

# HOLDEN FOLD DARWEN

## SHALLOW MINING SITE INVESTIGATION WORKS

**Job Number:** LKC 21 1081

**Date:** October 2021

**Client:** Blackburn with Darwen Borough Council



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## 1 Introduction

### 1.1 Background

LK Consult Ltd (LKC) has been commissioned by Blackburn with Darwen Borough Council (BDBC) to carry out an investigation works into the potential mining risks at the Holden Fold, Darwen.

The following work has previously been undertaken:

- Phase 1 Geo-Environmental Desk Study, undertaken by Capita (ref. CS/092870, dated 7<sup>th</sup> July 2017).

This investigation has been undertaken to confirm the ground conditions below the site and allow an assessment of the potential for the site to be affected by shallow coal seams/workings and mine entries. The report will aim to confirm the risks from historical coal mining and recommend further assessment and / or remediation as required.

The assessment and interpretation of the factual data obtained as part of this investigation has been undertaken in with currently accepted national and international guidelines including CIRIA758<sup>1</sup>.

Ground conditions can change rapidly, especially in areas of Made Ground; however, it is assumed that that the ground conditions observed are typical and representative of the site as a whole. The ground conditions have been determined from a limited number of exploratory holes, therefore only a small percentage of the total area of the property has been investigated. Conclusions drawn from the ground investigation should be read in this context. LKC cannot accept responsibility for any situations resulting from locally unforeseen ground conditions occurring between exploratory holes.

### 1.2 Site Details

A summary of the site details is presented in Table 1-1. Figures 1 and 2 indicate the site location and boundary.

<b>Location</b>	The site is to the north of Holden Fold, Darwen partly formed by former Darwen Vale High School and the surrounding fields to the north. Centred at approximate National Grid Reference 369752E, 423263N.
<b>Area</b>	Approximately 17.78 Ha.
<b>Topography</b>	188-213 metres above ordnance datum (AOD). The site generally slopes down to the south, west and north from a high point in the southeast. Several terraces have been made associated with the former use of sports pitches.
<b>Land Use</b>	The site currently comprises: -Demolition area of former Holden Fold School. -All-weather sports pitch adjacent west. -Pastoral farmland to the north of the former school. -Demolition crush has been noted across the site, with areas of vegetation throughout and former building foundations may still be present in the southern area of site. -Substation present adjacent to the eastern site boundary.
<b>Proposed Development</b>	Pre-Planning: Residential with associated infrastructure and community buildings.

Table 1-1. Summary of site details.

<sup>1</sup> CIRIA2019: C758D Abandoned mine workings manual. ISBN: 978-0-860017-765-4

## 2 Previous Work

### 2.1 Summary of Existing Information

A Phase 1 Report (Ref: CS/092870, dated 7<sup>th</sup> July 2017) has previously been undertaken by Capita. Relevant information has been summarised in Sections 2.2 to 2.4. It should be noted that the Phase 1 Report is for a larger boundary than is referred to within this report. The alteration of the boundary has been accounted for within the summary below.

### 2.2 Geology

The likely geology below the site has been determined from BGS Digital mapping and 1:50,000 scale BGS sheet mapping series (Sheet 76, Rochdale).

#### Made Ground

Given the historical uses of the site, including the potential mine shafts and recently demolished school in the south of the site made ground is considered likely.

#### Superficial Deposits

The southwest of the site is mapped to be underlain by Devensian Till. The mapping shows no superficial deposits across the remainder of the site.

#### Bedrock and Faulting

The site is underlain by the Milnrow Sandstone formation and the Pennine Lower Coal Measures. Milnrow Sandstone is generally mapped below the centre and south of the site while the Pennine Lower Coal Measures are recorded across the north.

Two faults are recorded on site. One fault is shown across the north of the site, close to the northern boundary. This fault trends approximately east to west and has a mapped downthrow to the north. The second fault is located in the southwest of the site trending east-southeast to west-northwest with a mapped downthrow to the west. Numerous faults are recorded in the wider area around the site. No dip or strike information relating to bedrock is noted within the vicinity of the site. Plate 2-1 shows an extract from the BGS geological sheet mapping.

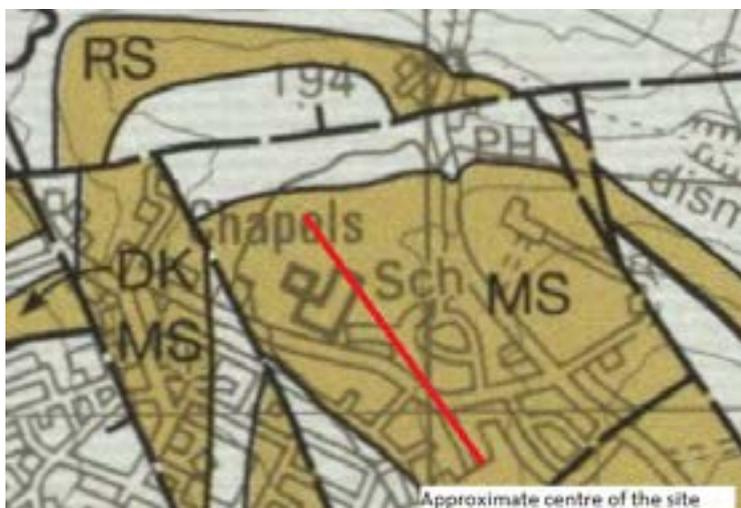


Plate 2-1: Extracts from 1:50,000, 2008 Bedrock geological mapping. Not to scale.

