: 0.50m bgl Clay: 2.50m bgl

		Sand and Gravel: 3.00m bgl Clay: 6.30m bgl Gravel: 17.50m bgl Sandstone: 24.00m bgl
	Manchester Smart Motorway M60 WS21362B (east onsite)	Confidential
	M60 Package 2 Sandgaet to Overbridge to River Irk DS/M60/2/46 west	Made Ground to 4.00m bgl
Section G	Several boreholes relating to the development of the M66 Junction 3	The historic boreholes located onsite for Junction 3 of the M66 do not detail the depths and give a simple cross section of the encountered strata comprising: Topsoil; Silty Clay; Clay and Silty Clay. It is anticipated that this was undertaken prior to the construction of the motorway.
Section H	A117337_GI_V5 Ground Investigation Report WYG (Now Tetra Tech)	The report describes the below conditions across Section H. The ground conditions generally comprise an imported Made Ground/Topsoil over an imported Made Ground backfill which has been identified as up to approximately 12m depth. Underlying the backfill are Glacial Deposits which are absent in some parts of the site. These are underlain by Coal Measures.

4.6 HISTORICAL GROUND INVESTIGATION

4.6.1 CCG-C-23-14270 Ground Investigation at Unsworth Farm November 2023

In November 2023, CCG were asked to investigate the area of Section F at Unsworth Moss Farm to provide geotechnical information for development in particular the possible presence of Peat. 32No. window sample were undertaken to 3.00m bgl across the area denoted as Peat by the BGS with the locations overlain onto drawing B048805-TTE-00-XX-DR-U-0028 Peat Plan.

The boreholes recorded topsoil material overlying interbedded Silt, Sand and Clay bands to 3.00m with groundwater encountered between 1.00m and 1.50m bgl with WS25 recorded groundwater at 3.00m.

None of the exploratory holes identified Peat soils within 3.00m bgl.

4.7 BGS SOIL CHEMISTRY

The Groundsure Report provides Rural Topsoil Soil Chemistry Averages for the site. The information is indicative of the general vicinity and is not specific to the site and is displayed in the Table 4-11.

Table 4-11 – Soil Chemistry Averages

Determinand	Section A	Section B	Section C	Section D	Section E	Section F	Section G	Section H
	Minimum to Maximum (mg/kg)							
Arsenic	15 – 35	15 – 35	15 – 35	15 – 35	15 – 25	15 – 35	15 – 35	15

Cadmium	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Total Chromium	60 – 120	60 – 90	60 – 90	60 – 90	40 – 120	40 – 120	60 – 90	60 – 90
Lead	100	100 – 200	100 – 200	100	100 – 200	100 – 200	100	100
Nickel	15 – 30	15 – 30	15 – 30	15 – 30	15 – 30	15 – 45	15 – 30	15 – 30

4.8 HYDROGEOLOGY

4.8.1 Aquifer Classification

Table 4.12 describes the Aquifer classification for the strata found onsite and should be read in conjunction with drawing B048805-TTE-00-XX-DR-U-0007 Geology Plan.

Table 4-12 – Aquifer Classification

Strata	Aquifer Designation	Section
<u>Superficial</u>		
Glacial Till	Secondary Undifferentiated Aquifer	Sections A B, C, D, E, F, H
Peat	Unproductive Aquifer	Section F
Glaciofluvial Ice Contact Deposits	Secondary A Aquifer	Sections A, B, C, D, E, F
Glaciofluvial Sheet Deposits	Secondary Undifferentiated Aquifer	Section A
Glaciolacustrine Deposits	Unproductive Aquifer	Sections A, B, H
Hummocky Glacial Deposits	Secondary A Aquifer	Sections A, D, E, G
Head	Secondary Undifferentiated Aquifer	Sections A, D, E, F, H
Alluvium	Secondary Undifferentiated Aquifer	Sections C, D, E, F
River Terrace Deposits	Secondary Undifferentiated Aquifer	Sections D, E
<u>Bedrock</u>		
Pennine Lower Coal Measures	Secondary A Aquifer	Sections A, B, C, D, E, F, G, H
Pennine Middle Coal Measures	Secondary A Aquifer	Sections E, F
Woodhead Hill Rock	Secondary A Aquifer	Sections A, D
Rough Rock	Secondary A Aquifer	Sections A, D
Rossendale Formation	Secondary A Aquifer	Sections A, D

4.8.2 Groundwater Vulnerability

Guidance released by the EA (Environment Agency, March 2017) states that activities that have the potential to affect the quality or quantity of groundwater must prevent groundwater pollution. All groundwater is vulnerable to pollution, and some geological formations are more vulnerable than others. The risks of groundwater pollution from any given activity depend in part on:

- The physical, chemical and biological properties of the underlying soil and rocks;
- Depth and quality of soil;
- The presence of glacial sediment and other materials – known as ‘Superficial’ deposits; and,
- Depth of the unsaturated zone.

All of the above affect how groundwater is more or less vulnerable to pollution, with type of vulnerability generally one of the following:

- Intrinsic vulnerability – this relates to the physical characteristics, it includes soil type, presence of superficial soils, or rock type; and,
- Specific vulnerability – this relates to the effect of the proposed activity including any contaminant and consequent risk to groundwater.

The Groundwater vulnerability is considered to be generally Low as the superficial aquifers are described as being primarily unproductive and low vulnerability with a low recharge potential with the bedrock strata described as low vulnerability.

4.8.3 Groundwater Source Protection Zones

None of the site (Sections A – H) is situated within an EA defined groundwater Source Protection Zone (SPZ) relating to protection of groundwater for public water supply.

4.8.4 Groundwater Abstractions

There is one active licence relating to a Borehole at Sump B at Pilsworth Landfill within the site boundary, (Section A), under licence NW/069/0002/013 for Dewatering due to expire on the 31st March 2027

There is one active licence relating to a Borehole at Hills Lane (Pike Fold Golf Club) within the site boundary, (Section F), under licence 2569002273/R01 for general use and spray irrigation with an annual volume of 8000m³ and max daily volume of 200m³ due to expire on the 31st March 2027.

Note lawful unlicensed abstractions may be present in the surrounding area.

There is one active licence off site relating to Sump A at Pilsworth Landfill Site under licence NW/069/0002/013 (same licence as Sump B but recorded off site) for dewatering due to expire on the 31st March 2027. The closest recorded location to site is 614m north of Section E.

4.9 HYDROLOGY

Details of the hydrology of the area have been obtained from the following sources:

- Environmental database – Groundsure Reports GSIP-2023-14200-16018_RR_A_1 to GSIP-2023-14200-16018_RR_F_1, and
- Environmental database – Groundsure Reports GS-4ZE-CGA-ZND-GJC to GS-QZX-I9X-A2Y-GPY

4.9.1 Watercourses

The absence or presence of watercourses at or within 100m of the site boundary have been summarised in Table 4-13.

Table 4-13– Details of Watercourses

Feature	Section	Details
Brightley Brook	Sections A, D and H	Flows from the north to south through H before from the east to the west through Section A and along the northern boundary of Section D before combining with Castle and Whittle Brook to become Hollins Brook on the northern boundary of Section E flowing northwest away from site
Pilsworth Clough	Section A, D and H	Flows from east to the west along the southern boundary of Section H before flowing through Section A then merging with Brightley Brook on Section D northern boundary.
Whittle Brook	Sections C – F	Flows from the southeast to the northwest and forms the boundaries of sections C to F before combining with Brightley and Castle Brook to become Hollins Brook on the northern boundary of Section E flowing northwest away from site.
Castle Brook	Sections E – F	Flows from the south to the north through sections E and F before combining with Brightley and Whittle Brook to become Hollins Brook on the northern boundary of Section E flowing northwest away from site.
Hollins Brook	Section E	Formed from the merging of Brightley, Castle and Whittle Brooks on the northern boundary of Section E before flowing offsite to the northwest
Unnamed watercourse	Section G	A small watercourse is mapped flowing through the northern portion of site flowing east to west. This flows to a reservoir 375m west of site which discharges into the River Roch.
Inland rivers/ponds/lakes reservoir	Across Site	Multiple unnamed watercourses and features are recorded across site.

4.9.2 Water Framework Directive Surface Water Body Catchments

The rivers onsite are all part of the Whittle Brook (Irwell) Water Body Catchment as part of the Roch Irk Medlock Operational Catchment. The northern tip of Section A falls within the River Roch (Spodden to Irwell) Water Body Catchment as part of the Roch Irk Medlock Operational Catchment. The unknown watercourse in Section G also belongs to the River Roch (Spodden to Irwell) Water Body Catchment as part of the Roch Irk Medlock Operational Catchment.

Both River Roch (Spodden to Irwell) and Whittle Brook (Irwell) have chemical ratings of Fail, ecological ratings of Moderate with an overall rating of Moderate (as of 2019). The River Roch is not likely to be affected by the Northern Gateway site as it is located 1167m northwest of Section A.

The groundwater body underlying the site is the Northern Manchester Carboniferous Aquifers with a chemical rating of Poor, and a quantitative rating of Good with an overall rating of Poor (as of 2019).

4.9.3 Surface Water Abstractions

There are no active surface water abstractions recorded across site or within 250m of the redline boundary.

4.9.4 Discharge to Controlled Waters

Discharge licences to controlled waters are summarised below. Further details can be found in Section 4.13 from each of the Groundsure reports described within Appendix B.

- Section A – 3no. Current licences for final / treated effluent discharges to tributaries to Brightley Brook and Whittle Brook;
- Section B – 3no. Current licences for final / treated effluent discharges to Whittle Brook;
- Section C – No recorded current licences;
- Section D – 1no. Current licence for final / treated effluent discharges to Brightley Brook;
- Section E – 3no. Current licences for final / treated effluent discharges to Castle Brook; and
- Section F – 1no. Current licence for final / treated effluent discharges to Castle Brook tributary.
- Section H - 1no. Current licence for final / treated effluent - Not Water Company discharges to unnamed watercourse located approximately 17m east of site.

4.9.5 Pollution Incidents

Pollution incidents recorded onsite are described below with further details found in Section 4.18 from each of the Groundsure reports described within Appendix B.

On Site Incidents

- Section A – Three minor impact incidents in 2002 and 2003;
- Section B – A significant impact from construction and demolition materials and waste in 2020. Relating to Viking Coaches at Doctor Fold Farm, OL10 2QE. One minor impact in 2002;
- Section C – One minor impact in 2002;
- Section D – Two minor impacts 2001 and 2002;
- Section E – Two minor impacts 2001 and 2002; and
- Section F – One minor impact in 2002.
- Section G – Two significant impacts, 1no. to air in 2023 associated with the landfill and 1no. to diesel in 2013 to water and land.
- Section H – none recorded onsite.

Off Site Incidents

Significant impacts recorded within 250m of the site are described below:

The pollution incident recorded as No. 10200 in June 2001 described a significant impact to water from contaminated water and was recorded as being 93m west of Section D, at Pilsworth Fishing Lakes.

The pollution incident recorded as No. 532544 in September 2007 described a significant impact to water from unidentified oil and was recorded as being 213m west of Section D and 5m north of Section E at the Garlic Plant Hire Depot (Former Bleachworks area).

4.10 RADON

The risk of radon potential has been broken down for each section (A-H) from the Groundsure datasets (based on residential properties) and describes:

- Section A is primarily <1% Radon potential, with areas of 1% to 30% to the east and west onsite where the bedrock subcrops;
- Section B is primarily <1% Radon potential;
- Section C is primarily <1% Radon potential, with the western boundary along Whittle Brook with a rating of 10% to 30%;
- Section D is primarily <1% Radon potential, with the western boundary along Whittle Brook with a rating of 10% to 30% and the centre eastern area on site between 1% to 30% where the bedrock subcrops;
- Section E is primarily <1% Radon potential, with the eastern boundary along Whittle Brook and through the centre of site along Castle Brook with a rating of 10% to 30%; and
- Section F is primarily <1% Radon potential, with the eastern boundary along Whittle Brook and through the centre north of site along Castle Brook with a rating of 10% to 30%.
- Section G is primarily <1% Radon potential;
- Section H, is primarily between 3 and 5% Radon potential where the bedrock subcrops, though locally along the southern boundary is recorded as between 10 and 30% along the unnamed watercourse.

The majority of the site has a radon potential of <1% of buildings estimated to be above the action level however, the maximum radon potential was between 10% and 30% of buildings estimated to be above the action level for new buildings, this elevated level occurred in areas of outcropping bedrock strata and along water courses. It is therefore recommended that radon testing is undertaken for the proposed development.

Should radon protection measures be required they will comprise a radon barrier positioned over the floor of the structure and linked to cavity trays at the edges. Supplementary protection is also provided by locating underfloor vents on two or more sides of the underfloor space. Although underfloor ventilation reduces the amount of radon, which the radon barrier provided in the floor construction has to exclude, it should not be looked upon as a primary defence, in line with BR211 guidance.

4.11 UNEXPLODED ORDNANCE (UXO)

4.11.1 Online Risk Rating

Based on freely available mapping data from Zetica UXO (Zetica UXO, 2008), the site is located within a low-risk area with regards to Unexploded Ordnance (UXO). A 'Low Risk' area is defined by Zetica as:

'Low risk regions are those with a bomb density of up to 10 bombs per 1000 acres. These areas are considered to have a significant but low UXB risk. In general, further action to mitigate the risk is considered prudent, although not essential. Care is required when assessing the risk for specific sites where the risk may be higher because of local wartime activity'.

4.11.2 Anecdotal Evidence

One of the landowners detailed that Birch Industrial Park was formerly an RAF Base and that firing and bombing had been undertaken across Sections C/D and E/F with the potential for Sections A and B.

4.11.3 Preliminary Desk Study Assessment

A Preliminary Desk Study Assessment (PDSA) has been obtained from Zetica, based on the anecdotal information provided by one of the landowners and is included in Appendix F. To summarise the PDSA describes “Royal Air Force (RAF) Heywood, was established in the Groundsure Section A Site, and adjacent to the Groundsure Section B, C, and D Sites and has been included on the Site Features Plans B048805-TTE-00-XX-DR-U-0004A to B048805-TTE-00-XX-DR-U-0004F and B048805-TTE-00-XX-DR-U-0004H.

The UED supplied spare parts and equipment, including airframes, propellers, gun turrets, and oil. Further dispersed sites of RAF Heywood were established in the vicinity of the Groundsure Section E and G Sites.

1No. bomb cemetery is recorded as being present on Pike Fold Golf Course, on the Groundsure Sections E and F Sites.

Anecdotal evidence provided by David Hilary of Unsworth Moss Farm indicates that practice bombing was conducted on the western parts of the Groundsure Section C, D, E, and F Sites.”

4.11.4 P14015-24-R1-A Zetica UXO Desk Study

A UXO Desk Study has been obtained for the site referenced as P14015-24-R1-B Zetica UXO Desk Study Northern Gateway, shown in Appendix F, and describes the level of UXO risk to be **Low**. The report summarises that:

Key findings: No significant sources of Unexploded Ordnance (UXO) hazard have been identified.

Key actions: An UXO awareness briefing is prudent for staff involved in excavations.

The main findings of the report are summarised below.

- No records of military activity on the Site during World War One (WWI) have been found.
- In June 1939, a Universal Equipment Depot (UED), known as RAF Heywood, was established on land encroaching on the Groundsure Sections A, D, and G parts of the Site. It was assigned to No. 35 Maintenance Unit (MU). It stored a wide range of military equipment including airframes, propellers, gun turrets, marine craft, and oil.
- After World War Two (WWII), RAF Heywood remained in use. It closed in 1965 and has since been repurposed for commercial use.
- During WWII, the main strategic targets in the vicinity of the Site included RAF Heywood, RAF Bowlee, aircraft manufacturing, chemical, engineering, and metal works, and Heaton Park Reservoir.
- No records have been found indicating that the Site was bombed during WWII. Records indicate that the nearest High Explosive (HE) bomb fell approximately 0.1km west of the Site on the 2nd October 1940, (Section E).
- There were 17No. Heavy Anti-Aircraft (HAA) and Rocket AA (ZAA) batteries within 10km of the Site during WWII. The potential for an Unexploded AA (UXAA) shell to have fallen on the Site cannot be discounted.

4.11.5 Recommended Mitigation Measures

The UXO Desk Study, P14015-24-R1-B Zetica UXO Desk Study Northern Gateway, shown in Appendix F, recommends further works comprising: a UXO awareness briefing for any staff involved in excavations. The report describes no mitigation measures required for boreholes or piling works.

5.0 ENVIRONMENTAL DATABASE SEARCH

5.1 INTRODUCTION

Regulatory authority information relevant to the site and its surroundings has been obtained from review of information presented in the Groundsure Reports presented in Appendix B.

- Environmental database – Groundsure Reports GSIP-2023-14200-16018_RR_A_1 to GSIP-2023-14200-16018_RR_F_1.
- Environmental database – Groundsure Reports GS-4ZE-CGA-ZND-GJC to GS-QZX-I9X-A2Y-GPY.

Distances stated are approximate and are taken from the boundary of the site to the database recorded entries.

The following summary is generally limited to locations within 250m of the site boundaries unless it is considered that installations or activities beyond that range could potentially have an impact on the site or be affected by the redevelopment of the site.

5.2 INFILLED FEATURES

The absence or presence of infilled features at or within 250m of the wider has been summarized in Section 4.2.1 for Made Ground and Section 4.4 for ground workings for Groundsure sections A to H. The locations of the Made Ground/infilled deposits with respect to the sections are described there.

5.3 WASTE

The absence or presence of waste facilities at or within 250m of the site boundary are detailed within Section 3 of the Groundsure reports with the key details summarised below.

5.3.1 Summary of Active Waste Facilities

- Pilsworth North landfill site operated by Viridor Waste Management Limited located to the north of Section A beyond Pilsworth Road likely associated with Pilsworth Opencast Pit. The landfill is described as waste landfilling >10 Tonnes /Day (T/D) with capacity for >25,000T excluding inert waste.
- Pilsworth South landfill site operated by Viridor Waste Management Limited located to the west of Section A, east of Section G and north of Sections D and E likely associated with Pilsworth Quarry. The landfill is described as waste landfilling >10 T/D with capacity for >25,000T excluding inert waste.

5.3.2 Summary of Historic Waste Facilities

- Pilsworth Sand Pit Phase A – Historic Landfill operated by T Adams Limited located to the northwest of Section A beyond Pilsworth Road adjacent to the former Pilsworth Opencast Pit. The landfill is described as receiving Inert, Industrial, Special Environmental Permitting Regulations last recorded the 31st December 1989 with the licence surrendered on the 11th April 1994.
- Hareshill Equestrian Centre located on Section H - operated by P Casey Enviro Ltd, transferred to Russells South Heywood limited in 2021. The landfill appears to have run between March 2012 and February 2022 and describes a deposit of waste to land as a recovery operation. The Environmental Permitting Regulations (Waste) Licence Number: PCE006. The waste management licence number was 103489 with an annual tonnage of 306000. The Groundsure does not indicate the licence has expired though no works were observed as part of the site walkover undertaken in November 2023.
- A Refuse Tip is recorded as being present on Section G in 1966.

There are multiple waste exemptions held by the many farms and smallholdings located across site. These exemptions are predominantly for the use and storage of waste including sludge and mulch with some exemptions for burning waste. Full details are available in the Groundsure Reports shown in Appendix B.

5.4 HAZARDOUS SUBSTANCES AND HEALTH & SAFETY

The absence or presence of sites subject to restrictions in relation to Health & Safety within 250m of the site boundary has been summarised in Table 5-1 below.

Table 5-1– Summary of Hazardous Substances and Health and Safety

Facility Type	Name	Section	Details
Control of Major Accident Hazard	Holchem Laboratories Limited, Pilsworth/Bury, M66 Trading Estate, Pilsworth Road, Pilsworth, Bury, Lancashire, BL9 8RD	250m northwest of Section E	Current COMAH Site
Hazardous Substance Storage	Eddie Stobart Logistics Limited, Heywood, Unit M2 Heywood Distribution Park, Pilsworth Road, Heywood, Greater Manchester, OL10 2TR	3m west of Section H 103m northwest Section A	No details on enforcements
Licenced Pollutant Release (Part A(2)/B)	Moto Hospitality Ltd, Birch Services (West), Heywood Old Road, Heywood, Lancashire, OL10 2QH	Section B record for each the westbound and eastbound sides to the services	Process: Unloading of Petrol into Storage at Service Stations Status: Current Permit Permit Type: Part B Comment: No Enforcements Notified

5.5 ENVIRONMENTAL DESIGNATIONS

The site is part of an area of greenbelt known as Merseyside and Greater Manchester under both Rochdale and Bury local Authorities.