## 2.3 Coal Mining

As part of the Phase 1 Report Capita obtained a CON29 Non-Residential Mining Report. Table 2-1 Summarises the findings of the Capita and CON29 reports.

<b>Mining Activity and Geology</b>	
Past underground mining	The property is in a surface area that could be affected by underground mining in 1 seam of coal at 70m to 110m depth, last worked in 1907.
Probable unrecorded shallow workings	None identified.
Spine roadways at shallow depth	None identified.
Mine entries (within 20m)	A total of 9no. mine entries were identified within the site or within 20m of the site boundary referred to within the Capita Report. Of those 4no. fall within the site boundary of this report and 1no. shaft falls within 20m of the site boundary.
Outcrops	The property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked sometime in the past.
Geological faults, fissures and break lines	2no. faults recorded on site. The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.
Opencast mines	The site is not within the boundary of an opencast site from which coal has been removed by opencast methods. The site is not within 200m of the boundary of an opencast site from which coal is being removed by open cast methods. There are no license requests outstanding to remove coal by open cast methods within 800m of the boundary. The property is not within 800m of the boundary of an opencast site for which a license to remove coal by opencast methods has been granted.
Coal Authority managed tips	None recorded within 500m of the enquiry boundary.
<b>Investigative or Remedial Activity</b>	
Site investigations	No information provided.
Remediated sites	The site has not been subjected to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.
Coal mining subsidence	The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50metres, since 31 <sup>st</sup> October 1994. There is no current Stop Notice delaying the start of remedial works or repairs to the property. The Coal Authority is not aware of any requests having been made to carry out preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.
Mine gas	The Coal Authority has no record of mine gas emission requiring action.
Mine water treatment schemes	No information provided.

Table 2-1: Summary of Coal Authority CON29 Coal Mining and Capita Reports.

<b>Licensing and Future Mining Activity</b>	
Future underground mining	The property is not in an area where the Coal Authority has plans to grant a license to remove coal using underground methods. The property is not in an area where a license has been granted to remove or otherwise work coal using underground methods. The property is not in an area likely to be affected from any planned future underground coal mining.
Coal mining licensing	None recorded.
Court Orders	None recorded.
Section 46 notices	No notices have been given, stating that the land is at risk of subsidence.
Withdrawal of support notices	Not in an area where a notice to withdraw support has been given or where a notice has been given cancelling the entitlement to withdraw support.
Payments to owners of former copyhold land	Not in an area where a relevant notice has been published.

Table 2-1 (continued): Summary of Coal Authority CON29 Coal Mining and Capita Reports.

## 2.4 Additional information

The mine entries recorded within the site boundary are identified by the Coal Authority as 369423-003, 369423-011, 369423-012 and 369423-029. The shaft within 20m of the site boundary is identified by the Coal Authority as 369423-001.

LKC contacted the Coal Authority (email dated 24<sup>th</sup> May 2021) requesting any available information that the coal authority may have on the shafts as well as any abandoned mine plans relevant to the site.

A review of the abandoned mine plans, contained in Appendix A, did not provide any additional information pertinent to these investigation works. The information available on each of the mine shafts has been summarised below.

- Shaft 369423-003 has been given an assumed diameter of 2.5m and a departure distance of +/-10m. No other information relating to the shaft has been recorded.
- Shaft 369423-011 is recorded as having been located, drilled, grouted, capped and sealed with hardstop in June 1973. The shaft was recorded to be 3.6m in diameter and 73m deep with a departure distance of +/-5m. The shaft is known as the Knowle Field Shaft.
- Shaft 369423-012 was searched for by boring in 1973 with drill holes spaced at 1.5m centres. No evidence of the shaft was found. Although no evidence of the shaft was found it is recorded as having been treated with a departure distance of +/-10m.
- Shaft 369423-029 was searched for circa 1975/76 but was not located although an adit to flag rock workings was found on the site of the shaft. Although not found the shaft has been given a departure distance of +/-10m and records indicate that the shaft has been treated.
- Shaft 369423-001 has been given an assumed diameter of 2.5m and a deviation of +/-10m. The mapped location places the shaft approximately 8m to the north of the northern site boundary.

LKC have also reviewed the information on The Coal Authority's interactive map viewer<sup>2</sup> which indicates that several areas of the site are within a Development High Risk Area (DHRA). The DHRA's recorded on site relate to the mapped locations of the mine shafts (including any departure distance) and to an area of outcrop in the northeast of the site. The location of the DHRA is illustrated on Figure 3.

information on the worked seam below the site, obtained from the Coal Authority map viewer, indicates that rock may dip approximately 2.9° to the southwest.

## **2.5 Mining Risk Summary**

LKC obtained the advice of Dr Stephen Knott of The Land Consultancy (TLC) to provide additional expertise when assessing the risks from historic mining activities.

The majority of the site is considered to be a very low risk of being affected by shallow coal mining. The north east of the site, where the DHRA relating to outcrop is recorded, is considered to be a low risk.

There is considered to be a high risk to a future development from the shafts 369423-003, 369423-012, 369423-029 and 369423-001.

The risk to the future development from shaft 369423-011 is considered to be low as it has been treated and capped.

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<sup>2</sup> <https://mapapps2.bgs.ac.uk/coalauthority/home.html>

### 3 Investigation Works

#### 3.1 Site Investigation Design and Methodology

On consultation with TLC and the Local Authority the following site investigation works were carried out on 24<sup>th</sup>-25<sup>th</sup> of June 2021 and 16<sup>th</sup>-20<sup>th</sup> August 2021:

- 3no. rotary boreholes to 30mbgl in the northeast of the site to investigate the recorded coal outcrop.
- Trial trenching for shaft 369423-003 on 1.5m centres.
- Trial trenching for shaft 369423-012 on 1.5m centres.
- Trial trenching to locate and expose the cap of shaft 369423-011.
- Trial trenching to locate shaft 369423-029. It is noted that this shaft may in fact be an adit to access underground Flagstone workings, If this is accurate trenching to be used to locate the entrance to the adit.

The Open Hole Rotary Drilling was carried out in 3no. locations positioned by TLC to determine if the coal seam and DHRA mapped to subcrop in the north east of the site was present.

The boreholes were undertaken by Talyor Drilling Services (TDS) using a Baretta T41 Rotary rig fitted with a PCD drill bit. All 3no. boreholes were sunk to a depth of 30metres below ground level (mbgl).

The trial trenching for the 4no. mine shafts located on site was carried out using an 8-tonne tracked excavator. Shaft 369423-001 (off site) was not investigated at this stage. This is discussed further in Section 4.

In order to carry out the above works permission is required from the Coal Authority. TLC were commissioned to apply for and obtain the permission certificate which is included in Appendix B.

The purpose of the trial trenching was to identify any anomalously deep made ground or other features which may be indicative of the presence of a mine shaft. Mine shaft fill material often includes colliery spoil, ash and clinker which is often visible when set within natural superficial deposits.

The rotary drilling will enable an assessment of the coal seam mapped in the northeast of the site (if present).

Upon completion the trial trenches were backfilled with arisings and the boreholes grouted up.

All site investigation locations are shown in Figure 3.

## 4 Ground Conditions

### 4.1 Rotary Open Hole Drilling

The rotary borehole logs are provided in Appendix C. The investigation locations are shown on Figure 3.

#### 4.1.1 Topsoil

Topsoil comprising gravelly slightly silty sand was recorded in all investigation locations.

#### 4.1.2 Natural Clay

A light brown clay was identified in all investigation locations to between 0.8mbgl and 0.9mbgl.

#### 4.1.3 Coal Measures

Rockhead was encountered between 0.8mbgl and 0.9mbgl in all locations below the natural clay strata. Bedrock comprised:

- Mudstone encountered in all locations to 15mbgl in RH101, 14.5mbgl in RH102 and 18mbgl in RH103.
- Sandstone, encountered in all locations below the mudstone to depths of 19.5mbgl in RH101, 19.2mbgl in RH102 and 20mbgl in RH103.
- RH101 encountered intact **coal** from 19.5mbgl to 21mbgl, RH102 encountered intact **coal** from 20mbgl to 21.3mbgl. No coal was encountered in RH103 however a 75% loss of flush was noted from 19.2mbgl.
- Sandstone was encountered below the coal in RH101 and RH102 to the base of the borehole at 30mbgl. Sandstone with 75% flush loss but no voids / broken drilling was encountered in RH103 from 19.2mbgl to the base of the borehole at 30mbgl.

It should be noted that evidence for the presence of coal workings can include (but is not limited to) partial or total loss of flush, broken drilling, fast drilling or the sudden dropping of the drill string.

Due to the similar depth at which the loss of flush was encountered it is reasonable to assume that the loss of flush in RH103 may represent an area of collapsed or backfilled workings within the coal seam proven in RH101 and RH102. If it is assumed that the loss of flush encountered in RH103 represents workings within the coal seam encountered in RH101 and RH102 then the results of the drilling indicate that the coal seam may dip at a shallow angle to the southwest.