The site falls within a SSSI Impact zone therefore, any aviation development will require further consultation.

5.6 FLOODING

The absence or presence of flooding potential at the site is in table 5-2 below and is shown by drawing B048805-TTE-00-XX-DR-U-0009 Flood Zones.

Table 5-2 – Summary of Flooding Potential

Designation	Presence	Detail and Section
Risk of Flooding from Rivers and Sea	Yes	Highest Risk Section C, D, E, F High – associated with section of Whittle Brook
Historical Flood Events	No	-
Flood Defences	No	-

Area Benefiting from Flood Defences	No	-
Flood Storage Areas	No	-
Flood Zone 2	Yes	Section C, D, E, F – Identified (within 50m of the redline boundary)
Flood Zone 3	Yes	Section C, D, E, F – Identified (within 50m of the redline boundary)
Groundwater Flooding	Yes	Highest Risk Section A, B, C, D, F, H – Moderate (within 50m of the redline boundary) Highest Risk Section E, G – Low Identified (within 50m of the redline boundary)
Surface Water Flooding	Yes	Section A, B, C, D, E, F, G, H – Highest risk (within 50m of the redline boundary): 1 in 30 years, 0.3m – 1.0m

5.7 HISTORICAL LAND USES

The potentially contaminative historical land uses at or within 250m of the wider site boundary have been summarised on drawing B048805-TTE-00-XX-DR-U-0008 Contaminant Constraints Plan with a full list detailed in Section 1 and 2 in each of the Groundsure reports in Appendix B.

The key contaminative historical land uses indicated on the historical maps can be summarised by:

- Two former bleach works with filter beds and a sewage works bordering both Section D and E to the north of Brightley Brook and Hollins Brook recorded between 1891 and 1955 and in 1956 (only) respectively;
- Various ground workings, unspecified pits, quarries, coal / sand and gravel pits, brick fields, cuttings and heaps located across all available mapping and site;
- Two refuse heaps recorded as being present 1938 and 1955 in Sections C and F.
- Electrical substations located within Sections A, B and D between 1956 and 1992, (though were observed as being present as part of the site walkover November 2023).
- Historical Garages describing Birch Services and a vehicle repair garage off Doctor Fold Lane between 1965 – 1992.
- Former RAF Heywood, (now Birch Industrial Park) within Section A bordering Sections B, C and D was present onsite during World War 2 and up until 1967.
- Industrial Estate across Section G.
- Hareshill Equestrian Centre (landfill) on Section H.
- Heywood Industrial Estate to the north of Section H.

5.8 CURRENT INDUSTRIAL LAND USES

The potentially contaminative current land uses shown on historical maps at or within 250m of the wider site boundary have been summarised on drawing B048805-TTE-00-XX-DR-U-0008 Contaminant Constraints Plan with a full list detailed in Section 4 in each of the Groundsure reports in Appendix B.

The key potentially contaminative current land uses can be summarised by:

- Electrical substations recorded within Section A, B and G.
- Gas Valve Compounds recorded within Section A and on the northern boundary of Section D as well as a gas distribution centre in Section E.
- Birch Services (Petrol Stations), RG Motors and Birch garages are described as road and rail infrastructure as well as for vehicle repair and servicing located within Section B.
- Asda Pilsworth Automat (Petrol Station) Section G.

6.0 PRELIMINARY COAL MINING RISK ASSESSMENT

6.1 INTRODUCTION

The whole Northern Gateway site (Sections A – H) falls within a Coal Mining Reporting Area. Sections A, B, D, G and H are located within a Development High Risk Area with respect to shallow coal. The coal mining risk has been assessed in accordance with CIRIA C758D Abandoned Mine Works Manual and should be read in conjunction with B048805-TTE-00-XX-DR-U-0003 Groundsure Section Plan.

This Preliminary Coal Mining Risk Assessment has assessed the following higher risk areas of coal mining:

- North-eastern area of the site, Sections A, D and H.
- Beneath J19 of the M62, Section B.
- Beneath J3 of the M66, Section G

British Geological Survey (BGS) records obtained for the site, described in Section 6.5, indicate that opencast prospecting boreholes were undertaken within the north-eastern area of the site.

Tenant farmers anecdotally describe a historic mining village onsite at Meadowcroft Fold which borders the location of subcropping Low Mountain Coal, they also described a colliery located around Pilsworth Fishery car park.

These areas have been incorporated onto the Coal Mining Features Plan Drawing B048805-TTE-00-XX-DR-U-0005.1 to be read in conjunction with this risk assessment.

6.2 HISTORICAL REPORTS

Section H has previously been investigated as part of a separate planning application 16/01399/HYBR. A preliminary Coal Mining Risk Assessment produced by WYG, (now Tetra Tech), A117337/PCMRA_V2, (November 2020), was undertaken for South Heywood planning application.

The Coal Mining Report indicates that the southwestern area of Section H falls within a Development High Risk Area with respect to shallow coal from five subcropping seams; the Bassey Seam, Lower Foot Seam, Lower Mountain Seam, Sand Rock Seam and Six Inch Seam. The Coal Mining Risk Assessment describes that the E3P investigation targeted the coal seams and found intact bedrock to 30m bgl however, the targeted Coal Seams were not identified in the ground investigation.

It was considered that there was still a residual risk attributed to the potential underlying coal seams and as such, a Revised Coal Mining Risk Assessment was undertaken by WYG to locate and determine the condition of the underlying seams, reported under A117337/RCMRA_V2 dated November 2020.

The Revised Coal Mining Risk Assessment describes the findings of the rotary borehole works (RBH401 – 403), which records solid drilling to 30.00m and no loss of flush / air recorded.

Therefore, it was determined that there was a low risk of mine workings and no further works were considered necessary.

6.3 SOURCES OF INFORMATION CONSULTED

The following sources of information have been used to assess Sections A, B, D and G:

- BGS 1:50000 Map, Sheet No. 85 Manchester Bedrock and Superficial Deposits;
- Mining Remediation Authority Interactive Viewer, accessed November 2023;
- BGS website and Geoindex (British Geological Survey, 2021), accessed November 2023;
- Environmental database – Groundsure Reports GSIP-2023-14200-16018_RR_A_1 to GSIP-2023-14200-16018_RR_F_1, presented in Appendix B.

- Environmental database – Groundsure Reports GS-4ZE-CGA-ZND-GJC to GS-QZX-I9X-A2Y-GPY, presented in Appendix B;
- Consultants Coal Mining Report – GS-MG3-KZK-OCD-BF8 (Junction 3 M66);
- CON29M reports 51001498280001 and 51001498068001;
- Consultants Mining Reports GS-UK8-NHF-5JQ-AU8 and GS-QPK-PNG-52L-4CG.
- BGS Borehole Data; and
- Anecdotal information.

6.4 GEOLOGY

The geology is described by drawing B048805-TTE-00-XX-DR-U-0007 Geology Plan and is summarised in Section 4.2. BGS Sheet 85 and Geoindex suggests that Made Ground associated with coal mining is not present onsite.

The areas of mining risk area all indicated to be underlain by bedrock strata of Pennine Lower Coal Measures of mudstone, siltstone and sandstone with Milnrow Sandstone and Darwen Flags.

6.5 LINEAR FEATURES

6.5.1 Coal Seams

BGS Sheet 85 and the MRA interactive viewer indicates that coal seams both outcrop and subcrop in beneath the site. These seams are recorded as becoming younger to the southwest and as such it is considered the strata dips to the southwest. The seams underlying the site comprise:

- Arley Coal approximately 0.90 – 2.00m thick, subcropping below the northbound junction 3 on the M66 and present at depth below junction 19 of the M62
- Lower Mountain Coal Seam approximately 1.30m thick, subcropping to the south of Higher Barn Farm, Higher Fields, north and east of Birch Industrial Estate.
- Lower Foot Coal Seam approximately 0.80m thick, subcropping to north and east of Birch Industrial Estate.
- Bassey Coal Seam approximately 1.20m thick, outcropping to the north Higher Barn Farm, along Brightley Brook to the east of Coal Pit Farm and east of Higher Fields.
- Subcrenatum Marine Band 0.15m thick, subcropping to the north of Higher Barn Farm, below Coal Pits Farm, south of Three Lanes End and south of Brightley Brook to the east on site; and
- Sand Rock Coal Seam approximately 0.70m thick, subcropping to the north of Higher Barn Farm, below Coal Pits Farm, south of Three Lanes End.

6.5.2 Faults

Numerous fault sets are mapped across the Development High Risk Area. Three are located to the north of site and trend northwest-southeast in Section A, linking up to an east-west trending fault across B and D. There are two faults across Section H. The named Ashton Moss Fault is located on the western edge of the Development High Risk Area and trends northwest-southeast through site.

There are two faults running from the southeast to the northwest and downthrow strata to the southwest beneath Section G.

6.6 MINING REMEDIATION AUTHORITY REPORTS

The MRA reports, 51001498280001 and 51001498068001 and Consultants Mining Report, GS-MG3-KZK-OCD-BF8, have been obtained the development high risk areas of the main site.

6.6.1 CON29M Report – 51001498280001

This report covers the northern half of the development area to Whittle Brook in the west and Higher Fields to the east, the report states these areas are not within a surface area that could be affected by recorded past, present or future underground mining though acknowledges, that there may be unrecorded workings beneath the site.

The report describes five mine entries as being present onsite with four located at Higher Barn Farm and one mine entry located at Barlow's Coal Pit Farm. It is unknown if any of the mine entries have been treated. The tenant farmer at Higher Barn Farm suggested they were day shafts (adits) with at least one concreted over. This would require investigation to confirm.

There are no records of accepted coal mining subsidence claims, mine gas or hazards relating to mining recorded by the Mining Remediation Authority.

6.6.2 CON29M Report – 51001498068001

This report covers the south western area of site from the M66 in the west to Birch Industrial Estate in the east. It states that there are no coal mining features which may affect these areas.

There was one subsidence claim made at land off Brick field Farm was made in June 2000 for the land at Brick House Farm however, the claim was rejected and is not considered to be in an area at risk of coal mining.

6.6.3 Consultants Mining Report, GS-UK8-NHF-5JQ-AU8

The Consultants' Mining Report obtained for Section G, M66 states that no recorded mining has taken place onsite. It states that there may be unrecorded mine workings onsite likely associated with the Arley Coal Seam recorded as subcropping onsite.

There is also a statement that abandoned mine plans exist for the site in this report. These were obtained for this desk top assessment and are described in section 6.7 – BGS Opencast Prospecting boreholes.

6.6.4 Consultants Mining Report, GS-QPK-PNG-52L-4CG

The Consultants' Mining Report obtained for Section H states that no recorded mining has taken place onsite, this is corroborated by the ground investigation works undertaken by WYG (now Tetra Tech) reported in A117337/RCMRA_V2 dated November 2020, which indicate that the coal seams are intact.

6.7 BGS OPENCAST PROSPECTING BOREHOLES

The Consultants Mining Report GS-UK8-NHF-5JQ-AU8 for Section G identifies available abandonment plans for the area including Sections A, B and D. These were procured from the BGS for this desk top assessment and describe an investigation referred to as Pilsworth Opencast Prospecting boreholes. These boreholes along with the other non-mining historic boreholes are shown on the drawing B048805-TTE-00-XX-DR-U-0012 Historical Borehole Location Plan.

The drilling works commenced in September 1982 as shown on the drilling logs under Pilsworth_1703_003.

The letter between the Area Surveyor and Minerals Manager to the Regional Planning Manager, October 1982 potentially identifies Shaft 6 at Borehole 257 (identified on the Coal Mining Features Plan B048805-TTE-00-XX-DR-U-0005.1). Borehole 257 describes soft fill to 14m before the borehole was terminated.

Boreholes located to the north of Higher Barn Farm and records bedrock at levels between 1.50m and 6.90m bgl an anomalous depth to bedrock was recorded within Borehole 267 to a depth of 28.50m bgl with local boreholes describing and as such is considered as being a potential unrecorded shaft location, based on its location with respect to the recorded shafts.

The BGS records indicate that prior to the opencast prospecting investigation, extensive mining had been undertaken in the Sand Rock Coal Seam underlying the site the depth of which is described in Table 6.1 and are shown by the Coal Mining Features Plan B048805-TTE-00-XX-DR-U-0005.1 and Historical boreholes B048805-TTE-00-XX-DR-U-0012. The drillers logs describing physical cavities (voids), broken ground and areas of fill underlying the site.

Table 6-1 – Depth of Recorded Mine Workings from BGS Borehole records

Depth (m)	Recorded Location
0 – 10	West of Coal Pit Farm, Section A, D
10 - 20	Northeast and east of Higher Barn Farm Section D West and south of Higher Fields Section A
20 - 30	North and southeast of Higher Fields Section A
30 - 40	South of Higher Barn Farm Section D
40 - 50	Northwest of Higher Barn Farm East of Meadowcroft Fold Section D
50+	East of Meadowcroft Fold Section D

The drillers records have been provided with Appendix E.

The BGS boreholes undertaken on Section B, describe intact bedrock with Coal not present to 50m bgl.

Drill and grout records for the boreholes undertaken on the site have been provided with the BGS data and are dated March 1984. Based on the anecdotal notes below, it is anticipated that the grout works were to backfill boreholes undertaken in the first phase due to some of the boreholes previously collapsing. The workings were not backfilled as part of the works.

6.8 MINE ENTRIES

The abandonment plans include Drawing 03/1703/03 Composite Prospecting Information dated 1982, shown in Appendix E, produced by the National Coal Board, which shows 6no. “disused shafts” labelled 2 to 7 (there is no evidence of Shaft 1 on the plan). Shafts 4, 5 and 6 are generally consistent with the four shafts shown around Higher Barn Farm, Section D, in the MRA Interactive Viewer (Shafts 383408-005 – 008). The mine entries are summarised in Table 6.2 and are displayed on the Coal Mining Features Plan B048805-TTE-00-XX-DR-U-0005.1. The Coal Mining Features Plan Reference for the mine shafts is the numbering taken forward in this report.

Table 6-2 – Summary of Mine Entries

MRA Interactive Viewer	Pilsworth-03-1703-03 1982 Plan	Recorded Location	Coal Mining Features Plan Reference
383408-005	4	Higher Barn Farm, Section D	1

383408-006	5		2
383408-007	6 – Anticipated to		3
383408-008	be the same record		4
383408-009	No shaft recorded.	Coal Pits Farm, Section A	5
383408-001	7– Anticipated to		6
383408-002	be the same record	Pilsworth Fishing lake, northwest	7
383408-003	2	Section D	8
383408-004	3		9

Shaft 1 – 4 are located around Higher Barn Farm, Section D. Shaft 1 may be in the haybale storage area adjacent to the northern barn structure at Higher Barn Farm (based on the site walkover and anecdotal evidence from farmers in November 2023). Shaft 3/4 was potentially identified as part of the BGS boreholes by borehole 257 and was reported in a letter between the Area Surveyor and Minerals Manager to the Regional Planning Manager, October 1982.

Shaft 5 is located at Barlow Coal Pits, Section A.

Shafts 6 - 9 are located off site in Pilsworth Fisheries, northwest of Section D, and outside of the area of the MRA reports. These shafts are shown on the Coal Mining Features Plan B048805-TTE-00-XX-DR-U-0005.1. The letter between the Area Surveyor and Minerals Manager to the Regional Planning Manager, March 1982 identifies that Shaft 1 which appears to be located in the now offsite Pilsworth Fishing Lake Car Park and was sunk 132 feet (approximately 40m) to the Sand Rock Mine.

6.9 ANECDOTAL EVIDENCE

The tenants at Higher Barn Farm, Section D, have indicated the presence (in anecdotal conversation) of a former mining village at Meadowcroft Fold to the southwest of Higher Barn Farm. They indicated it is detailed by the 1850 – 1860 census for the area. This has not been obtained by Tetra Tech though the historical mapping shows multiple structures present between these dates at Meadowcroft Fold which were no longer recorded after 1890.

The tenant farmers also described a colliery in the car parking area of Pilsworth Fishing, as suggested by recorded mine shafts 6 – 9 on the Coal Mining Features Plan. This included a mine entry which is anticipated to have followed the Sand Rock Coal Seam based on the BGS records described above.

The farmers have also described works undertaken by the National Coal Board (NCB), (now Mining Remediation Authority), who drilled over 100no. boreholes as part of the Pilsworth Opencast Prospecting boreholes project and is corroborated by the BGS records in Section 6.6. They said that approximately 30no. of the exploratory holes collapsed after completion, and were recorded as being variable in depth, approximately 30m deep in some cases. The NCB returned to site and undertook drill and grout operations of their exploratory holes, only, as well as stoning up some of the larger holes. The collapse of the exploratory holes was put down to poor backfill and flowing water anticipated to be in potential workings.

The BGS locations and recorded collapse and stone filled positions are shown by the drawing B048805-TTE-00-XX-DR-U-0012 Historical Borehole Location Plan based on the BGS plan, Pilsworth_1703_012A.

The farmers described the recorded mine shafts, (1 – 4 on the Coal mining Features Plan), around Higher Barn Farm as Day Level, also known as an adit, though the BGS records, described above, would suggest they are likely shafts based on the 14m of fill and 28.5m of superficial strata recorded by BGS boreholes 257 and 267 respectively. They claimed that at least one of the entry points was concreted over and located in the hardstanding area where the hay bales are stored to the north of the farm and anticipated to be Shaft 1 on the Coal Mining Features Plan B048805-TTE-00-XX-DR-U-0005.1. They suggested that there may be additional unrecorded mine entries recorded in the fields immediately north of the Higher Barn Farm as reported by the drilling crews who undertook the prospecting investigation, as well as unrecorded mine entries around Meadowcroft Fold associated with the historic mining village.

6.10 COAL MINING HISTORY

Based on the information provided above, a summary timeline has been produced and will be used to inform the risk assessment section of this report:

- There are five records for mine entries onsite and one “located” potential unrecorded mine entry (Opencast investigation Borehole 267) recorded onsite as well as four records for mine entries located off site in the now Pilsworth Fishing Lake Car Park with one of those shafts identified as being approximately 40m deep sunk to the Sand Rock Mine by the BGS records. The BGS Sheet 85 for Manchester shows the Sand Rock Seam as being present onsite.
- The anecdotal information provided by the farmers from Higher Barn Farm suggest that the onsite shafts predate the historical mapping dated 1848 and that they were likely associated with the Meadowcroft Fold Mining Village shown to be present up until 1860 and corroborated by the census data from 1850 to 1860, not presented to Tetra Tech. Further, the shafts recorded offsite to the north may be associated with a colliery not recorded by the mapping data.
- The BGS records for the NCB Pilsworth Opencast prospecting boreholes (undertaken in 1982) identified mine workings across the northeast of the site as indicated on the coal mining features plan B048805-TTE-00-XX-DR-U-0005.1. These workings are anticipated to be associated with the Sand Rock Coal Seam at variable depths between:
 - 3.20 – 8.90m bgl to the west of Coal Pit Farm;
 - 10.83 – 20.90m bgl to the northeast of Higher Barn Farm and west of Higher Fields;
 - 23.20 – 29.70m bgl to the north and southeast of Higher Barn Farm;
 - 32.00 – 40.50m bgl to the northeast of Meadowcroft Fold;
 - 40.20 – 51.00m bgl to the northwest of Higher Barn Farm and north of Meadowcroft Fold; and
 - 56.70 – 57.70m bgl north of Meadowcroft fold.
- There are BGS records of grouting of the 1980s boreholes however, there are no grout records/plans for the mine workings themselves.

6.11 IDENTIFICATION AND ASSESSMENT OF COAL MINING RISKS

Table 6.4, below summarises the potential risks associated with the coal mining legacy for the site and have been determined from the MRA CON29M reports, 51001498280001 and 51001498068001 as well as the MRA Mining Report GS-MG3-KZK-OCD-BF8 in Appendix D. Information to support the risk assessment, as provided by the sources consulted discussed above, and have been incorporated onto the drawing B048805-TTE-00-XX-DR-U-0005.1 Coal Mining Features Plan to be read in conjunction with this risk assessment.