The above corresponds with the information obtained from the Coal Authority relating to the deeper mined seam which is noted to dip 2.9° to the southwest. This would position the actual outcrop of the coal seam to the north of the sites northern site boundary.

#### 4.1.4 Ground Gas

No detectable concentrations of methane, carbon dioxide, carbon monoxide or hydrogen sulphide or any oxygen depletions were measured during the rotary drilling process.

## 4.2 Mine shaft Investigation

As set out in Section 3 the mapped locations of the 4no. mine shafts within the site boundary were investigated via trial trenching. The trenching was carried out on 1.5m spacings as summarised on Figure 3. A photographic record of the works has been included in Appendix D.

### Mine Shaft 369423-003

The mapped location of this shaft is positioned under the boundary wall between two fields. Anecdotal evidence from a neighbouring landowner also corroborated this location. Machine access was only possible to the western field at the time of the investigation works. A trial trench was carried out as close to the fence line and drystone wall as practicably possible without undermining either wall or fence.

A possible mine entry was identified at the mapped location of the shaft. A light yellowish-brown clay encountered at 0.4mbgl gave way to black and grey ash, clinker and colliery spoil saturated with groundwater. A second trench was extended perpendicular to the initial trench to expose the extent of the made ground. The intersection of the trenches was also deepened at the location of the shaft to approximately 1.7mbgl; however, due to water influx and partial collapse of the trench side walls towards the drystone boundary wall excavations were terminated.

The area of made ground exposed appeared to be a semi-circle approximately 3m across with the remainder passing below the fence line/drystone wall.

### Mine Shaft 369423-011

The southern edge of the concrete cap was located 1.2mbgl at the mapped location of the mine shaft. The centre of the cap is approximately 5m to the north of the mapped location. Trial trenches were extended across the slab to expose its limits demonstrating it to be approximately 8.5m x 8.5m.

The upper 0.15-0.3m of the concrete cap is noted to be highly weathered with the consistency of a soft gravelly clay. Reinforcement bar approximately 1 inch in diameter was noted to be 'free' and no longer bound within solid concrete across this weathered surface. In some locations the rebar passed deeper into and was anchored by the intact concrete below.

### Mine Shaft 369423-012

Trial trenches to rock head, encountered from 1.5-2.0mbgl as a orangish red sandstone, were extended out from the mapped location of the shaft across the potential departure. Evidence of the previous investigation works were noted in a number of the trenches in the form of 50-100mm diameter holes into rock head on a 1.5-2m spacing.

A possible mine entry was located approximately 8m to the south of the mapped mine shaft location. The possible mine entry was shown to be a 1.2-1.5m diameter oval where made ground comprising grey to black ash, clinker and colliery spoil penetrated rockhead.

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Mine Shaft 369423-029

Extensive trial trenching was carried out from the mapped location of the shaft. Evidence of the previous investigation works which identified the adit was noted; where in situ natural strata gave way to disturbed reworked strata with relic organic soils mixed with weathered sandstone rock and sandy clay.

No evidence of the shaft or the adit was recorded identified during the investigation works.

Mine Shaft 369423-001

The mapped location of this shaft is approximately 8m to the north of the site boundary with a deviation of +/-10m. This would potentially mean that the mine shaft could be located 2m within the site boundary. At this stage it was determined that it would not be prudent to investigate the potential on site location due to the proximity of the works to the boundary wall and because it is highly likely that the risk from this offsite shaft can be mitigated at the design stage of any future development.

## 5 Conclusions and Recommendations

The desk study information indicated that the site would be underlain by superficial deposits of Till over Milnrow Sandstone in the centre and south of the site with no superficial deposits over Pennine Lower Coal Measures in the north of the site. The desk study also indicated the possible presence of a coal outcrop in the northeast of the site as well as 4no. mine shafts within the site boundary and 1no. mineshaft within 20m of the site boundary.

No shallow or probable shallow workings have been identified by the Coal Authority. The DHRAs noted on site relate only to the probable outcrop in the north east and to the mine shafts across the rest of the site.

To investigate the above potential hazards a total of 3no. rotary open hole boreholes were sunk to 30mbgl in the northeast of the site while each of the onsite shaft locations were extensively trial trenched.

The investigation works identified 0.8-0.9m of clayey superficial deposits in the northeast of the site underlain by coal measures. The trenching for mine shafts in the south of the site identified up to 0.3-2.0m of made ground (likely relating to the construction of the school) and superficial deposits over sandstone generally confirming the desk study information.

### Shallow Coal Mining

An intact coal seam was encountered in RH101 from 19.5mbgl to 21.0mbgl (1.5m thick) and 20.0mbgl to 21.2mbgl (1.3m thick).

Evidence of potential workings was encountered in RH103 with a 75% loss of flush was encountered in RH103 from 19.2mbgl, although no broken drilling or voids were encountered.

All boreholes terminated at 30mbgl in sandstone and did not encounter any additional coal.

The depths the coal seam was encountered at indicates a shallow dip to the southwest in line with the information gathered from the Coal Authority.

Shallow workings related ground subsidence events may manifest as localised crown hole collapses at the surface (which are related to workings roof failures), or can be associated with more extensive ground movements, typically associated with pillar collapse, floor heave, or a combination of roof and pillar failure. As there is limited evidence for structural damage caused by pillar failure compared with that resulting from roof collapses, the focus of engineering assessments of the potential instability at the surface has focussed on roof collapses as the more likely mechanism of failure.

The limit height on void migration, where no appreciable surface subsidence can result is termed 'acceptable cover'. The calculation of the amount of acceptable cover is determined by the worked thickness of the seam (t) and the amount of overlying rock cover (h). The acceptable cover criterion is generally referred to as ht.

According to CIRIA C758D, from the examination of mines within Coal Measures, the height of collapse migration might exceptionally extend to 10t the height of the original extraction. As a result of this, the 10t criterion has been adopted by the industry as

providing reasonable assurance against surface subsidence from roof collapses in old pillar and stall mines. However, there are documented cases, albeit rare, where migrations in excess of 20t have been observed.

CIRIA C758D, lists a number of circumstances where the acceptable cover criterion may need to be increased from 10t. These include:

- Where the strata dip is  $>20^\circ$  (unlikely on this site).
- Strong groundwater flows within workings and rising or falling groundwater levels. The deep groundwater regime is unknown beneath the site.
- Where multi-seam extractions have taken place (unlikely on this site).

Coal seams or potential workings have been encountered in RH101-RH103 with a thickness up to 1.5m. Assuming a possible extracted thickness of 1.5m for this coal seam  $t=1.50\text{m}$  which implies that the 10t height of rock cover will be 15m. This investigation has proven that there is  $>10\text{t}$  of rock cover overlying the coal seams in all investigation locations. As bedrock is unlikely to dip at  $>20^\circ$  and as multiple seams have not been extracted the 10t guidelines are considered appropriate.

As the investigation information obtained by LKC indicates that the subcrop of the coal seam is likely to be further north of the mapped location (and location of the DHRA) LKC also considered the risk from shallow mining in the area of the site to the north of the DHRA. The topographical information available shows that the land falls away to the northeast while the coal dips to the southwest indicating that the coal is likely to be shallower in the northeast of the site.

At the lowest point on the north-eastern boundary LiDAR data and topographical data indicates the site level is 190.2mAOD. Extrapolating the coal seam out to the point where it crosses this boundary indicates that the coal seam is likely to be 14.2mbgl or 13.4m below rock head. Any future development in this area of the site may require stabilisation works.

### Mine Shafts

Mine shafts 369423-011, 369423-003 and 369423-012 were located via trial trenching close to the mapped positions indicated by the Coal Authority. Mine shaft/adit 369423-029 could not be located however evidence of the previous investigation works which identified the adit were located at the mapped position of the shaft. It is likely that the boundary wall over 369423-003 will require removal for additional investigation works to be carried out.

The concrete cap of shaft 369423-003 was identified as being significantly weathered with reinforcement bar no longer set within solid concrete. LKC recommend that this shaft is test drilled over safety staging to establish the integrity of the cap and the backfill material used.

At this stage LKC recommend that shafts 369423-011 and 369423-012 are test drilled over safety staging to establish the depth of the shaft and integrity of the fill material within them.

As shaft/adit 369423-029 could not be located, but evidence of the previous investigations which identified the adit were located, LKC recommends additional