6.11.1 Risk Assessment Section A and D

Table 6-3– Coal Mining Legacy Risk Assessment

Coal Mining Feature	Risk	Preliminary Risk Assessment
Opencast Mining	Moderate	There are no records for opencast mining works from the Coal Mining reports. However, there is the potential for localised unrecorded

		opencast works based on the outcropping coal seams present onsite as well as the recorded shallow mine workings 3.20 – 8.90m bgl located around the reservoir located to the west and on Coal Pits Farm, Section D and Section A.
Underground Coal Mining	High	There are nine recorded mine entries anticipated to be associated with the Sand Rock Coal Seam. The Sand Rock, Subcrenatum Marine Band, Bassey Coal and the Lower Mountain Coal seams all subcrop the across the site. Historic mining village recorded at Meadowcroft Fold, Section D, which predates the historical mapping (1848). The NCB boreholes undertaken as part of the prospecting borehole works have identified mine workings in the Sand Rock Coal Seam, Section D and A and detailed on B048805-TTE-00-XX-DR-U-0012 Historical Borehole Location Plan. • 3.20 – 8.90m bgl to the west of Coal Pit Farm near a reservoir; • 10.83 – 20.90m bgl to the northeast of Higher Barn Farm and west of Higher Fields; • 23.20 – 29.70m bgl to the north and southeast of Higher Barn Farm; • 32.00 – 40.50m bgl to the east of Meadowcroft Fold; • 40.20 – 51.00m bgl to the northwest of Higher Barn Farm and east of Meadowcroft Fold; and • 56.70 – 57.70m bgl at Meadowcroft fold. Ground Investigation will need to be undertaken to determine the extent of the mine workings. Grouting of mine workings is likely to be required to facilitate the development.
Mine Entries (Shafts or Adits)	High	There are five mine entry records with four mine entries recorded around Higher Barn Farm, Section D and one at Coal Pits Farm, Section A, as detailed by drawing, B048805-TTE-00-XX-DR-U-0005.1 (Coal Mining Features Plan), with the five shaft records: • Mine Shaft 1. Assumed diameter 2.50m, no treatment records, margin of error on location 10m. Anecdotal information suggests this has been concreted over and is located underlying the Haybale store to the North of Higher Barn Farm. • Mine Shaft 2. Assumed diameter 2.50m, no treatment records, margin of error on location 10m. • Mine Shaft 3. Assumed diameter 2.50m, no treatment records, margin of error on location 10m. Potentially identified as part of the NCB Prospecting works in 1982 in borehole 257, which recorded very soft fill to 14.00m bgl. • Mine Shaft 4. Assumed diameter 2.50m, no treatment records, margin of error on location 10m. • Mine Shaft 5. Assumed diameter 2.50m, no treatment records, margin of error on location 10m. Name: Barlow's Coal Pits. There are four mine entry recorded around Pilsworth Fishing Lake, northwest of Section D, Mine Shaft 6 – 9, though no details have been

		provided. There is one BGS shaft record for the shafts around Pilsworth Fishing Lake Car Park which refers to targeting the Sand Rock Coal Mine. Borehole 267 undertaken as part of the NCB opencast prospecting works identified anomalous depth to bedrock of 28.50m with local boreholes describing 1.50 to 6.90m thickness to bedrock and as such is considered a potential unrecorded shaft. Anecdotal information provided by the farmers at Higher Barn Farm described a mining village as being present at Meadowcroft Fold which was detailed in the 1850 – 1860 census and shown on the historical maps as being present. Therefore, it is considered that there is potential for unrecorded mine entries. The shafts will need to be identified prior to redevelopment of the site. They are likely to require treatment. This can be confirmed based upon the proposed masterplan.
Coal mining geology (fissures)	Low	There are no recorded mining induced fissures recorded onsite. There are four northwest-southeast trending faults, down throwing strata to the southwest which cross site. The Ashton Moss fault is recorded as being present to the west of Meadowcroft Fold. There is one fault beneath Junction 19 of the M62 Section B. Faults can act as pathways for mine gas into structures.
Risk of mine gas emissions	High	Mine workings and mineshafts have been identified around Coal Pit Farm, Higher Barn Farm, Higher Fields, Meadowcroft Fold and Reservoir, Sections A and D. Gas monitoring should be included as part of the ground investigation works to assess the risk to the development.
Spontaneous Combustion of Coal Seams	Low	The coal seams recorded onsite are not listed by the MRA as being seams with a history of spontaneous combustion (Coal Authority, 2015).
Risk of coal mining subsidence hazard	Moderate / High	There are no records of coal mining subsidence within 50m of the Development High Risk Areas. Whilst there are no MRA records for coal mining subsidence onsite the risk is high from collapse of recorded shallow mine workings and mine entries onsite. Anecdotal evidence from conversations with tenant farmers suggest that the exploratory holes undertaken as part of the Pilsworth Opencast Prospecting Boreholes collapsed due to the backfill being washed away by flooded mine workings at depth. The BGS have provided records of the filling of the cavities with stone and grout.
Colliery Spoil – Including mine waste/coal dust within	Moderate	There are no records for colliery spoil onsite with none observed as part of the walkover.

made ground and embankments		However, given the presence of recorded mine workings it is anticipated around Coal Pit Farm, Higher Barn Farm, Higher Fields, Meadowcroft Fold and Reservoir.
Coal Infrastructure (e.g. headstock, foundations)	Moderate	There are no records for collieries or infrastructure present onsite with none observed as part of the walkover. However, given the presence of recorded mine workings and mine entries, some buried infrastructure may be present around Coal Pit Farm, Higher Barn Farm, Higher Fields, Meadowcroft Fold and Reservoir.

6.11.2 Risk Assessment Section B

Table 6-4 – Potential Coal Mining Legacy Risk Assessment

Coal Mining Feature	Risk	Preliminary Risk Assessment
Opencast Mining	Low	There are no records for opencast mining works from the Coal Mining reports, further, the BGS boreholes indicate underlying Coal Seams are >50m bgl.
Underground Coal Mining	Moderate/Low	The Arley Coal Seam is recorded as being worked below Junction 19 of the M62 however, is anticipated to be at a depth greater than 10x seam thickness with the BGS boreholes indicating solid bedrock to 50m however, these boreholes were undertaken on the western part of Section B.
Mine Entries (Shafts or Adits)	Low	There are no records of mine entries with 100m of the site boundary.
Coal mining geology (fissures)	Moderate/Low	There are no recorded mining induced fissures recorded onsite. There are five faults beneath Section B. Faults can act as pathways for mine gas into structures.
Risk of mine gas emissions	Low	Faults can act as pathways for mine gas. Tetra Tech has not been provided with any records of mine gas. Given that intact bedrock is recorded for 50m below Section B, gas monitoring is unlikely to be required as part of the investigation works.
Spontaneous Combustion of Coal Seams	Low	The coal seam recorded onsite is not listed by the MRA as being a seam with a history of spontaneous combustion (Coal Authority, 2015).
Risk of coal mining subsidence hazard	Low	There is the potential for mining to have taken place though is anticipated to be >10 seam thickness below the site.
Colliery Spoil – Including mine waste/coal dust within made ground and embankments	Low	There is the potential for colliery spoil to be present within the motorway embankment. However, given the proposed development, this is unlikely to be impact the remainder of Section B.

Coal Infrastructure (e.g. headstock, foundations)	Low	The closest mine entries relating to the Arley Coal Seam are located 400m from site and the BGS boreholes indicate 50m of solid bedrock and as such it is unlikely that there are mine entries onsite.
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6.11.3 Risk Assessment Section G

Table 6-5 – Potential Coal Mining Legacy Risk Assessment

Coal Mining Feature	Risk	Preliminary Risk Assessment
Opencast Mining	Moderate/ Low	There are no recorded opencast mine workings onsite by the consultants mining report. There is the potential for localised unrecorded opencast works based on the outcropping coal seam as well as recorded ground workings present onsite though is anticipated to have been addressed as part of the development of the M66.
Underground Coal Mining	Moderate	The Arley Coal Seam is recorded as subcropping the junction therefore, there is the potential for mining to have taken place though is anticipated to have been addressed as part of the development of the M66. Further investigation for mineworkings should be undertaken if the junction is to be expanded.
Mine Entries (Shafts or Adits)	Moderate/Low	There are no records of mine entries with 100m of the site boundary. However, given the Arley seam is recorded as subcropping the site there is the potential for mine entries to be present though are anticipated to have been addressed as part of the development of the M66. Further investigation for mine entries may be required if the junction is to be expanded.
Coal mining geology (fissures)	Low	There are no recorded mining induced fissures recorded onsite. There is one fault beneath Junction 3 of the M66 Section G. Faults can act as pathways for mine gas into structures.
Risk of mine gas emissions	Low	Faults can act as pathways for mine gas. Tetra Tech has not been provided with any records of mine gas. Given that any development around Junction 3 is expected to be to expand the junction only, gas monitoring is unlikely to be required as part of the investigation works.
Spontaneous Combustion of Coal Seams	Low	The coal seam recorded onsite is not listed by the MRA as being a seam with a history of spontaneous combustion (Coal Authority, 2015).
Risk of coal mining subsidence hazard	Low	There is the potential for mining to have taken place though is anticipated. This is likely to have been addressed as part of the development of the M66 but further investigation can be expected to be required if the junction is to be expanded.

Colliery Spoil – Including mine waste/coal dust within made ground and embankments	Low	There is the potential for colliery spoil to be present within the motorway embankment. However, given the proposed development, this is unlikely to be impacted as part of the development of the M66.
Coal Infrastructure (e.g. headstock, foundations)	Low	Given the Arley seam is recorded as subcropping the site there is the potential for mine infrastructure to be present though are anticipated to have been addressed as part of the development of the M66.

6.12 SUMMARY OF RISK ASSESSMENT

6.12.1 Section, A and D Risk Summary

The two main risks attributed to the site comprise: 1) shallow mine workings and 2) mine shaft collapse.

- 1) It is considered that based on the recorded shallow mine workings and anecdotal information that there is a **High** risk of shallow workings associated with the Sand Rock Coal Seam around Higher Barn Farm, Higher Fields, Coal Pit Farm and Meadowcroft Fold.
- 2) There is a **High** risk associated with mine entry collapse based on the presence of five recorded mine entries around Higher Barn Farm and Coal Pits Farm as well as the potential collapse risk of unrecorded mine entries based on anecdotal information for the area around Meadowcroft Fold and around Higher Barn Farm.
- 3) It is considered that there is a low risk of shallow mine workings in Section B based on the BGS boreholes

6.12.2 Section B

The risk from shallow mine workings to Section B is considered to be **Moderate/Low** based on the potentially unrecorded mine workings. However, it is considered likely that any shallow mine workings would have been identified and mitigated as part of the development of the motorway. Furthermore, the BGS boreholes indicate solid strata to 50m bgl and as such it is considered that sufficient bedrock will be present to mitigate the risk from any mineworkings below 50m bgl. Tetra Tech have not been provided with any information regarding the development on the M62.

6.12.3 Section G

The risk from shallow mine workings to Section G is considered to be **Moderate** based on the potentially unrecorded mine workings and mine entries. However, it is considered likely that any shallow mine workings would have been identified and mitigated as part of the development of the motorway. Tetra Tech has not been provided with any information regarding the development on the M66 and Pilsworth Industrial Park.

6.12.4 Section H

The risk from mine workings to Section H is considered to be **low** based on previous works undertaken by WYG, reported under A117337/RCMRA_V2 dated November 2020.

6.13 HAZARD MITIGATION STRATEGY

6.13.1 Sections A and D Hazard Mitigation Strategy

The hazards presented by the coal mining legacy to the site of the intended development should be further investigated as part of a hazard mitigation strategy as follows:

- Ground investigation to identify the MRA recorded mineshafts and the shaft at BH257.
- Further discussion with tenant farmers to establish risk from / locations of unrecorded mineshafts at and around BH267.
- Boreholes including rotary coring to determine the extent, depth and condition of the workings identified during the opencast prospecting ground investigation, this is to enable geotechnical assessment for foundations and ultimately for grouting specification.
- Gas monitoring to determine mine gas emissions through the coal measures and/or old workings where present;
- Refinement of the Coal Mining Risk Assessment following the ground investigation;

Mitigation to be considered as follows:

- Consideration of the masterplan to avoid known mineshafts where possible;
- Detailed design and mineshaft caps will be required where any construction is proposed over mineshafts. If building over mineshafts is required, it will need justification and build over agreements will need to be sought from the MRA and can be expected to require detailed design and consultation;
- Grouting of identified mine workings if present beneath proposed structures within depth of influence;
- Piled foundations may be required which extend below worked seams (including where grouted) where mine workings are within depth of influence of shallow foundations.
- Re-engineering of opencast backfill if present on site.

All ground investigations and remedial works that will disturb MRA mining interests must only be implemented after permission has been obtained from the MRA. The works must be conducted in accordance with the terms of the permission granted.

6.13.2 Section B and G Hazard Mitigation Strategy

The hazards presented by the coal mining legacy to the site of the intended development should be further investigated as part of a hazard mitigation strategy as follows:

- Boreholes including rotary coring to determine the extent, depth and condition of the unrecorded mine workings, this is to enable geotechnical assessment for foundations and ultimately for grouting specification.
- Gas monitoring to determine mine gas emissions through the coal measures and/or old workings where present;
- Refinement of the Coal Mining Risk Assessment following the ground investigation;

Mitigation to be considered as follows:

- Consideration of the masterplan to avoid any identified mineshafts and or mine workings in areas of the proposed development;
- Grouting of identified mine workings if present beneath proposed structures within depth of influence;
- Piled foundations may be required which extend below worked seams (including where grouted) where mine workings are within depth of influence of shallow foundations.

- Re-engineering of opencast backfill if present on site.

All ground investigations and remedial works that will disturb MRA mining interests must only be implemented after permission has been obtained from the MRA. The works must be conducted in accordance with the terms of the permission granted.

7.0 CONCEPTUAL SITE MODEL AND PRELIMINARY GROUND CONTAMINATION RISK ASSESSMENT

7.1 OVERVIEW

The information presented in the previous sections of this report have been collated and evaluated to establish an initial qualitative risk assessment for the Northern Gateway site, (Sections A – F). A preliminary conceptual model of the site has been generated based on information derived from this assessment, supplemented by information attained during the Tetra Tech site walkover. The off site M66 Junction 33 is considered separately in Section 9.0.

Sections A – F have been considered with regard to current UK legislation and guidance, namely Part 2A of the Environmental Protection Act 1990 and the Contaminated Land (England) Regulations 2006, as amended, and in accordance with current UK good practice guidelines (for example BS10175:2011).

In general, ground contamination can occur through several causes, particularly from historical operations and activities. Contamination can result from either on-site sources or from on-site migration from off-site sources, leading to long term liabilities under recent legislation for any site owner.

For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- Source, i.e., a substance that is capable of causing pollution or harm;
- Pathway, i.e., a route by which the contaminant can reach a target; and
- Receptor (target), i.e., something which could be adversely affected by the contaminant.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

7.2 CURRENT SITE USAGE AND PROPOSED DEVELOPMENT

The site according to presently available masterplans currently has a commercial end use and this assessment is undertaken on the basis of future commercial use.

7.3 CONCEPTUAL SITE MODEL

The key source, pathway and receptor model is outlined below within the context of the commercial use of the site.

7.3.1 Potential Sources of Contamination

Potential sources associated with each section have been described below and are shown on the contamination constraints plan B048805-TTE-00-XX-DR-U-0008 (Contamination Constraints Plan):

On-site Sources

- 1) Hydrocarbon/contaminants in above/below ground tanks and potential spills/leaks associated with farming land use and gas valve compound;
- 2) Hydrocarbon/contaminants in above/below ground tanks and potential spills/leaks associated with fuel storage, petrol and electrical sub stations;
- 3) Made Ground – potential for hydrocarbons in Made Ground and Ground Gas generation associated with unknown fill material, (landfill, ponds, pits, quarries etc);
- 4) Use of Pesticides/herbicides across farmland;

- 5) Made ground Asbestos Containing Materials (ACMs); and
- 6) Mining Waste - Colliery Spoil unknown contaminants and potential ground gas;

Off-site Sources

- 7) Pilsworth Landfill to the north, leaching of contaminants, ground gas generation;
- 8) Former Bleach works on northwest boundary and potential for historic spills/leaks;
- 9) Substations and potential for historic spills/leaks; and
- 10) Adjacent commercial land use.

7.3.2 Potential Contaminant Pathways

The following contaminant pathways are considered to potentially be active based on the current site use and proposed development and are shown on the contamination constraints plan B048805-TTE-00-XX-DR-U-0008 (Contamination Constraints Plan):

Human Exposure Pathways

- 11) Direct dermal contact or ingestion of soils, or inhalation of dust and/or vapours (i.e. human interaction with surface and sub-surface materials).

Environmental Pathways

- 12) Leaching and horizontal or vertical migration through the unsaturated ground, either through permeable sub-surface materials and/or preferential pathways;
- 13) Lateral and vertical migration of groundwater through permeable sub-surface materials and/ or preferential pathways;
- 14) Leaching to surface water run-off/drainage; and
- 15) The migration and accumulation of gases or vapours through permeable sub-surface materials and/ or preferential pathways.

7.3.3 Potential Receptors at Risk

The following potential receptors have been identified, numbered and are shown on the contamination constraints plan B048805-TTE-00-XX-DR-U-0008 (Contamination Constraints Plan):

Human Health

- 16) Future site users (residential/commercial/industrial);
- 17) Construction / Maintenance Workers (during and post construction); and
- 18) Adjacent site users (residential/commercial/industrial).

Wider Environment

- 19) Underlying Superficial Unproductive Aquifer (Peat, Glaciolacustrine strata);
- 20) Underlying Superficial Secondary Undifferentiated Aquifer (Glacial Till, Glaciofluvial Sheet Deposits, Head, Alluvium, River Terrace Deposits);
- 21) Underlying Superficial Secondary A Aquifer within Glaciofluvial Ice Contact Deposits, Hummocky Glacial Deposits;
- 22) Underlying Bedrock strata are all Secondary A Aquifers;
- 23) Building Infrastructure and supply pipes; and
- 24) Adjacent Properties.

Surface waters

- 25) Whittle Brook;
- 26) Castle Brook;
- 27) Brightley Brook;
- 28) Hollins Brook;
- 29) Pilsworth Fishery Reservoir;
- 30) Ponds; and
- 31) Unnamed surface water courses.

7.4 GROUND CONTAMINATION RISK ASSESSMENT

The source, pathway, receptor linkages are presented with a qualitative risk assessment in the following tables.

The risk assessment assesses potential risks to identified receptors in relation to the existing site setting and the proposed development. CIRIA C552 methodology has been used for the risk assessment and is presented in Appendix G.

Northern Gateway

Phase 1 Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

Table 7-1 – Preliminary Contamination Qualitative Risk Assessment for Commercial Use

This matrix is based on CIRIA C552 risk evaluation methodology, definitions for risk ratings is presented in Appendix G						
Source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk Classification	Justification & Potential Risk Management
Made Ground – potential contaminants associated with historical land use (hydrocarbon spillages from tanks PAH, TPH, pesticides and herbicides) (1, 2, 3, 4, 7, 8, 10, 11)	Dermal contact, ingestion and/or inhalation of or dusts 11	Human Health – Future site users (industrial) 16	Medium	Unlikely	Low	Localised areas of Made Ground are likely to be present based on a review of the site conditions. It is anticipated that the superficial soils are primarily cohesive (Glacial Till) and any spillages will be localized. Given the proposed development (commercial end use) it is likely that any Made Ground encountered will be placed below hardstanding or subsoil/topsoil in landscaped areas therefore removing the source pathway receptor linkage.
		Human Health (Construction and Maintenance Workers) 17	Medium	Low	Moderate/Low	Risk to be reduced through the use of appropriate site practices and PPE if contamination is identified during the ground investigation or subsequently during construction works.
	Leaching to groundwater, drainage and lateral / vertical migration. 12, 13, 14	Surface Water bodies 25, 26, 27, 28, 29, 30, 31	Medium	Low	Moderate/Low	Made Ground is likely to be present but given the history of the site any contamination is likely to be localized. Presence of buildings and hardstanding following development reduces the potential for infiltration and leaching. Cohesive superficial deposits will limit the potential for downward and lateral migration of water from the surface to the underlying aquifers and to surface water bodies by drainage systems. Coal Measures is a secondary aquifer and there are no source protection zones for groundwater abstraction at or near the site To be confirmed through ground investigation.
		Underlying Aquifers 19, 20, 21, 22	Medium	Unlikely	Low	
	Migration along/into service ducts and pipework 15	Buildings and Services 18, 23, 24	Medium	Low	Moderate/Low	Given the history of the site significant contamination is not anticipated. Testing of soils along supply routes may be required in accordance with the utility provider's assessment criteria once routes are known. Upgraded clean water pipework (e.g. HDPE) may be required in some areas.
	Dermal contact,	Human Health – Future site users	Severe	Unlikely	Moderate/Low	The site is primarily agricultural land and as such asbestos is not likely to be present across the majority of the site.