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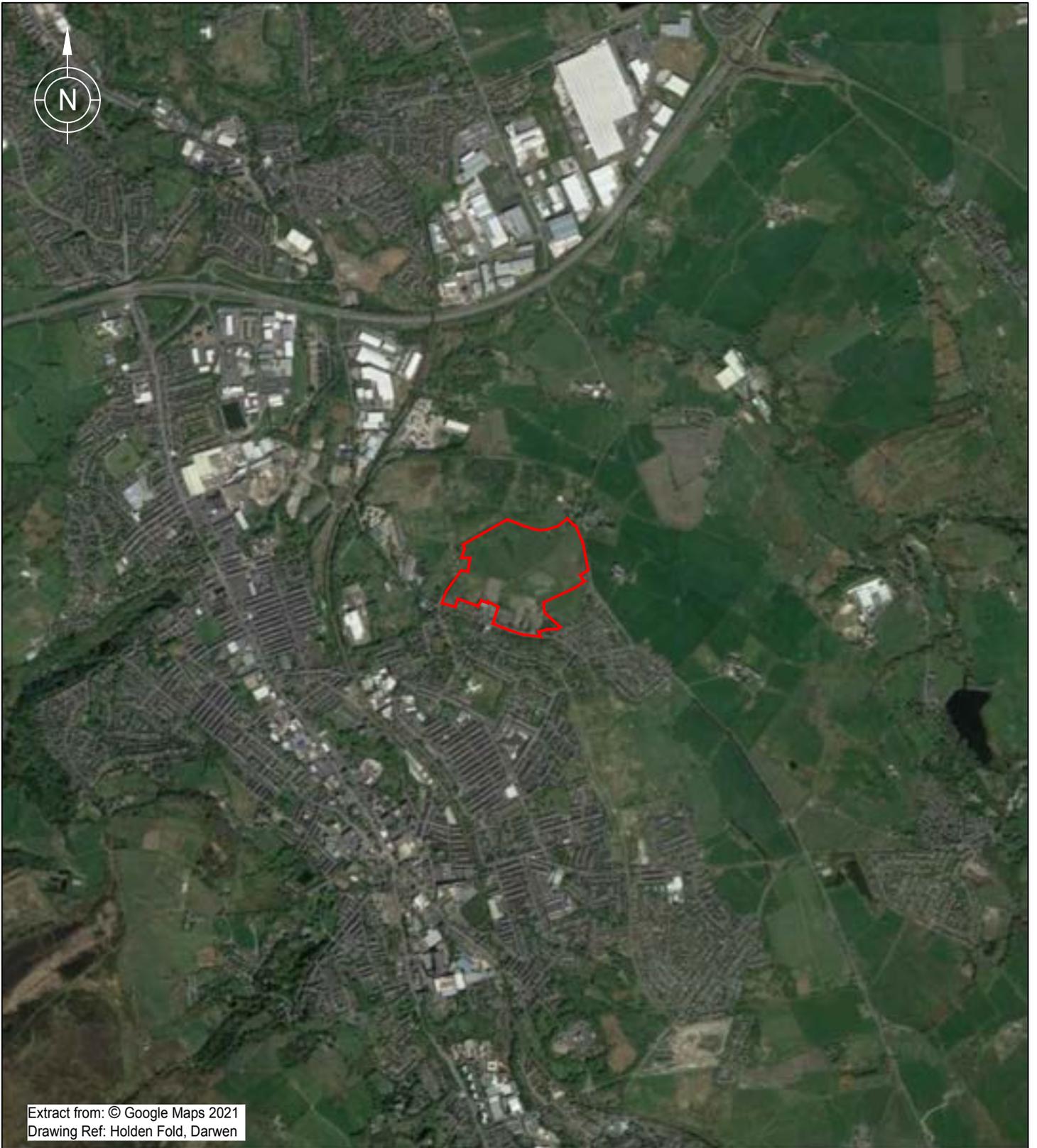
investigation outside the departure zone mapped by the Coal Authority and, once located, tracing of the adit's azimuth, width and depth to identify any areas which require treatment.

### **5.1 Additional Advice**

A Coal Authority permit would need to be obtained prior to any further coal mining investigative or treatment works being carried out on this site. Treatment and capping of the shaft(s) will need to be agreed in advance of the works taking place with the Coal Authorities engineering department, the local authority and building control.

In line with the guidance supplied by the Coal Authority there remains a risk of encountering unrecorded mine entries during the redevelopment of the site. Mine entries are likely to manifest as potentially square, rectangular or circular areas of dark deep Made Ground (which may or may not be brick lined) surrounded by natural soils/weathered rock; mine shafts could also be potentially be capped – e.g. with a large block of concrete. If the presence of mine entries is suspected, the affected area should be cordoned off immediately and the advice of a coal mining engineer sought.

## Figures



Extract from: © Google Maps 2021  
 Drawing Ref: Holden Fold, Darwen

KEY



Site Boundary

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

Client: Blackburn with Darwen Borough Council				Title: Site Location Plan			
Site: Holden Fold, Darwen				Scale (See Scale Bar): See Scale Bar	Figure: 1		Revision:
Job No.: LKC 21 1081	Drawn By: AC	Checked By: BR	Drawn: Oct 2021				



**KEY**

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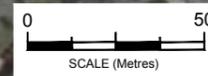
Client:  
Blackburn with Darwen Borough Council