Northern Gateway

Phase 1 Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

This matrix is based on CIRIA C552 risk evaluation methodology, definitions for risk ratings is presented in Appendix G						
Source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk Classification	Justification & Potential Risk Management
Asbestos within the Made Ground / infilled quarries 5, 9	ingestion and/or inhalation of or dusts 11	(residential with plant uptake)				Given the age of some of the farm buildings and historic land use onsite there is the potential for asbestos in higher amounts in those areas. Also potential asbestos within backfilled quarries and sand pits. To be confirmed through ground investigation.
		Human Health (Construction and Maintenance Workers with PPE)				
Made Ground contaminants associated with infilled ground and colliery spoil 3, 6	Dermal contact, ingestion and/or inhalation of or dusts 11	Human Health – Future site users (industrial) 16	Medium	Unlikely	Low	If any colliery spoil is present it will likely be in Sections A, B (north), D, in the areas around Coal Pits Farm and Higher Barn Farm. No significant colliery spoil was noted as part of the walkover. Given the proposed development (commercial end use) it is likely that any colliery spoil encountered will be placed below hardstanding therefore removing the source pathway receptor linkage and any risk of combustion To be confirmed by ground investigation.
		Human Health (Construction and Maintenance Workers) 17	Medium	Low	Moderate/Low	Risk to be reduced through the use of appropriate site practices and PPE if contamination is identified during the ground investigation.
	Leaching to groundwater, drainage and lateral / vertical migration. 12, 13, 14	Surface Water bodies 25, 26, 27, 28, 29, 30, 31	Medium	Unlikely	Low	Contamination in any colliery spoil is likely to be limited. Presence of buildings and hardstanding following development reduces the potential for infiltration and leaching.
		Underlying Aquifers 19, 20, 21, 22	Medium	Unlikely	Low	Cohesive superficial deposits will limit the potential for downward and lateral migration of water from the surface to the underlying Aquifers and to surface water bodies by drainage systems. To be confirmed through ground investigation.

Northern Gateway

Phase 1 Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

This matrix is based on CIRIA C552 risk evaluation methodology, definitions for risk ratings is presented in Appendix G						
Source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk Classification	Justification & Potential Risk Management
	Migration along/into service ducts and pipework 15	Buildings and Services 18, 23, 24	Medium	Unlikely	Low	Contamination in any colliery spoil is likely to be limited. Testing of soils along proposed supply routes once known may in accordance with the utility provider's assessment criteria.
Ground Gas and vapours associated with infilled ground, adjacent landfills and underlying Pennine Coal Measures 3, 6, 7	Generation and migration / accumulation of ground gases	Human Health – Future site users (industrial) 16	Severe	Likely	High	Mine workings and mine shafts present a gas risk in the north eastern part of site (Sections A, B north, C and D). Multiple geological faults recorded across site could act as a pathway for mine gas. Gas monitoring is required as part of ground investigation.
		Human Health (Construction and Maintenance Workers with PPE) 17				
		Buildings and Services 18, 23, 24	Severe	Likely	High	

8.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

This section summarises the anticipated ground conditions and preliminary geotechnical assessment for the site, including highlighting the potential constraints for future development, based on the information identified in the preceding sections for the Northern Gateway site. Junction 3 of the M66 is considered separately in Section 9.0.

Actual ground conditions will need to be confirmed through several phases of ground investigation.

8.1 ANTICIPATED GROUND CONDITIONS

The following ground conditions are anticipated to be underlying the site as detailed by drawing B048805-TTE-00-XX-DR-U-0007 Geology Plan.

- Made Ground associated with infilled ponds, pits, quarries, motorway cuttings, and potential shallow or opencast workings.
 - Landfilled Made Ground associated with the former landfill on Section H.
- The following superficial deposits are identified
 - Glacial Till across the majority of the site
 - Ice contact deposits (mainly sand with some gravel) in the centre and northeast.
 - Glaciofluvial Deposits (sand and gravel with lenses of clay and stony clay) adjacent to the north western boundary and adjacent to the M66.
 - A linear section of Head deposits (rock fragments and pebbles within a clay and sand matrix) follows the brooks; Whittle Brook; Brightley Brook and Castle Brook.
 - Morainic deposits (poorly sorted sand, gravel and silty clay with a hummocky topography) to the northwest.
- The bedrock strata are primarily the Pennine Lower Coal Measures of mudstone, siltstone and sandstone with the Pennine Middle Coal Measures underlying the western part of the site.
- Information about groundwater is very limited. Two of the boreholes located to the west of Birch Industrial Estate detailed by the historical borehole plan B048805-TTE-00-XX-DR-U-0012 indicate groundwater was encountered between 2.50m and 3.50m bgl. Groundwater was not recorded as being encountered in the BGS boreholes though there are records of the boreholes being filled with water to ground level as part of the drilling records.
- The BGS record Peat as present in Section F, however the CCG-C-23-14270 Ground Investigation at Unsworth Farm November 2023 describes 32No. window sample boreholes to 3.00m bgl, with the boreholes recording topsoil material overlying interbedded Silt, Sand and Clay bands to 3.00m and no Peat is present at depth. Groundwater was encountered between 1.00m and 1.50m bgl with WS25 recorded groundwater at 3.00m.

8.2 POTENTIAL GEOTECHNICAL CONSTRAINTS TO DEVELOPMENT

Potential ground constraints are shown on drawing B048805-TTE-00-XX-DR-U-0006 Geotechnical Constraints Plan and listed below:

- | | |
|---|--|
| • Coal Mining – workings and mineshafts | • Glacial Till – poor for wet weather working |
| • Un-engineered Made Ground Infilled areas (former quarries, landfilled material and sand pits) | • Compressible soils – Lignite |
| • Gas risk associated within fill and mine gas. | • Slope instability. |
| | • Cutting into bedrock |
| | • Moderate risk of Landslides along riverbanks |

- Hummocky soils related to glacial deposition
may contain obstructions (boulders etc)

8.3 COAL MINING

Five known mineshafts are present on site which will need to be identified. The Coal Mining Risk Assessment for the site concludes that there is a high risk of shallow mine workings as recorded by the NCB boreholes which recorded cavities associated with the Sand Rock Mine around Coal Pit Farm, Higher Barn Farm, Higher Fields, Meadowcroft Fold and Reservoir. There is also potential mine entry collapse located around Higher Barn Farm and Coal Pits Farm. Further to this anecdotal evidence suggests that there is the potential for unrecorded mine entries and workings located around Meadowcroft Fold.

Excavation of near surface mineworkings and grouting of deeper mineworkings can be expected to be required.

Structures over mineshafts should be avoided where possible (even if they are treated and capped prior to construction). If building over mineshafts is required, it will need justification and build over agreements will need to be sought from the Mining Remediation Authority and can be expected to require detailed design and consultation.

Mineworkings and mineshafts to be confirmed through intrusive investigation and laboratory testing in due course to inform geotechnical design. Further details are presented in Section 6.0.

8.4 GEOTHERMAL VIABILITY

Shallow mine workings have been recorded as being present by the NCB boreholes which recorded cavities associated with the Sand Rock Mine around Coal Pit Farm, Higher Barn Farm, Higher Fields, Meadowcroft Fold and Reservoir. Therefore, there is the potential for geothermal power generation assuming the mine workings are flooded.

The NCB boreholes (undertaken in 1982) identified mine workings across the northeast of the site as indicated on the coal mining features plan B048805-TTE-00-XX-DR-U-0005.1. These workings are recorded at viable depths for geothermal heating between:

- 3.20 – 8.90m bgl to the west of Coal Pit Farm;
- 10.83 – 20.90m bgl to the northeast of Higher Barn Farm and west of Higher Fields;
- 23.20 – 29.70m bgl to the north and southeast of Higher Barn Farm;
- 32.00 – 40.50m bgl to the northeast of Meadowcroft Fold;
- 40.20 – 51.00m bgl to the northwest of Higher Barn Farm and north of Meadowcroft Fold; and
- 56.70 – 57.70m bgl north of Meadowcroft fold.

However, the proposed development will result in cutting / removing some of the shallow mine workings and the remaining mine workings may need to be grouted for stability. The feasibility of geothermal heating from the mine workings will be revisited following the preliminary ground investigation.

8.5 GEOCHEMISTRY

Pyritic soil conditions may exist within the Pennine Lower and Middle Coal Measures associated with the coal. A full suite of sulphate testing to allow the characterisation of ground aggressivity for concrete classification across the site will be required at ground investigation survey.

8.6 ENABLING WORKS

8.6.1 Cut and Fill and Earthworks

Significant cut and fill works are expected to be required to achieve development platforms for the proposed development. In general it is expected that material will be cut from the east and placed in the west due to the

general site topography which slopes down towards the west. Significant cut depths in the northeast could result in cutting into bedrock and potentially exposing mineworkings.

Much of the site is underlain by superficial Glacial Till deposits which are generally cohesive. In dry conditions such material is usually suitable for re-engineering in areas of filling. However, during winter and periods of wet weather, the material will be less suited to re-engineering and can be expected to require lime modification. It will also present poor tracking conditions for site plant during wet weather.

8.6.2 Materials Management

Cut and fill works will need to be undertaken in accordance a Materials Management Plan (MMP) following the CL:AIRE Code of Practice The Definition of Waste. The MMP will need to demonstrate material geotechnical and chemical suitability for use, certainty of use and that the volumes of material proposed for re-use are required.

The aim should be to achieve a site cut/fill balance to minimise lorry movements on and off site and to minimise waste disposal costs.

8.6.3 Temporary Works

Groundwater depths are currently unknown so the need for dewatering or excavation support is unknown.

All excavations requiring entry of personnel should be fully supported. Gas risks to construction personnel should also be considered.

Temporary works can be initially assessed after the first phase of ground investigation anticipated to be undertaken during 2024.

8.7 FOUNDATIONS

The foundations required will be dependent upon the structure types and loadings and the ground conditions.

In areas of cut or where Glacial Till is at or near surface, shallow foundations are likely to be suitable for lightly loaded structures. More heavily loaded structures may require ground improvement or piled foundations.

In areas of fill, where Glacial Till has been re-engineered to a suitable earthworks specification, demonstrated by post-earthworks conformance testing, shallow or raft foundations may be suitable for lightly loaded structures.

In the northeast, mine workings within the depth of influence of surface and foundation loadings will require grouting.

Shallow foundations may be suitable for some structures above grouted mine workings where the depth of influence of the foundation is shallower than the grouted mine workings depth.

Piled foundations may be required through grouted mine workings for more heavily loaded structures or where the grouted mine workings are within the depth of influence of the mine workings.

If peat or lignite are identified in any currently un-investigated areas it is expected that foundations will need to penetrate through any peat deposits to more competent strata beneath.

8.8 FLOOR SLABS, ROADS AND HARDSTANDING

Soils in areas of filling should be re-engineered to a suitable earthworks specification (and potentially in areas of cut depending upon the ground conditions) to facilitate the required floor slabs, hardstanding and roads.

In areas underlain by mine workings, grouting of the workings will be required beneath ground bearing floor slabs, even where slabs are supported by piles.

The risk of differential settlements should be considered in areas of variable ground conditions or where structures span cut and fill areas.

Settlement of hardstanding around buildings should also be assessed where buildings are piled.

Infilled quarries present a risk of differential settlement and should be identified and delineated and re-engineered near surface as required for tolerable settlements.

9.0 GEOTECHNICAL RISK REGISTER

9.1 OVERVIEW

This section presents an updated Geotechnical Risk Register (GRR) for the scheme. The risks have been evaluated using the risk evaluation matrix suggested in CD 622 'Managing Geotechnical Risk, which is reproduced as Table 9-1, and are presented in Table 9-2.

For the purposes of this report, risk has been assessed with reference to 'likelihood', 'severity' and 'risk'.

Table 9-1 – Risk Evaluation Matrix

Risk Matrix						
Likelihood		Severity				
		1	2	3	4	5
		Minor	Moderate	Serious	Major	Catastrophic
1	Extremely unlikely	1	2	3	4	5
2	Unlikely	2	4	6	8	10
3	Likely	3	6	9	12	15
4	Extremely likely	4	8	12	16	20
5	Almost certain	5	10	15	20	25
Potential severity of harm occurring						
1	Minor	Minor damage or loss - (no human injury)				
2	Moderate	Moderate damage or loss - (slight injury or illness)				
3	Serious	Substantial damage or loss - (serious injury or illness)				
4	Major	Major damage or loss - (fatal injury)				
5	Catastrophic	Catastrophic damage or loss - (multiple fatalities)				
Risk Classification						
Low (1-8)	Ensure assumed control measures are maintained and reviewed as necessary.					
Medium (9-19)	Additional control measures needed to reduce risk rating to a level that is equivalent to a test of "reasonably required" for.					
High (20-25)	Activity not permitted. Hazard to be avoided or risk to be reduced to tolerable level.					

Northern Gateway

Phase 1 Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

(1) Hazard Reference	(2) Activity/Process/ Material/Element	(3) Hazard (also indicate who is at risk and how)	(4) Stage of Work	(5) Initial Risk Level			(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk Level			(8) Is there a 'significant' residual risk to be passed on? (Y/N)	(9) Status (Active / Closed)
				Likelihood	Severity	Risk Level		Likelihood	Severity	Risk Level		
1	Collapse of mine workings	Building Settlement / Failure of Foundations / highway or hardstanding failure	During Design, During Construction, During operation	4	5	20	Detailed ground investigation (non intrusive and intrusive investigation) under an MRA permit the assess the shallow workings. Remedial measures such as grouting, designed to prevent collapse.	2	5	10	Yes Possible Unidentified Workings	Active
2	Collapse of mine shafts(known locations)	Building Settlement / Failure of Foundations. Coal Authority may not permit build over agreements	During Design, During Construction, During operation	4	5	20	Detailed ground investigation (non intrusive and intrusive investigation) under an MRA permit as required to locate and assess the condition of mine shafts Remedial measures 1) avoid construction over mine shafts 2) early consultation with the MRA and detailed design and construction of mine shaft caps if build over required 3) risk also to be assess for any development even where not buildings	1	5	5	No	Active

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Phase 1 Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

3	Collapse of mine shafts (unknown locations)	Building Settlement / Failure of Foundations. Coal Authority may not permit build over agreements	During Ground Investigation, Design, During Construction, During operation	4	5	20	Detailed ground investigation (non intrusive and intrusive investigation) over sufficiently wide area under an MRA permit as required to locate and assess the condition of mine shafts	2	5	10	Yes Risk of collapse of unknown mineshafts	Active
4	Collapse compression	Un-engineered made ground within quarries / backfilled pits / landfill	During Design, During Construction, During operation	4	4	16	Ground investigation to assess ground conditions, depth of fill and presence of groundwater within fill. Ground improvement method such as surcharging to be designed and constructed to appropriately mitigate risk if risk is considered to remain following GI and assessment	2	4	8	No	Active
5	Un-engineered made ground – particularly backfilled quarries / landfill	Building Settlement / Failure of Foundations	During Design, During Construction, During operation	4	3	12	Ground investigation to assess ground conditions, depth of fill etc. Foundation and ground improvement to be designed and constructed to appropriately mitigate the risk	2	3	6	No	Active
6	Loading land adjacent to water courses	Slope failures along the river banks	During Design, During Construction, During operation	3	3	9	Avoid construction close to watercourses. If construction required close to water courses, ground investigation and slope stability analysis to assess the potential for slope failures / landslide. Remedial measures to mitigate risk if required	2	3	6	No	Active

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Phase 1 Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

7	Differential settlement between buildings and infrastructure e.g. hardstanding, utilities and roads	Foundation solution for buildings is robust but un-engineered made ground supporting utilities and pavement	During Design, During Construction, During operation	3	3	9	Ground investigation to assess ground conditions, depth of fill etc. Foundation solution to be considered together with ground solutions for pavement and infrastructure. Ground improvement or re-engineering to be implemented if required to mitigate risk	2	3	6	No	Active
8	Compression of the natural ground	Compressible lignite deposits (Sections B and C)	During Design, During Construction, During operation	2	4	8	Ground investigation to assess lateral and vertical extents of lignite deposits and its compressibility potential. Ground improvement method or remedial measures to be designed and constructed to appropriately mitigate risk to development or it may be removed as part of the site cut to level	1	4	4	No	Active
9	Obstructions in the ground	Extensive, deep or heavily reinforced obstructions including foundations etc in the ground associated in particular with the bleach works and woollen mill	During ground investigation, design and Construction	2	4	8	Ground investigation to assess risk of obstructions Earthworks specification to address extent of foundations and obstructions and to remove them as appropriate. Future purchasers / developers to be made aware of risk of obstructions remaining in the ground	1	4	4	Risk remains during construction period	Active

Northern Gateway

Phase 1 Geo-environmental and Geotechnical Desk Study and Coal Mining Risk Assessment

10	Unexpected contamination - outside of areas where it is anticipated based on historical information (see contamination risk assessment sections of this desk study report for further details)	Unexpected contamination - H&S and cost	During construction	4	2	8	Ground investigation to assess the anticipated areas. Other unexpected contamination on site is likely to be localised. Earthworks specification to include for measures should contamination be encountered. Cost plan to include allowance.	2	2	4	Risk remains during construction period	Active
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10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

10.1.1 Preliminary Geotechnical Assessment

Foundations are likely to be variable across site and will be dependent on the proposed structure loadings as well as the strength and compressibility of superficial deposits, depth to bedrock and depth to mineworkings. Piled foundations can be expected to be required in some areas whilst shallow foundations may be suitable within shallow bedrock subject to depth, mine workings (see below) and design loads.

Unengineered made ground may be present in former quarries and landfilled areas, presents a risk of different settlement.

There may be potential for geothermal heat generation associated with shallow mine workings and mine water though it is likely that grouting of shallow workings will be required for development stability, rendering them unsuitable for heat generation.

10.1.2 Coal Mining Risk Assessment

The Coal Mining Risk Assessment for the site concludes that there is a **High** risk of shallow mine workings recorded by the cavities identified as part of the BGS borehole records associated with the Sand Rock Mine around Coal Pit Farm, Higher Barn Farm, Higher Fields, Meadowcroft Fold and Reservoir Section A and Section D. There is also a **High** risk from potential mine entry collapse located around Higher Barn Farm and Coal Pits Farm Section A and Section D.

Excavation of near surface mineworkings and grouting of deeper mineworkings can be expected to be required.

Structures over mineshafts should be avoided where possible (even if they are treated and capped prior to construction). If building over mineshafts is required, it will need justification and build over agreements will need to be sought from the Mining Remediation Authority and can be expected to require detailed design and consultation which still may not be given.

The risk from shallow mine workings to Sections B and G is considered to be **Moderate to Moderate/Low**. Grouting may be required below any junction expansion / improvements.

The risk from shallow mine workings to Section H is considered to be Low and assessed as part of previous investigations.

10.1.3 Ground Contamination

The risk from ground contamination at the site is considered to be as follows:

- **High risk** for ground gas associated with the infilled land, South Heywood landfill, mine shafts and mine workings and peat.
- **Moderate/Low** risk to future site users and construction and maintenance workers from made ground on site
- **Low risk** to controlled waters (underlying aquifers) from made ground on site.
- **Moderate/Low** risk to the surface water courses from the potential Made Ground on site.

10.2 RECOMMENDATIONS

10.2.1 Northern Gateway

Several phases of intrusive ground investigation will be required across the site. It can be expected that more than one phase will be required in each part of the site as design progresses.

Boreholes will also need to be progressed deeper into the bedrock to assess the coal mining in the north west of the site and refinement of the coal mining risk assessment will be needed. Geophysics, trial trenching and potentially boreholes will be needed to locate the mineshafts. Refinement of the Coal Mining Risk Assessment will be required following investigation to determine the nature, extent and condition of mine workings. Grouting of mineworkings and capping of mineshafts can be expected to be required.

Several phases of geotechnical ground investigation will be required to determine the parameters of the underlying soils and to obtain data for geotechnical design including foundations, earthworks, retaining structures, settlement assessment and pavement design and to provide information about groundwater levels.

Geo-environmental investigation and testing of the underlying soils will be required for areas including infilled ground and the former bleach works.

Ground gas and mine gas have been identified as a potential risk associated with the areas of infilled land, potential mine workings and adjacent landfill. Gas monitoring will be required to provide a preliminary assessment of the ground gas risk.

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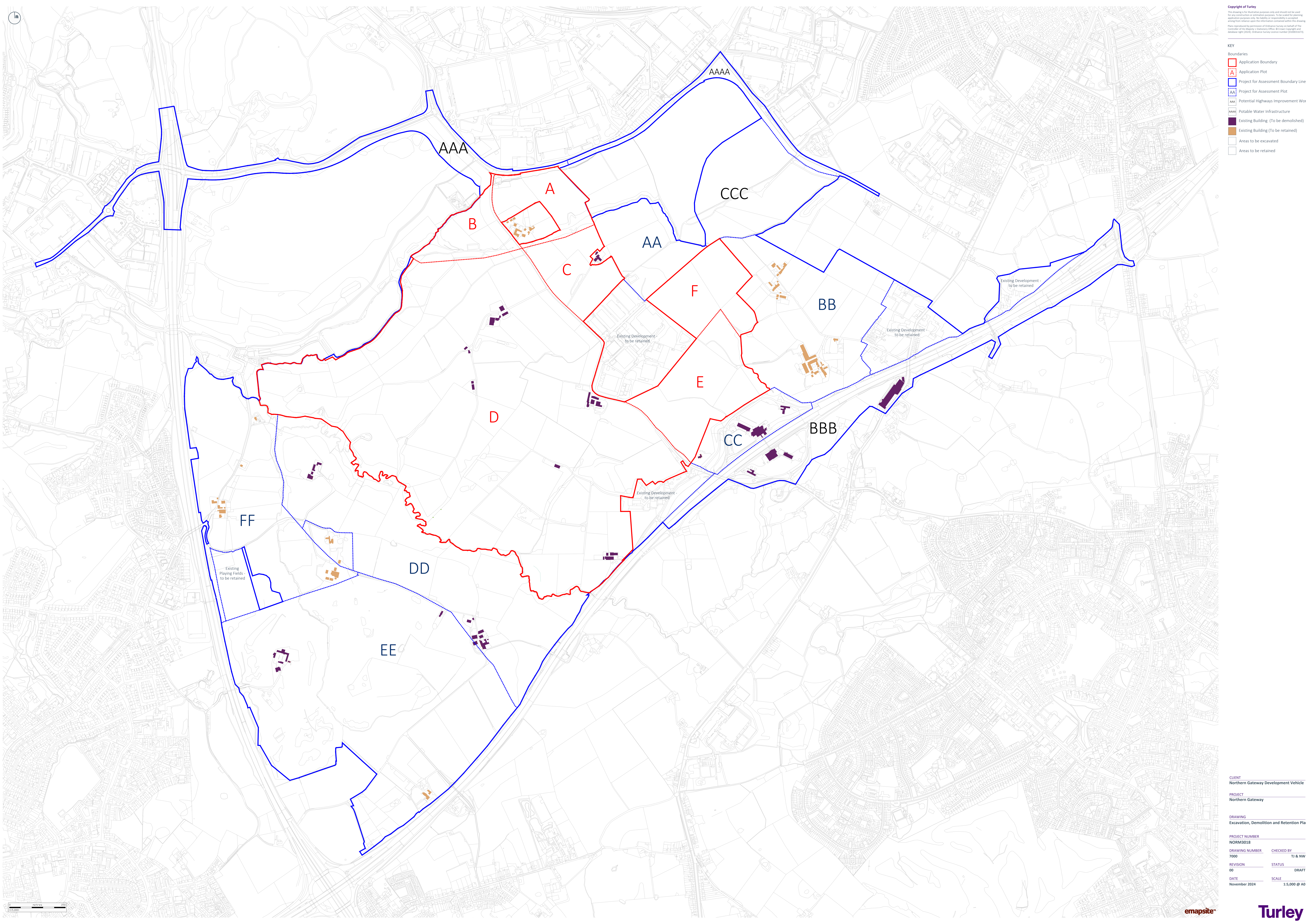
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P14015-24-R1-A Zetica UXO Desk Study Northern Gateway dated March 2024

THIRD PARTY DRAWINGS

DRAWINGS



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KEY

Boundaries

- Application Boundary
- Application Plot
- Project for Assessment Boundary Line
- Project for Assessment Plot
- Potential Highways Improvement Works
- Potable Water Infrastructure
- Existing Building (To be demolished)
- Existing Building (To be retained)
- Areas to be excavated
- Areas to be retained

CLIENT
Northern Gateway Development Vehicle

PROJECT
Northern Gateway

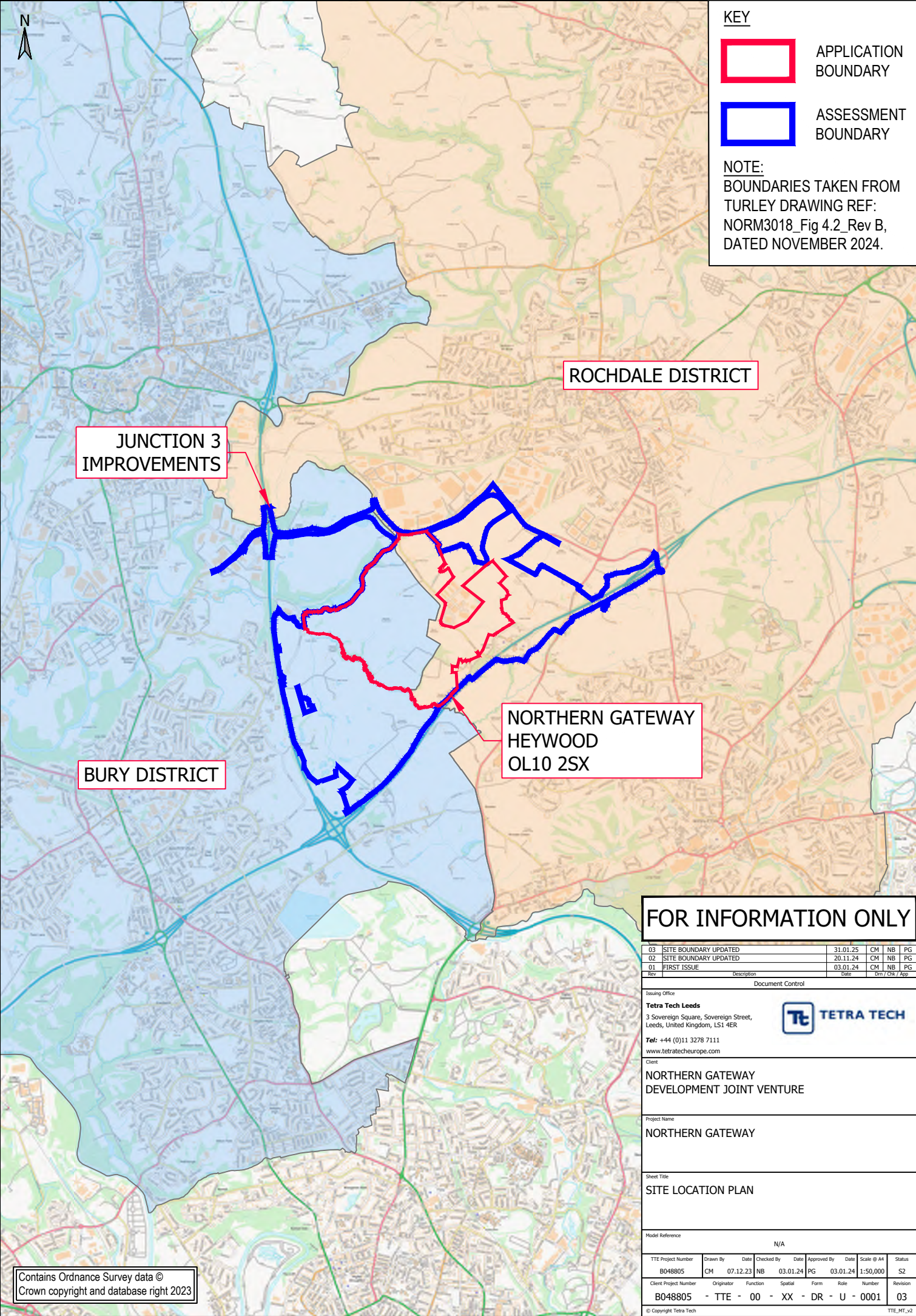
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Excavation, Demolition and Retention Plan

PROJECT NUMBER
NORM3018

DRAWING NUMBER 7000	CHECKED BY TJ & NW
REVISION 00	STATUS DRAFT
DATE November 2024	SCALE 1:5,000 @ A0

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KEY



APPLICATION
BOUNDARY



ASSESSMENT
BOUNDARY

NOTE:

BOUNDARIES TAKEN FROM
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DATED NOVEMBER 2024.

ROCHDALE DISTRICT

JUNCTION 3
IMPROVEMENTS

BURY DISTRICT

NORTHERN GATEWAY
HEYWOOD
OL10 2SX

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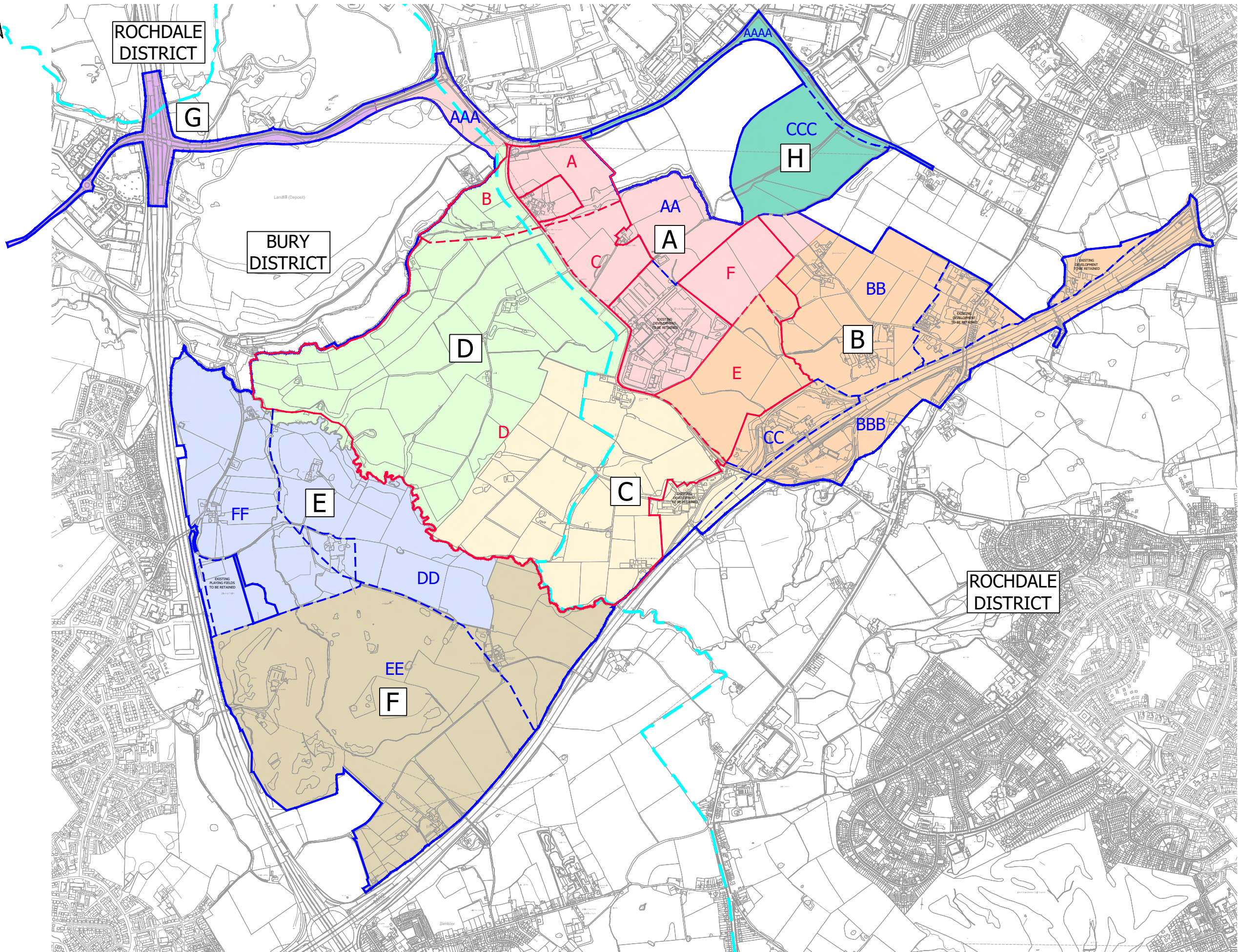
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Sheet Title
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Model Reference
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KEY

- ASSESSMENT BOUNDARY
- ASSESSMENT PLOTS
- APPLICATION BOUNDARY
- APPLICATION PLOTS
- DISTRICT BOUNDARY
- GROUNDSURE SECTION A
- GROUNDSURE SECTION B
- GROUNDSURE SECTION C
- GROUNDSURE SECTION D
- GROUNDSURE SECTION E
- GROUNDSURE SECTION F
- GROUNDSURE SECTION G
- GROUNDSURE SECTION H

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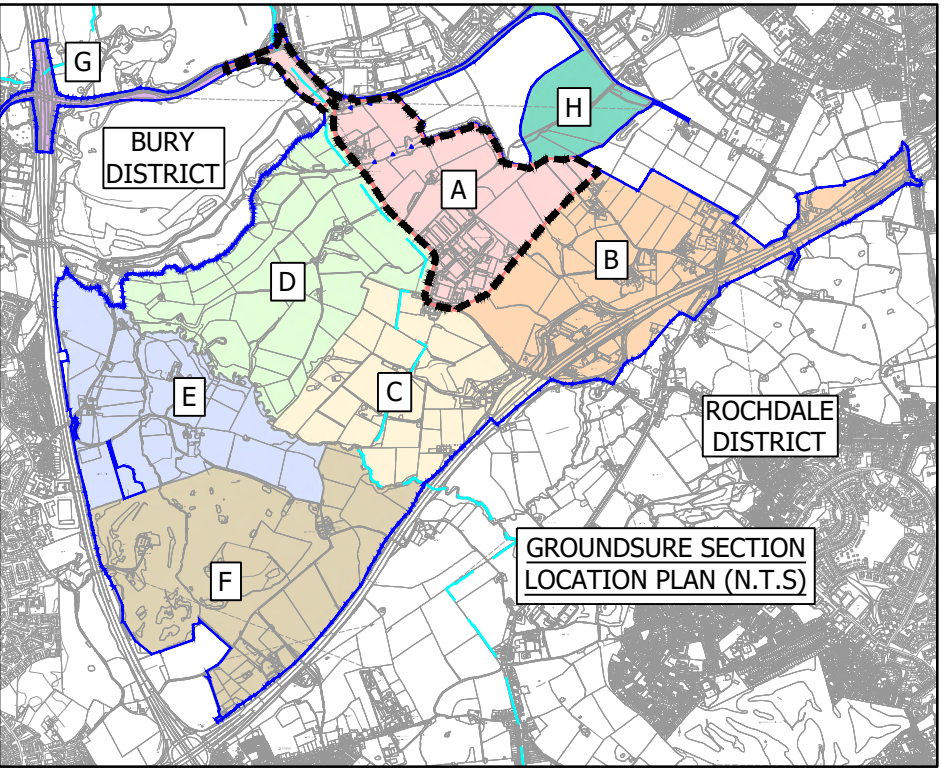
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Project Name:
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Sheet Title:
GROUNDSURE SECTION PLAN

Model Reference:
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- KEY**
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 - GROUNDSURE SECTION A
 - FIELDS / GRASS / VEGETATION
 - HARDSTANDING / ROADS / TRACKS / FARMS / INDUSTRIAL
 - PONDS / WATERCOURSES
 - APPROXIMATE LOCATION OF FORMER RAF HEYWOOD - POTENTIAL FOR UXO
 - DISTRICT BOUNDARY

- NOTES:**
1. WALKOVER UNDERTAKEN IN NOVEMBER 2023.
 2. FIELDS & FIELD ACCESSES WERE NOTED AS BEING VERY WET & BOGGY.
 3. ANECDOTAL UXO INFORMATION WAS PROVIDED BY DAVID HILLARY AT UNSWORTH MOSS FARM & HAS BEEN CORROBORATED BY THE ZETICA PSDA IN APPENDIX F.