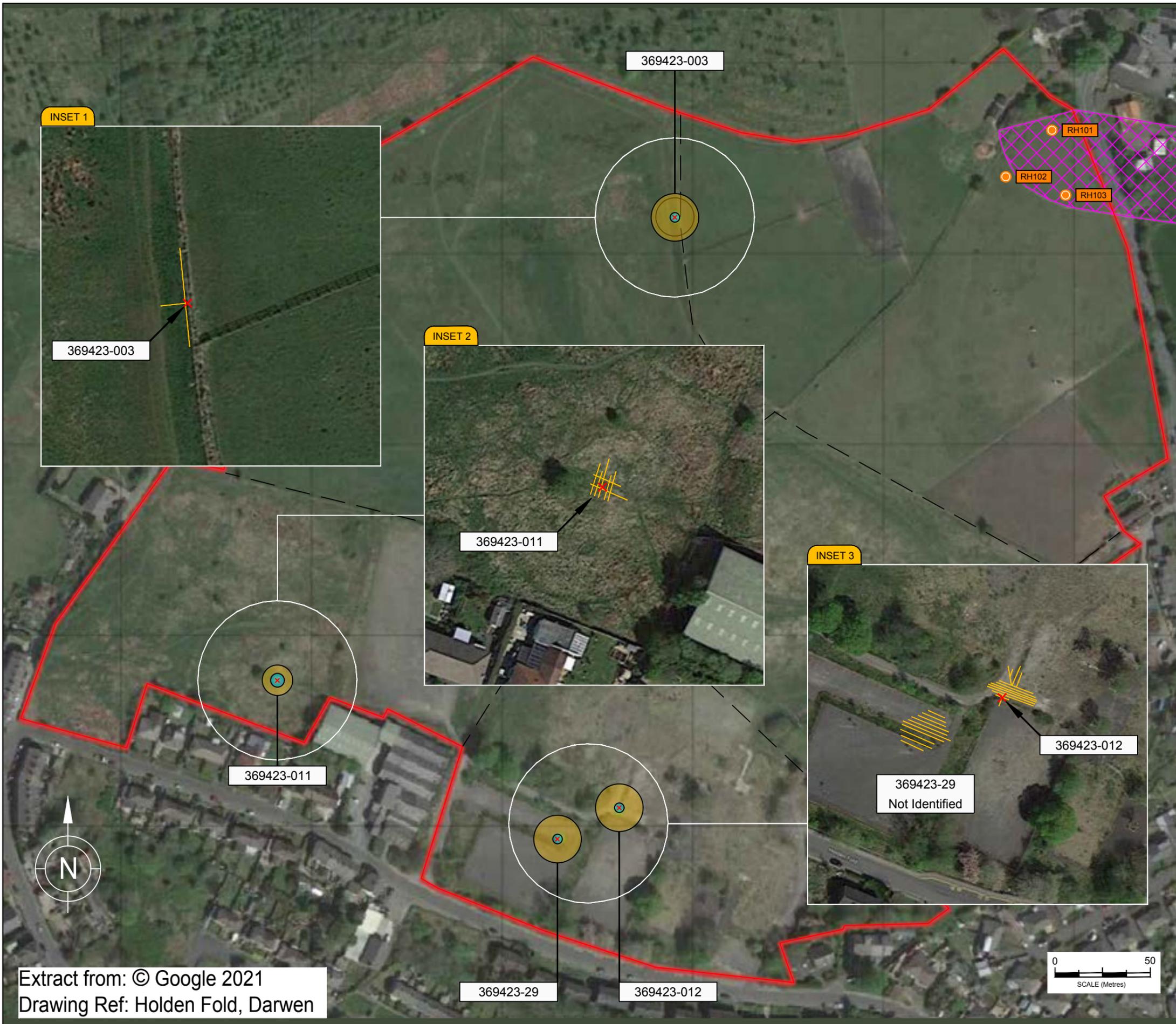
Site:  
Holden Fold, Darwen

Title:  
Site Boundary Plan

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LKC 21 1081	See Scale Bar	2	
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AC	BR	Oct 2021	

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**KEY**

-  Site Boundary
-  Rotary Borehole (RH)
-  Coal DHRA
-  Mine Entry Location
-  Mine Entry Diameter
-  Mine Entry Departure
-  Trench Location

**NOTE:**  
 Insets not to scale

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client:  
 Blackburn with Darwen Borough Council

Site:  
 Holden Fold, Darwen

Title:  
 Shallow Coal Mining Investigation Locations

Job No.:	Scale (See Scale Bar):	Figure:	Revision:
LKC 21 1081	See Scale Bar	3	
Drawn By:	Checked By:	Drawn:	
AC	BS	Oct 2021	

Extract from: © Google 2021  
 Drawing Ref: Holden Fold, Darwen

# **Appendix A**

## **Abandoned Mine Plans**



Catalogue No.: NW270 Sheet info: 1 OF 2

Date: 02/06/2021

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Accession No.: The Coal Authority 2003 Linnell Lane, Mansfield, Notts, NG18 4PL, UK

Scale: 30 YARDS TO 1 INCH (1 TO 1080)