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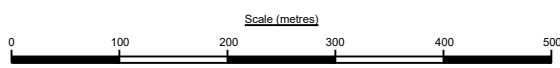
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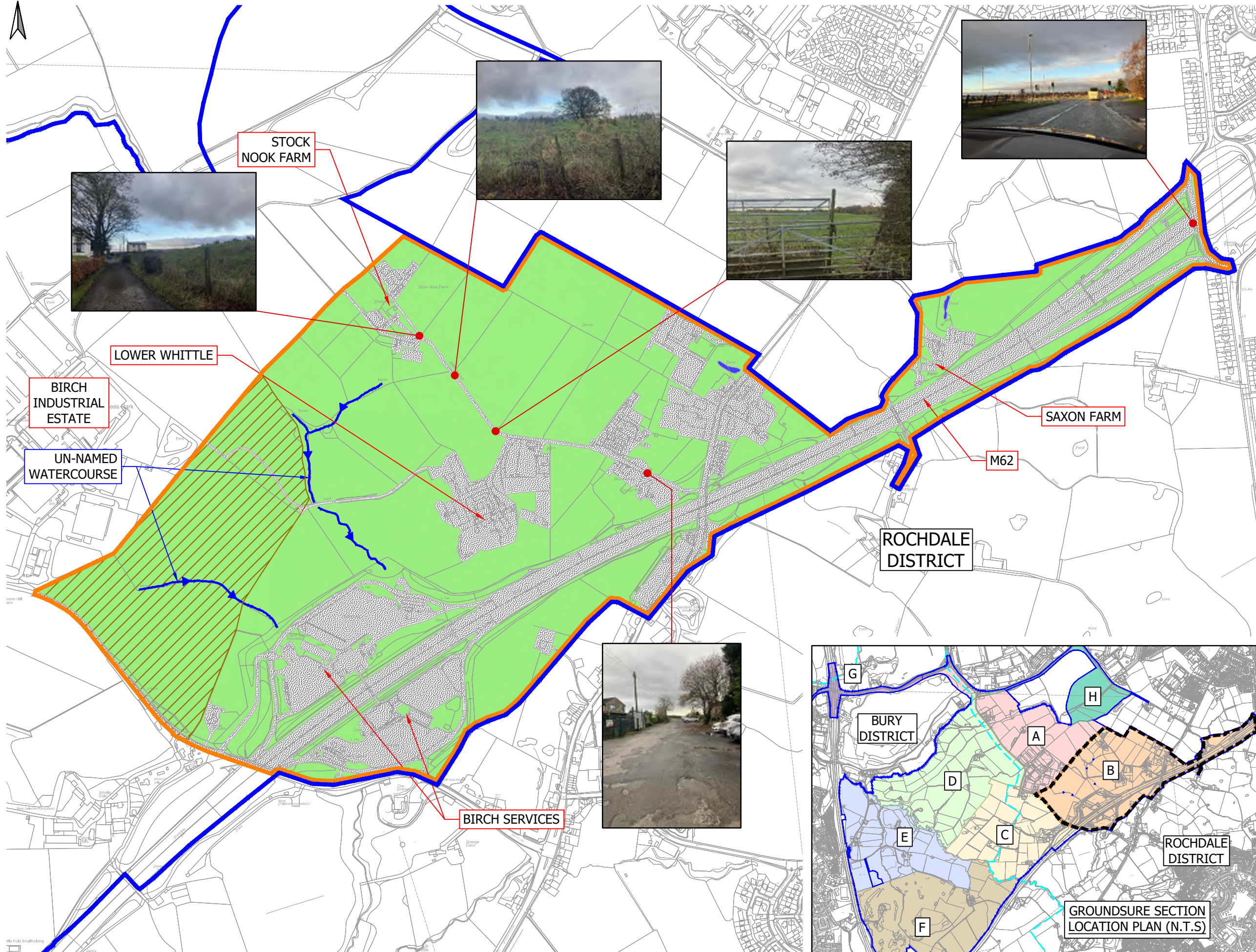
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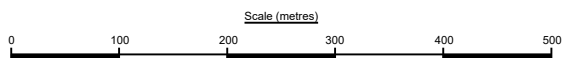
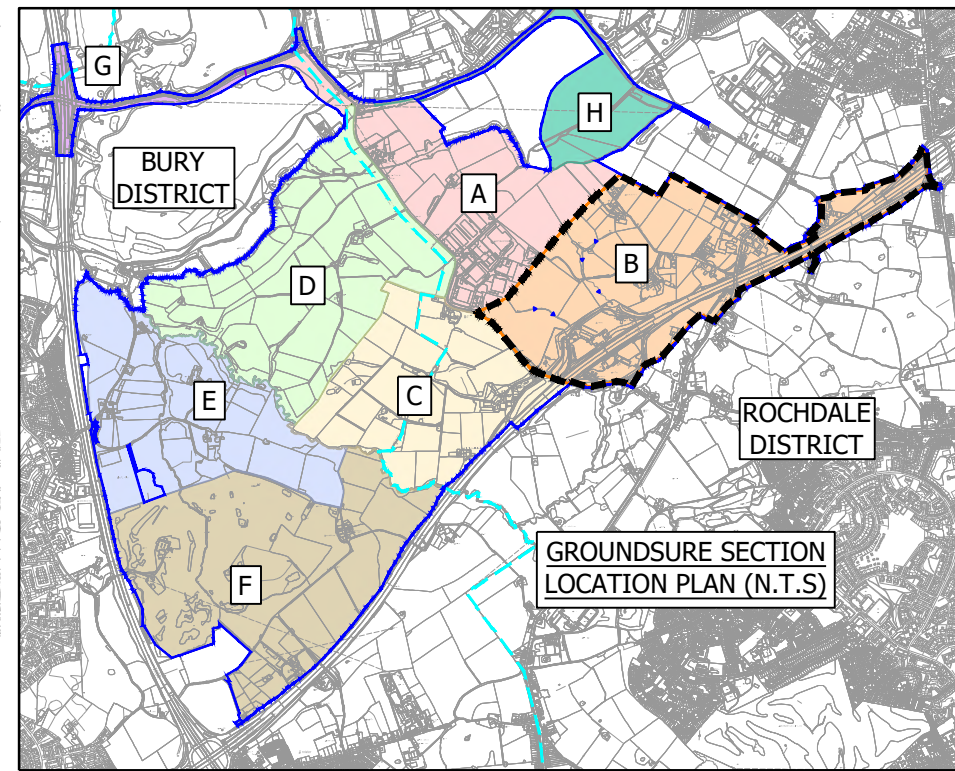
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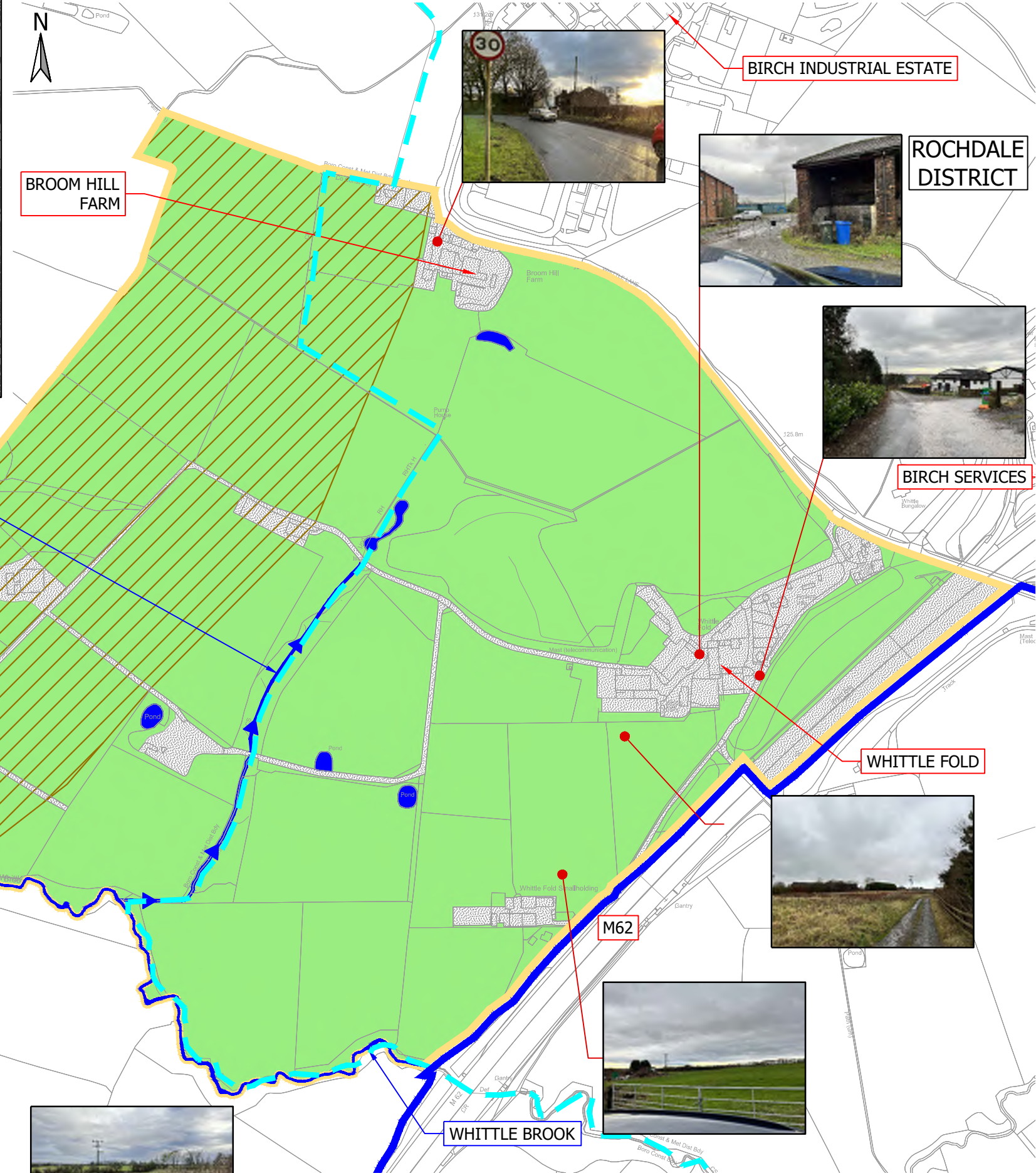
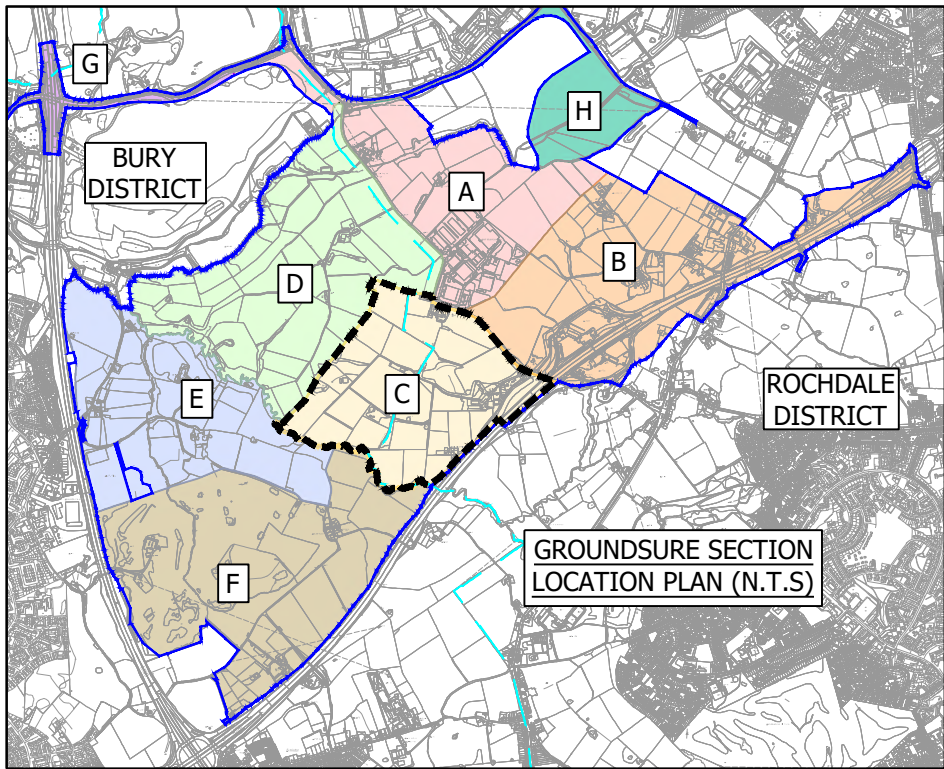
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- PONDS / WATERCOURSES
- POTENTIAL FOR UXO FROM ASSOCIATED FORMER RAF HEYWOOD
- DISTRICT BOUNDARY

- NOTES:**
1. WALKOVER UNDERTAKEN IN NOVEMBER 2023.
 2. FIELDS & FIELD ACCESSES WERE NOTED AS BEING VERY WET & BOGGY.
 3. ANECDOTAL UXO INFORMATION WAS PROVIDED BY DAVID HILLARY AT UNSWORTH MOSS FARM & HAS BEEN CORROBORATED BY THE ZETICA PDSA IN APPENDIX F.

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KEY

- ASSESSMENT BOUNDARY
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- FIELDS / GRASS / VEGETATION
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- PONDS / WATERCOURSES
- POTENTIAL FOR UXO FROM ASSOCIATED FORMER RAF HEYWOOD
- DISTRICT BOUNDARY

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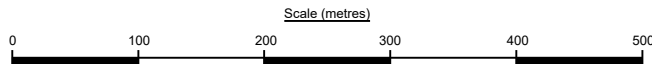
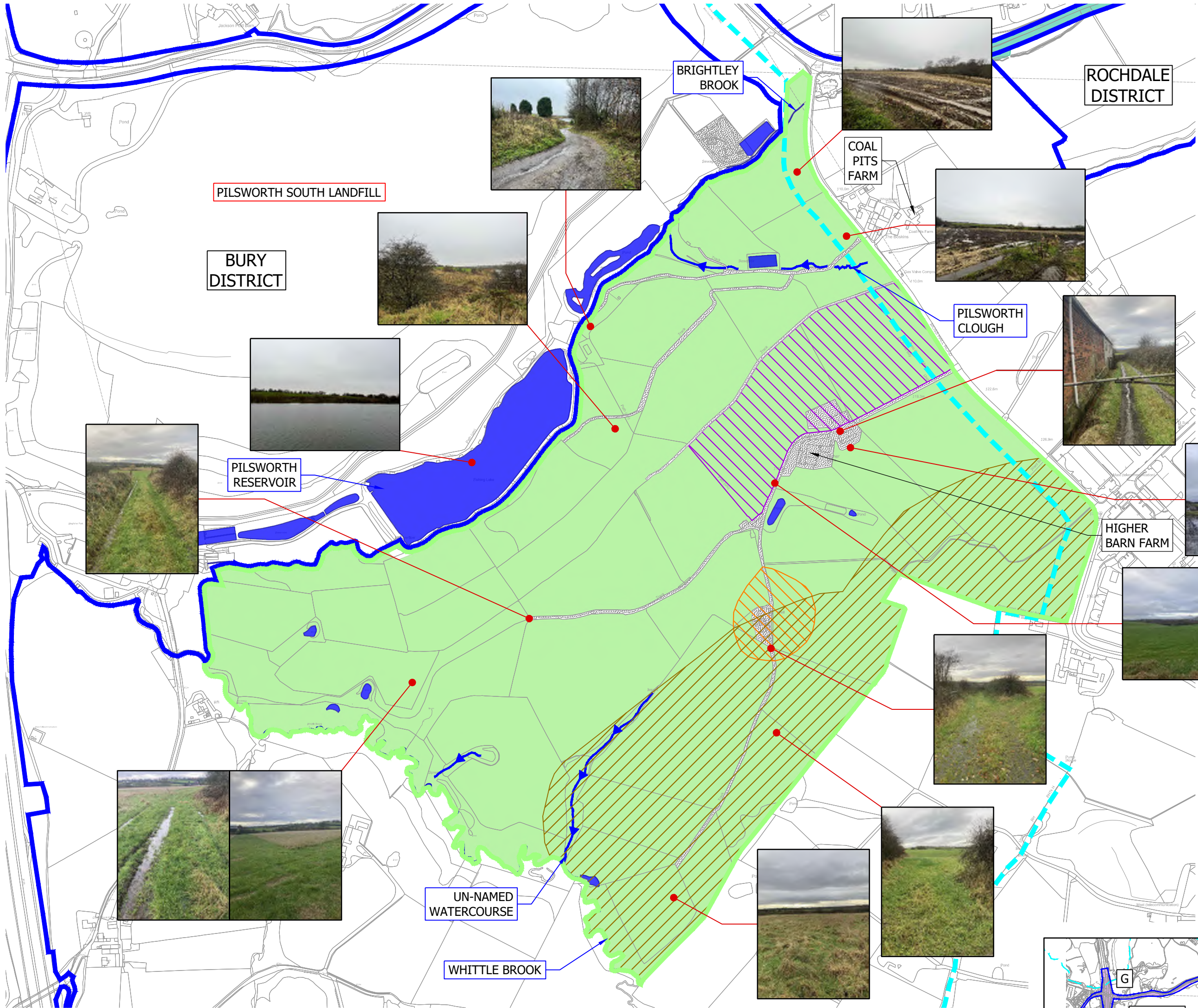
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- POTENTIAL FOR UXO FROM ASSOCIATED FORMER RAF HEYWOOD
- ANECDOTAL POTENTIAL FOR ADDITIONAL MINE SHAFTS
- ANECDOTAL POTENTIAL MINING VILLAGE PRE 1848

----- DISTRICT BOUNDARY

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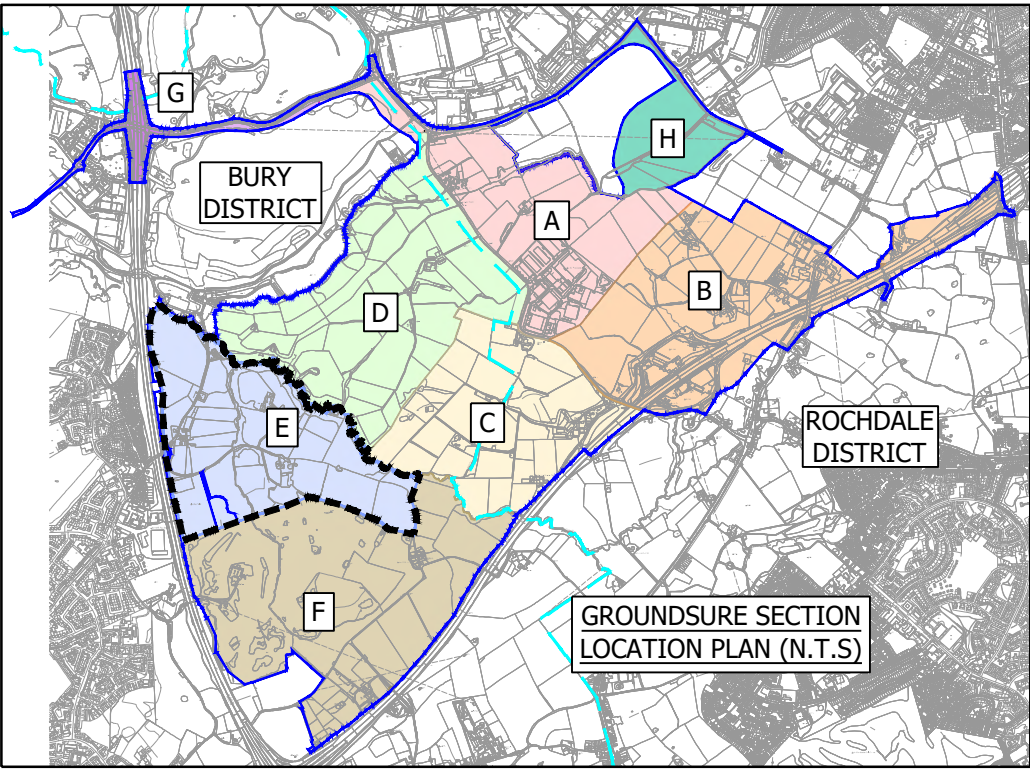
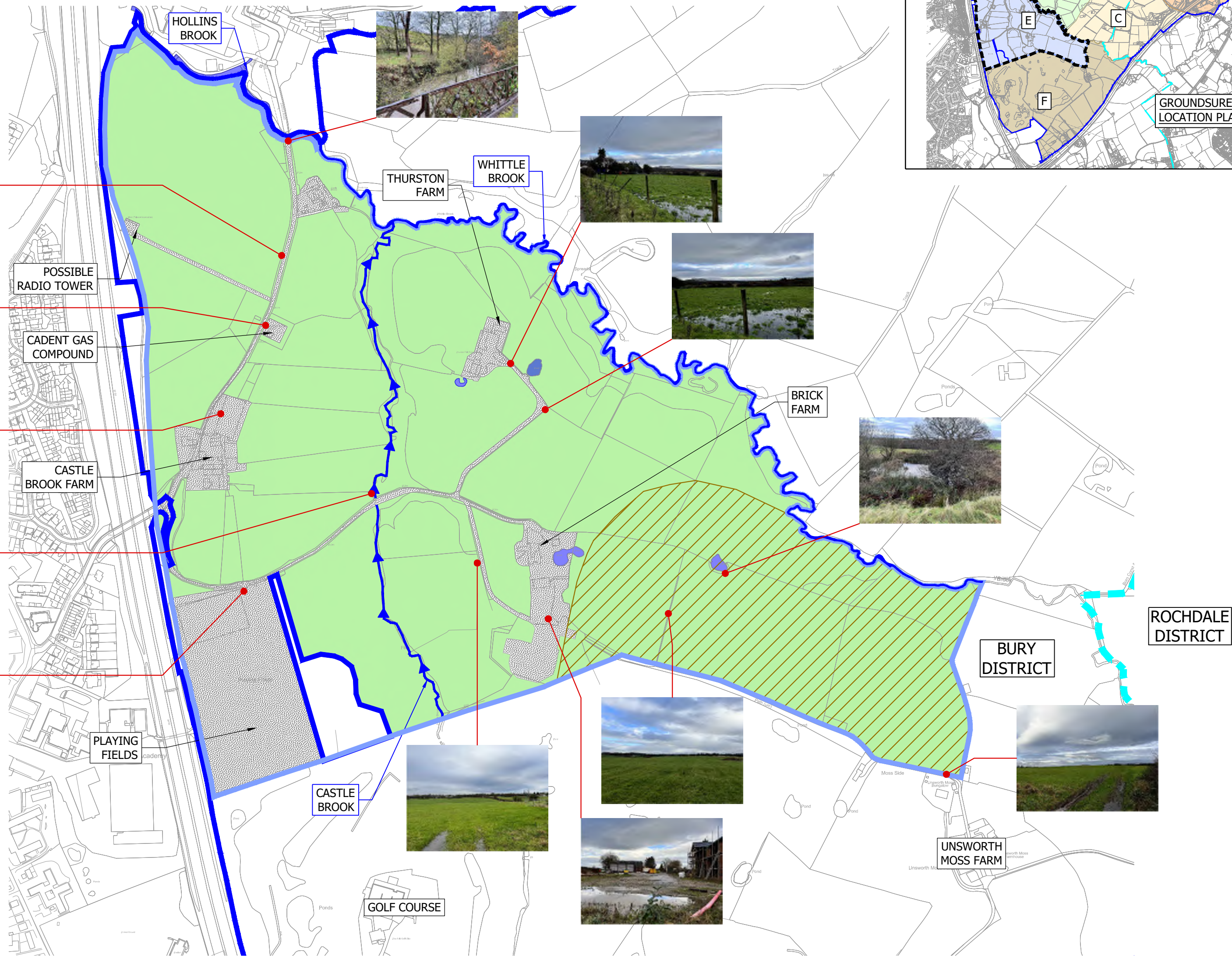


Client
**NORTHERN GATEWAY
DEVELOPMENT JOINT VENTURE**

Project Name
NORTHERN GATEWAY

Sheet Title
**SITE FEATURES PLAN
GROUNDSURE SECTION D**

Model Reference									
N/A									
TTE Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A2	Status	
B048805	CM	07.12.23	NB	09.01.24	PG	09.01.24	1:6,000	S2	
Client Project Number	Originator	Function	Spatial	Form	Role	Number	Revision		
B048805	- TTE -	00	- ZZ -	DR	- U -	0004D	03		



- KEY**
- ASSESSMENT BOUNDARY
 - GROUNDSURE SECTION E
 - FIELDS / GRASS / VEGETATION
 - HARDSTANDING / ROADS / TRACKS / RESIDENTIAL / FARMS / INDUSTRIAL
 - POND / WATERCOURSE
 - POTENTIAL FOR UXO FROM ASSOCIATED FORMER RAF HEYWOOD
 - DISTRICT BOUNDARY

- NOTES:**
- WALKOVER UNDERTAKEN IN NOVEMBER 2023.
 - FIELDS & FIELD ACCESSES WERE NOTED AS BEING VERY WET & BOGGY.
 - ANECDOTAL UXO INFORMATION WAS PROVIDED BY DAVID HILLARY AT UNSWORTH MOSS FARM & HAS BEEN CORROBORATED BY THE ZETICA PDSA IN APPENDIX F.

FOR INFORMATION ONLY

03	SITE BOUNDARY & GROUNDSURE SECTION BOUNDARIES UPDATED	03.02.25	CM	NB	PG
02	SITE BOUNDARY UPDATED. DISTRICT BOUNDARY ADDED	21.11.24	CM	NB	PG
01	FIRST ISSUE	10.01.24	CM	NB	PG
Rev	Description	Date	cm	chk	App

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Client

**NORTHERN GATEWAY
DEVELOPMENT JOINT VENTURE**

Project Name

NORTHERN GATEWAY

Sheet Title

**SITE FEATURES PLAN
GROUNDSURE SECTION E**

Model Reference

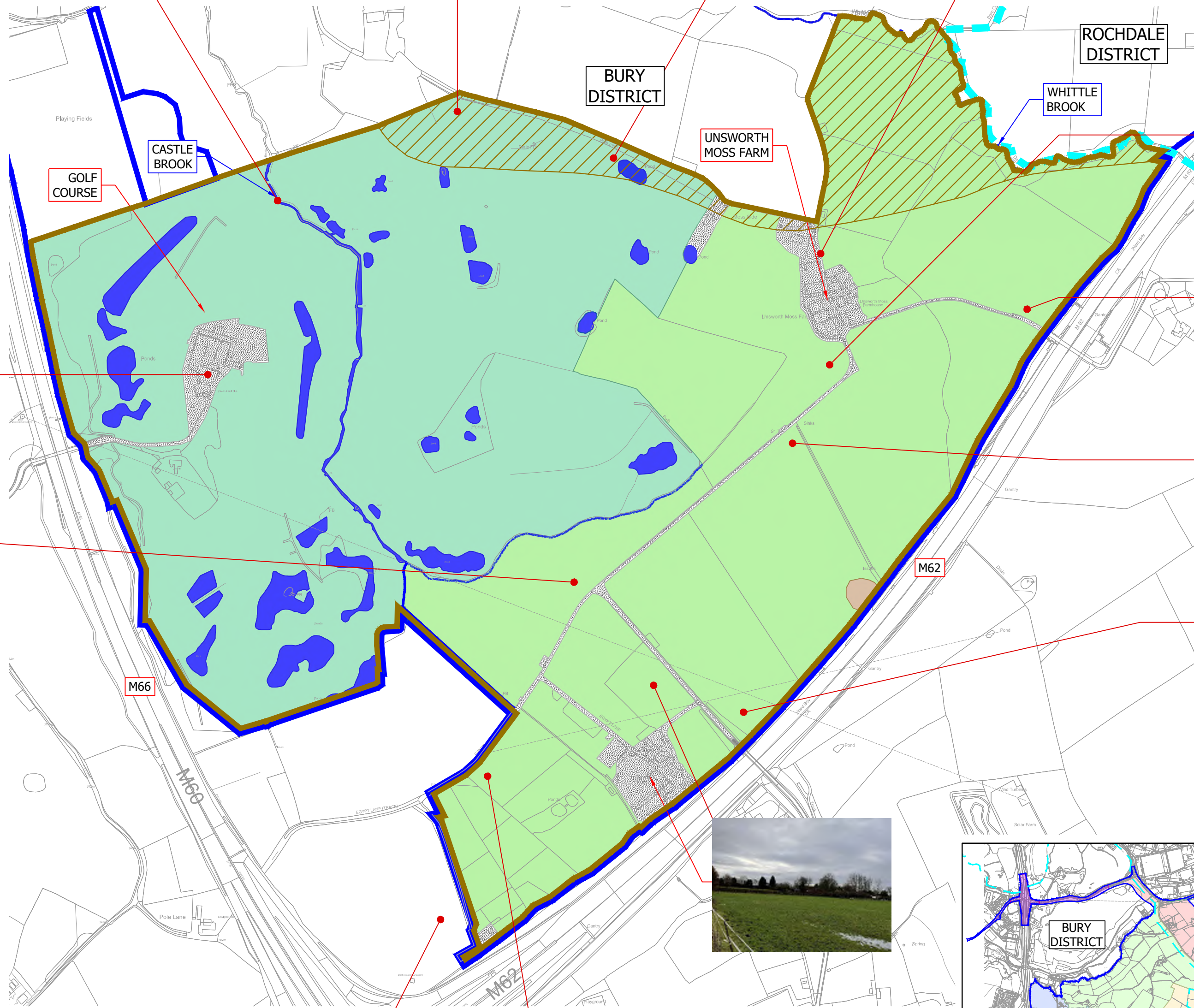
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TTE Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A2	Status
B048805	CM	07.12.23	NB	10.01.24	PG	10.01.24	1:5,000	S2
Client Project Number	Originator	Function	Spatial	Form	Role	Number	Revision	
B048805	- TTE -	00	- XX -	DR	- U -	0004E	03	

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0 50 100 150 200 250m
SCALE 1:5000



- KEY**
- ASSESSMENT BOUNDARY
 - GROUNDSURE SECTION F
 - FIELDS / GRASS / VEGETATION
 - PIKE FOLD GOLF COURSE
 - HARDSTANDING / ROADS / TRACKS / RESIDENTIAL / FARMS / INDUSTRIAL
 - POND / WATERCOURSE
 - ANECDOTAL POTENTIAL SPOIL MOUND
 - POTENTIAL FOR UXO FROM ASSOCIATED FORMER RAF HEYWOOD
 - DISTRICT BOUNDARY

- NOTES:**
- WALKOVER UNDERTAKEN IN NOVEMBER 2023.
 - FIELDS & FIELD ACCESSES WERE NOTED AS BEING VERY WET & BOGGY.
 - ANECDOTAL UXO INFORMATION WAS PROVIDED BY DAVID HILLARY AT UNSWORTH MOSS FARM & HAS BEEN CORROBORATED BY THE ZETICA PDSA IN APPENDIX F.

FOR INFORMATION ONLY

03	SITE BOUNDARY AND GROUNDSURE SECTION BOUNDARIES UPDATED	03.02.25	CM	NB	PG
02	SITE BOUNDARY UPDATED. DISTRICT BOUNDARY ADDED	21.11.24	CM	NB	PG
01	FIRST ISSUE	10.01.24	CM	NB	PG
Rev	Description	Date	cm	chk	App

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Client
**NORTHERN GATEWAY
DEVELOPMENT JOINT VENTURE**

Project Name
NORTHERN GATEWAY

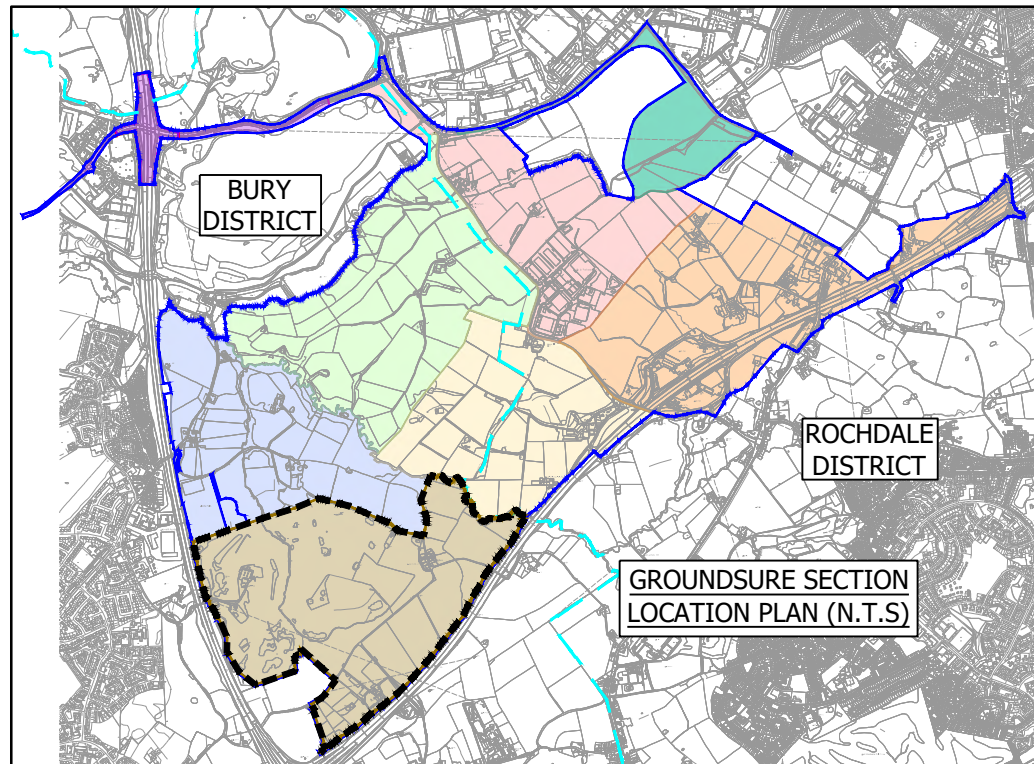
Sheet Title
**SITE FEATURES PLAN
GROUNDSURE SECTION F**

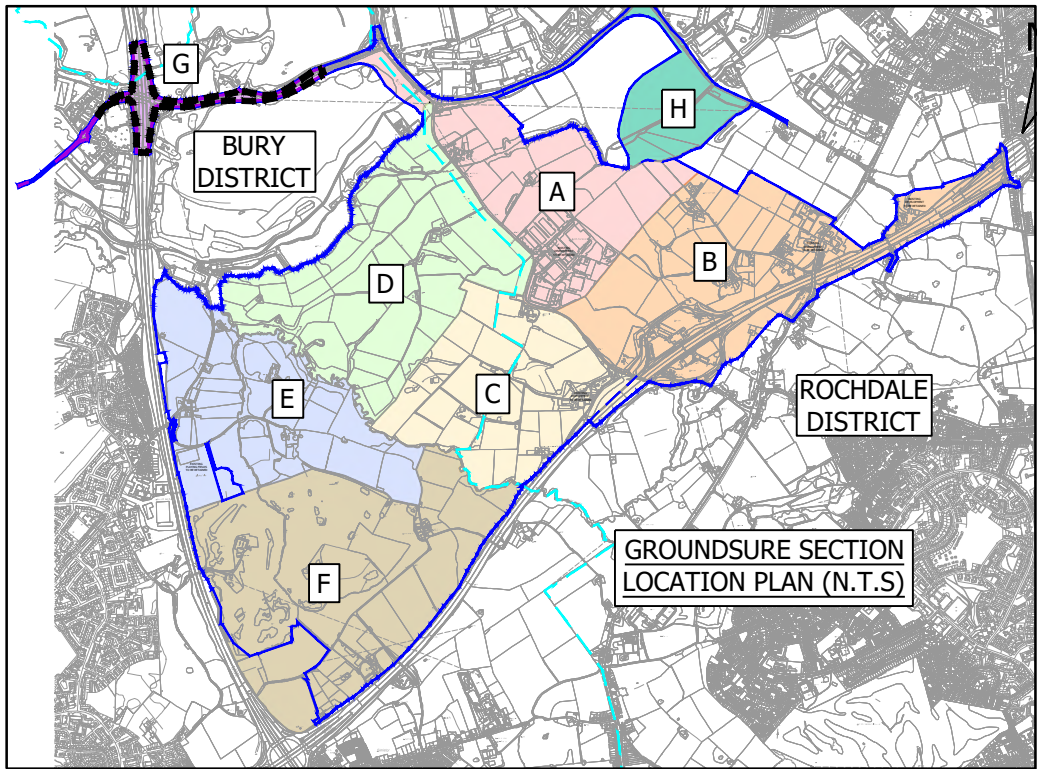
Model Reference									
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B048805	CM	07.12.23	NB	10.01.24	PG	10.01.24	1:5,000	S2	
Client Project Number	Originator	Function	Spatial	Form	Role	Number	Revision		
B048805	- TTE	- 00	- XX	- DR	- U	- 0004F	03		

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0 50 100 150 200 250m
SCALE 1:5000





PILSWORTH INDUSTRIAL ESTATE



ROCHDALE DISTRICT



PILSWORTH NORTH LANDFILL



BURY DISTRICT

KEY

- PROJECT FOR ASSESSMENT
- GROUNDSURE SECTION G
- GRASS / VEGETATION
- ROADS / TARMAC / HARDSTANDING
- DISTRICT BOUNDARY

NOTES:
1. WALKOVER UNDERTAKEN IN NOVEMBER 2023 & FEBRUARY 2025.

FOR INFORMATION ONLY

03	SITE & SECTION BOUNDARIES UPDATED	30.01.25	CM	NB	PG
02	SITE BOUNDARY UPDATED. DISTRICT BOUNDARY ADDED	28.11.24	CM	NB	PG
01	FIRST ISSUE	05.01.24	CM	NB	PG

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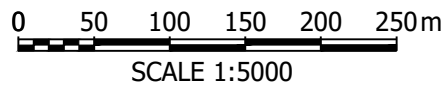
Client:
**NORTHERN GATEWAY
DEVELOPMENT JOINT VENTURE**

Project Name:
NORTHERN GATEWAY

Sheet Title:
**SITE FEATURES PLAN
GROUNDSURE SECTION G**

Model Reference:
N/A

TTE Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A3	Status
B048805	CM	11.12.23	NB	05.01.24	PG	05.01.24	1:4,000	S2
Client Project Number	Originator	Function	Spatial	Form	Role	Number	Revision	
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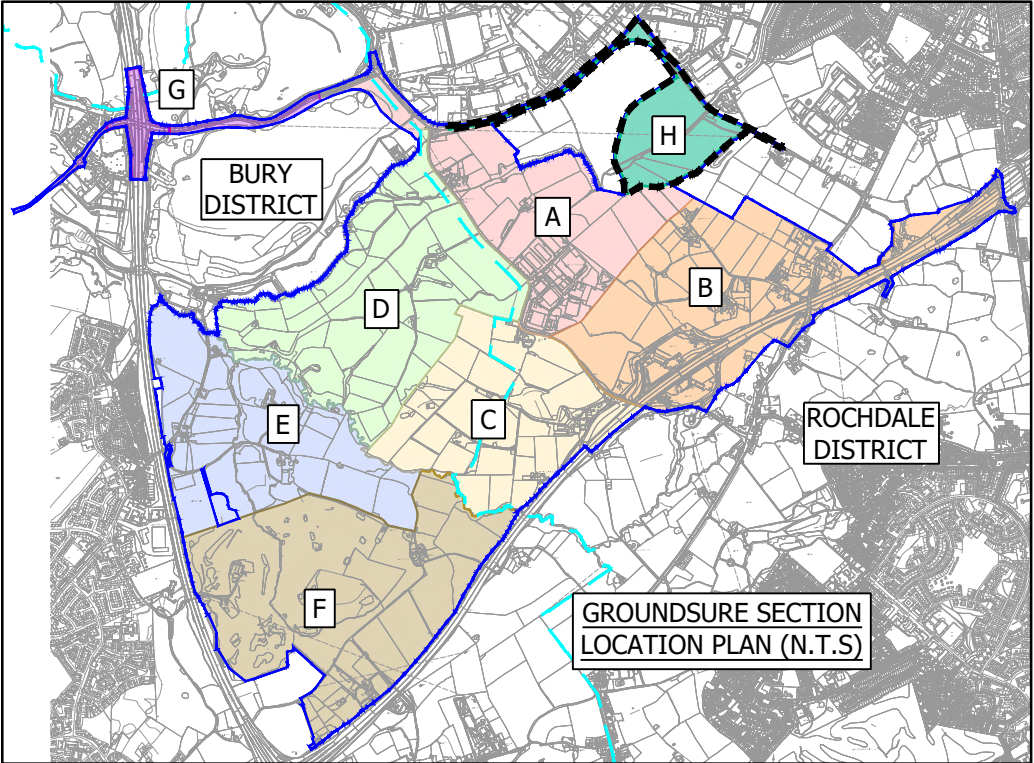


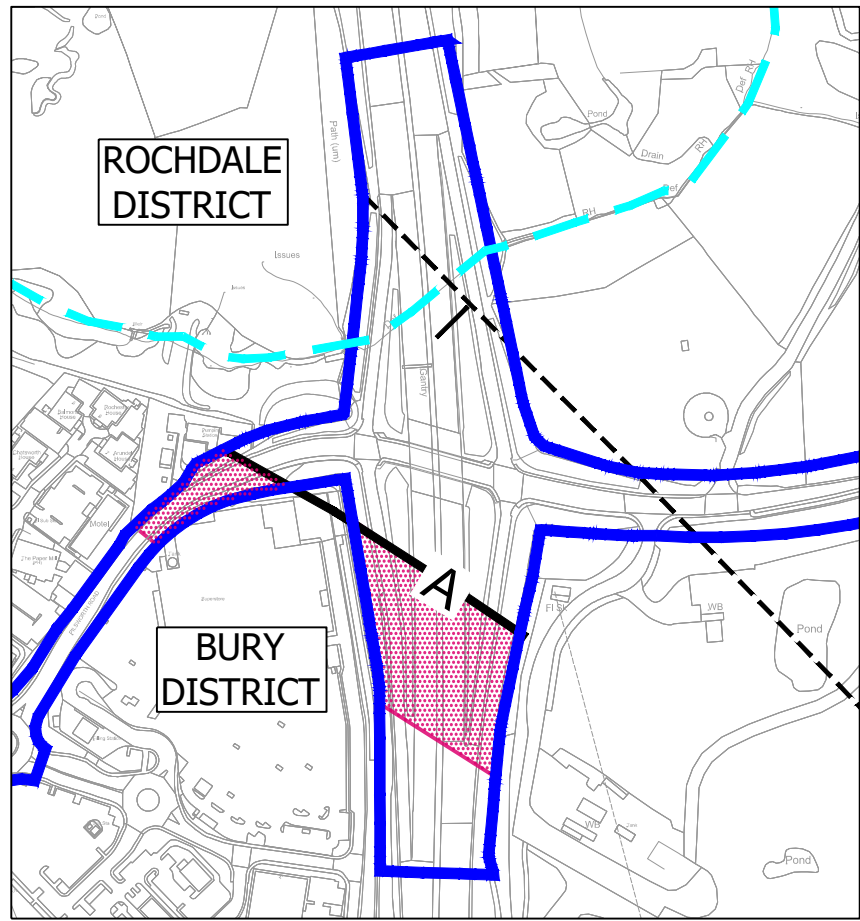
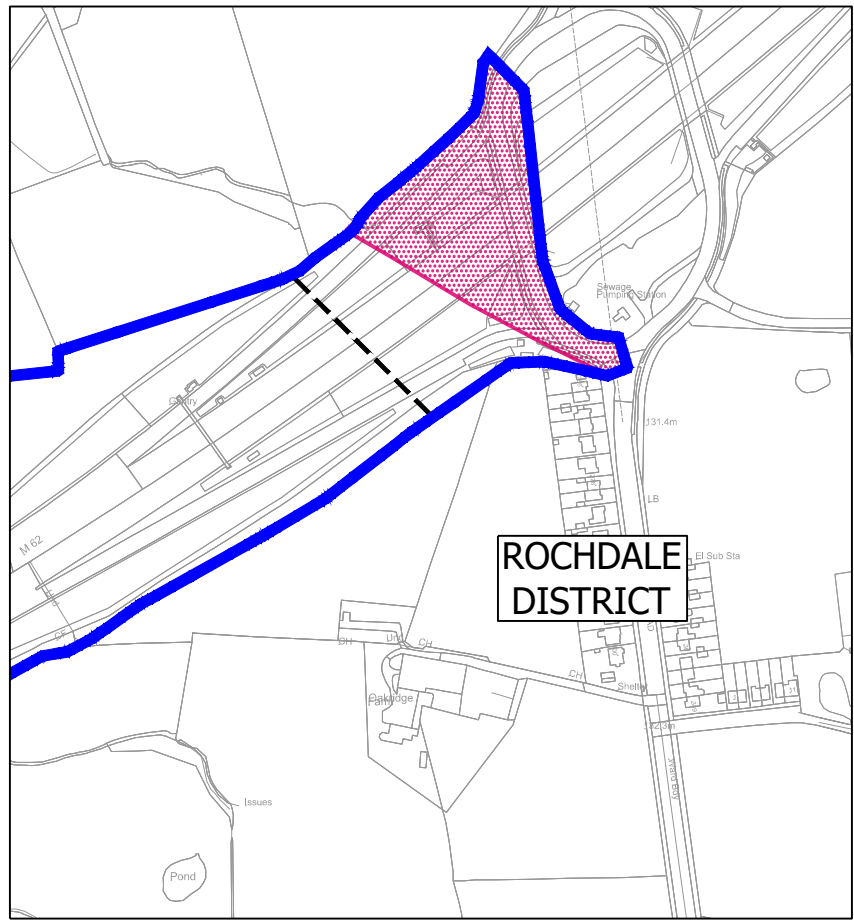
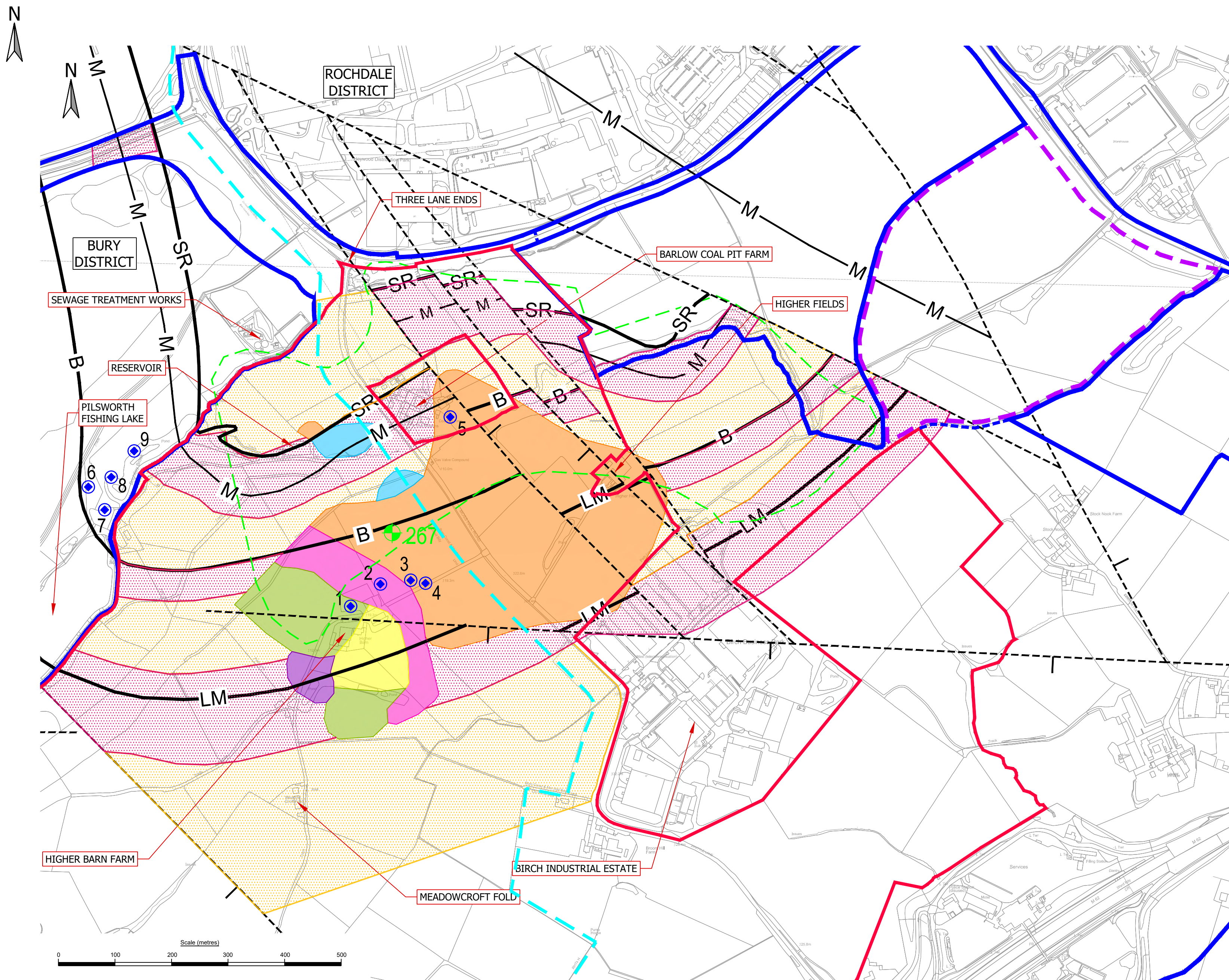
- KEY**
- ASSESSMENT BOUNDARY
 - GROUNDSURE SECTION H
 - FIELDS / GRASS / VEGETATION
 - LANDFILL PERMITTED AREA
 - HARDSTANDING / ROADS / TRACKS / RESIDENTIAL / FARMS / INDUSTRIAL
 - POND / WATERCOURSE
 - DISTRICT BOUNDARY

NOTES:
WALKOVER UNDERTAKEN IN FEBRUARY 2025.
FIELDS WERE NOTED AS BEING VERY BOGGY.

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01	FIRST ISSUE	03.02.25	CM	NB	PG
Rev	Description	Date	Chk	App	
Document Control					
Issuing Office					
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Client					
NORTHERN GATEWAY DEVELOPMENT JOINT VENTURE					
Project Name					
NORTHERN GATEWAY					
Sheet Title					
SITE FEATURES PLAN GROUNDSURE SECTION H					
Model Reference					
N/A					
TTE Project Number	Drawn By	Date	Checked By	Date	Approved By
B048805	CM	03.02.25	NB	03.02.25	PG
Client Project Number	Originator	Function	Spatial	Form	Role
B048805	- TTE -	00	- XX -	DR - U	-0004H
					Revision
					01
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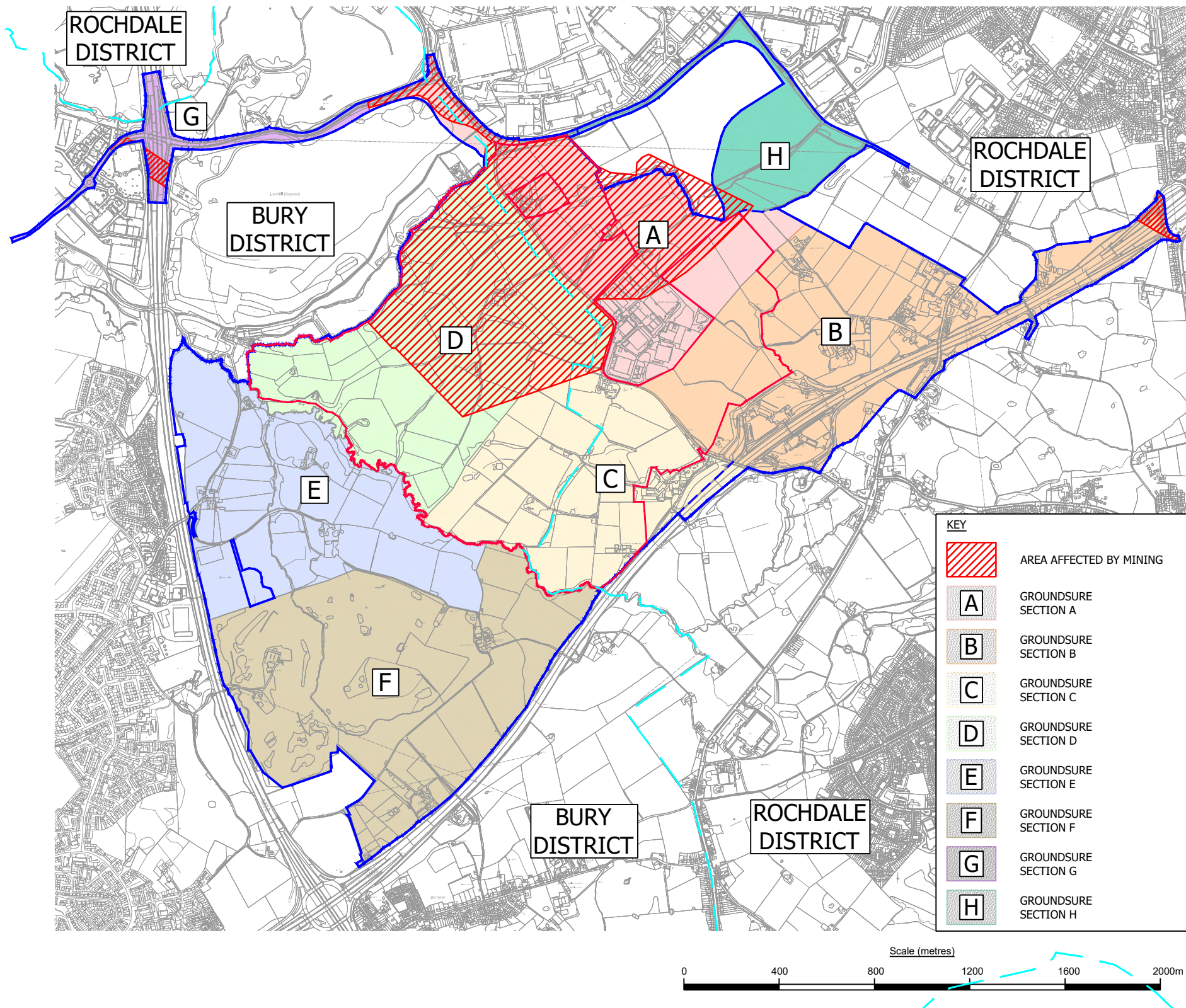


- KEY**
- ASSESSMENT BOUNDARY
 - APPLICATION BOUNDARY
 - DISTRICT BOUNDARY
 - SOUTH HEYWOOD AREA
- COAL SEAMS**
- LM LOWER MOUNTAIN COAL SEAM
 - B BASSEY COAL SEAM
 - SR SAND ROCK COAL SEAM
 - A ARLEY COAL SEAM
 - M SUBCRENATUM MARINE BAND (6")
- STRUCTURAL GEOLOGY**
- FAULT LINES
- CONSTRAINTS**
- CONSIDERATION TO BE GIVEN TO CUT LEVELS WHICH COULD ENCOUNTER SHALLOW BEDROCK IF GREATER THAN 5m
- COAL MINING**
- COAL MINING REPORTING AREA (HIGH RISK FOR DEVELOPMENT)
 - REVISED DEVELOPMENT HIGH RISK AREA BASED ON BGS PLANS
- RECORDED WORKINGS DEPTHS AS PART OF SAND ROCK MINE**
- 0-10m
 - 10-20m
 - 20-30m
 - 30-40m
 - 40-50m
 - 50m+
- NATIONAL COAL BOARD BOREHOLE: POTENTIAL UNRECORDED SHAFT LOCATION
 - COAL AUTHORITY INDICATED MINESHAFT - EXACT LOCATION / BACKFILL UNKNOWN

CONSTRAINTS IDENTIFICATION
COAL MINING POSSES A POTENTIAL ISSUE AS MINE SHAFTS AND SHALLOW WORKINGS CAN COLLAPSE. THE COLLAPSE CAN BE MIGRATORY FROM DEPTH TO THE SURFACE MEANING THAT IN ORDER TO BUILD THEY NEED TO BE STABILISED.

SURFACE EXTRACTION MEANS THAT A COMMODITY HAS BEEN REMOVED FROM SURFACE TO BELOW GROUND LEVEL. THE RESULTANT EXCAVATION MAY OR MAY NOT HAVE BEEN BACKFILLED. IF THE EXCAVATION HAS BEEN BACKFILLED IT IS LIKELY TO HAVE BEEN IN AN UNCONTROLLED MANNER AND MAY BE WITH MATERIALS THAT POSE AN UNACCEPTABLE RISK TO CONTROLLED WATERS & HUMAN HEALTH. UNCONTROLLED FILLING MAY LEAD TO GROUND COLLAPSE, UNACCEPTABLE SETTLEMENTS AND THE FAILURE OF FOUNDATIONS.

- NOTES:**
- WHOLE SITE FALLS WITHIN A COAL MINING REPORTING AREA
 - FOR OTHER MINERAL EXTRACTION INFORMATION REFER TO DRAWING B048805-TTE-00-XX-DR-U-0005.2-01.
 - RECORDED WORKINGS IDENTIFIED FROM BGS RECORDS ASSOCIATED WITH SAND ROCK COAL SEAM.



Mineshaft Feature References			
Coal Authority Interactive Viewer	Pilsworth-03-1703 -03 1982 Plan	Recorded Location	Coal Mining Features Plan Reference
383408-005	4	Higher Barn Farm	1
383408-006	5	Higher Barn Farm	2
383408-007	6 - Anticipated to the same record	Higher Barn Farm	3
383408-008		Higher Barn Farm	4
383408-009		Coal Pits Farm	5
383408-001	7 - Anticipated to the same record	Pilsworth Fishing Lake	6
383408-002		Pilsworth Fishing Lake	7
383408-003	2	Pilsworth Fishing Lake	8
383408-004	3	Pilsworth Fishing Lake	9

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04	APPLICATION SECTIONS REMOVED. GROUNDSURE SECTION BOUNDARIES ADDED	30.01.25	CM	NB	PG
03	SITE BOUNDARY UPDATED. DISTRICT BOUNDARY ADDED	28.11.24	CM	NB	PG
02	UPDATED FOLLOWING CLIENT COMMENTS	08.03.24	CM	NB	PG
01	FIRST ISSUE	19.12.23	CM	NB	PG

Rev	Description	Date	Drn / Chk / App
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Client
**NORTHERN GATEWAY
DEVELOPMENT JOINT VENTURE**

Project Name
NORTHERN GATEWAY

Sheet Title
COAL MINING FEATURES PLAN

Model Reference
N/A

TTE Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A1	Status
B048805	CM	07.12.23	NB	19.12.23	PG	19.12.23	As Shown	S2

Client Project Number	Originator	Function	Spatial	Form	Rate	Number	Revision
B048805	- TTE -	00	- XX -	DR - U	-0005.1	04	



ROCHDALE
DISTRICT

BURY
DISTRICT

ROCHDALE
DISTRICT

- KEY
- PROJECT FOR ASSESSMENT
 - PROJECT FOR ASSESSMENT PLOTS
 - PROPOSED SCHEME
 - PROPOSED SCHEME PLOTS
 - DISTRICT BOUNDARY
 - PERMITTED LANDFILL (TAKEN FROM WARDELL ARMSTRONG DRAWING No. ST17174-003)
 - OTHER EXTRACTIVE MINING
 - COAL PIT FARM (BARLOW'S COAL PITS)
 - BGS RECORDED MINERAL SITE (OPENCAST EXTRACTION CEASED)

- WHITTLE FOLD SAND PIT.
- COLD GATE SAND PIT.
- SANDFIELD SAND PIT.
- WHITTLE SAND & GRAVEL PIT.
- THREE LANDS END - SANDSTONE.
- WHITTLE LAND SAND PIT.
- LOWER WHITTLE SAND PIT.
- DOCTOR'S MOSS SAND PIT.
- HOLLIS SAND PIT.
- UNSWORTH MOSS SAND PIT.
- THREE LAND ENDS - SANDSTONE.
- THREE LAND ENDS - SAND.
- THREE LAND ENDS - SAND.
- PLISWORTH CLOUGH - SAND.
- PILSWORTH SOUTH QUARRY - SAND.

- FORMER SANDSTONE QUARRY
- FORMER QUARRY
- FORMER BRICK FIELD
- FORMER GRAVEL PIT
- FORMER SAND PIT

NOTE:
1. FOR COAL MINING INFORMATION REFER TO DRAWING B048805-TTE-00-XX-DR-U-0005.1-01

CONSTRAINTS IDENTIFICATION

SURFACE EXTRACTION MEANS THAT A COMMODITY HAS BEEN REMOVED FROM SURFACE TO BELOW GROUND LEVEL. THE RESULTANT EXCAVATION MAY OR MAY NOT HAVE BEEN BACKFILLED. IF THE EXCAVATION HAS BEEN BACKFILLED IT IS LIKELY TO HAVE BEEN IN AN UNCONTROLLED MANNER AND MAY BE WITH MATERIALS THAT POSE AN UNACCEPTABLE RISK TO CONTROLLED WATERS & HUMAN HEALTH. THERE IS A CONSTRAINT IN RELATION TO CONTAMINATED LAND AND LAND STABILITY DUE TO UNCONTROLLED FILLING WHICH MAY LEAD TO THE FAILURE OF FOUNDATIONS.

MITIGATION - LAND STABILITY

COAL PITS MAY INCLUDE SURFACE EXTRACTION OF COAL AND/OR OTHER SHALLOW DRIFT MATERIALS. THE MITIGATION FOR THIS IS THE SAME AS QUARRIES / PITS.

QUARRIES / PITS - LOCATE HIGH WALLS TO DETERMINE EXTENTS. UNDERTAKE DRILLING OF THE BACKFILL TO DETERMINE COMPETENCY OF THE GROUND. DEPENDENT ON FINAL BUILD OUT - MAY REQUIRE SPECIALIST FOUNDATIONS IF TO STRADDLE THE HIGHWALL. GROUND IMPROVEMENT OF BACKFILL MAY BE REQUIRED / RE-ENGINEERING.

MITIGATION - CONTAMINATED LAND

GROUND CONTAMINATION AND GROUND GAS MAY POSE A RISK ASSOCIATED WITH THE COAL MINING AND SURFACE EXTRACTION. A GROUND INVESTIGATION SHOULD BE UNDERTAKEN TO REALISE THE RISKS AND THEN FOLLOWED UP WITH REMEDIAL MEASURES WHICH MAY INCLUDE LOCALISED REMEDIATION AND/OR GROUND GAS MITIGATION WITHIN FUTURE BUILDINGS.

03	PERMITTED LANDFILL ADDED	04.02.25	CM	NB	PG
02	SITE BOUNDARY UPDATED. DISTRICT BOUNDARY ADDED	21.11.24	CM	NB	PG
01	FIRST ISSUE	10.01.24	CM	NB	PG
Rev	Description	Date	Iss	CHK	App

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Client:
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DEVELOPMENT JOINT VENTURE**

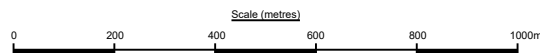
Project Name:
NORTHERN GATEWAY

Sheet Title:
MINERAL EXTRACTION PLAN

Model Reference:
N/A

TTE Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A3	Status
B048805	CM	10.01.24	TM	10.01.24	PG	10.01.24	1:15,000	S2
Client Project Number	Originator	Function	Spatial	Form	Role	Number	Revision	
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