NW.270



## **Appendix B**

### **Coal Authority Permit to Enter or Disturb Mine Workings**



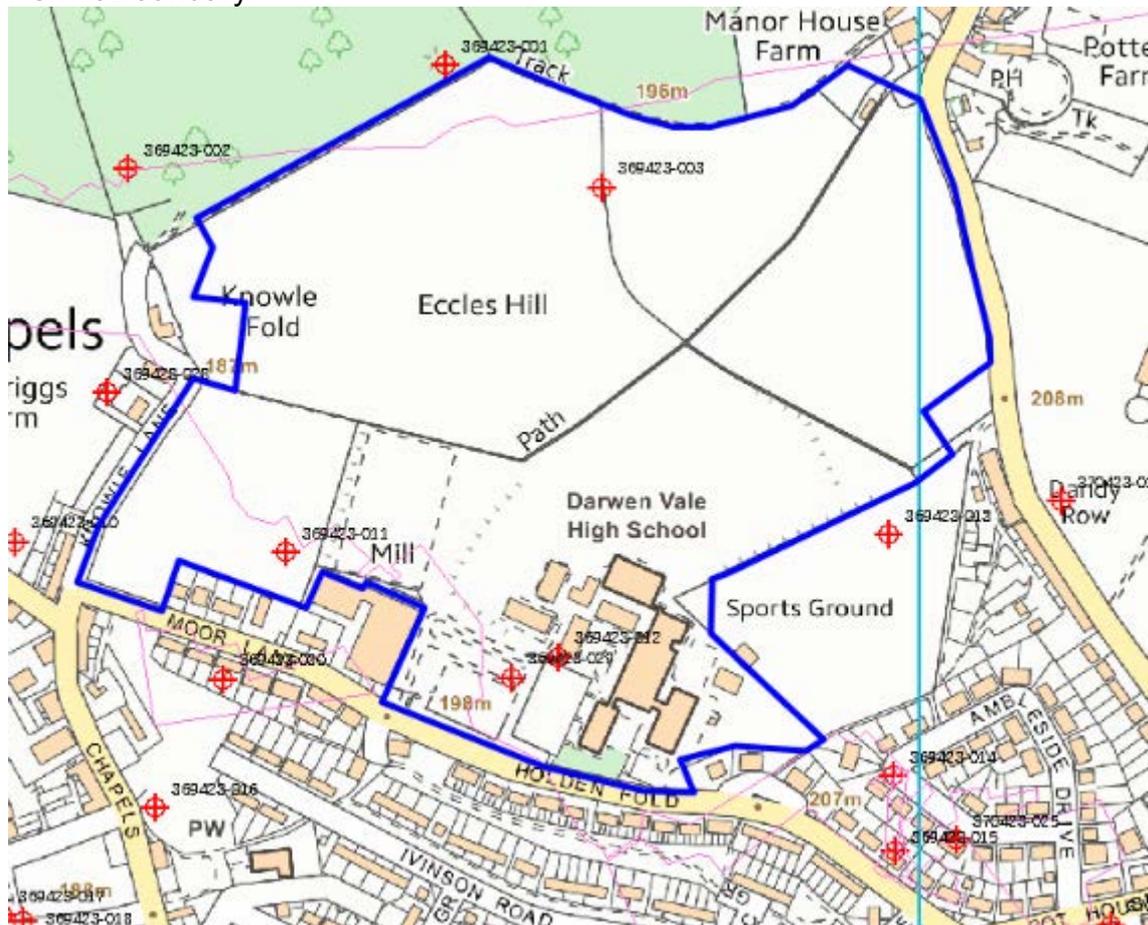


The Coal  
Authority

# Granted Permit Boundary

Permit Ref: 22201

Permit Boundary:



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## **Appendix C**

# **Rotary Borehole Drilling Logs**



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Tel: 0161 763 7200 web: www.thelkgroup.com

**Site**  
Holden Fold, Darwen

**Borehole Number**  
**RBH101**

**Machine :**  
**Flush :**  
**Core Dia :** mm  
**Method :** Rotary Cored

**Casing Diameter**  
100mm cased to 3.00m

**Ground Level (mOD)**

**Client**  
Blackburn with Darwen Borough Council

**Job Number**  
LKC 21 1081

**Location**

**Dates**  
24/06/2021

**Engineer**  
LKC

**Sheet**  
1/3

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							0.15	TOPSOIL: Brown gravelly slightly silty SAND. Sand is fine to coarse. Gravel is fine to medium, angular to subangular comprised of mudstone, sandstone and coal.		
							0.75	1. Light brown CLAY		
							0.90	1. Light brown and light grey weathered MUDSTONE with frequent black shale bands		
							(14.10)			

**Remarks**  
1. Driller's log description

**Scale (approx)**  
1:50

**Logged By**  
FP

**Figure No.**  
LKC 21 1081.RBH101



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**Site**  
Holden Fold, Darwen

**Borehole Number**  
**RBH101**

<b>Machine :</b>		<b>Casing Diameter</b>		<b>Ground Level (mOD)</b>		<b>Client</b>		<b>Job Number</b>	
<b>Flush :</b>		100mm cased to 3.00m				Blackburn with Darwen Borough Council		LKC 21 1081	
<b>Core Dia : mm</b>		<b>Location</b>		<b>Dates</b>		<b>Engineer</b>		<b>Sheet</b>	
<b>Method : Rotary Cored</b>				24/06/2021		LKC		2/3	

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							15.00	1. Light brown SANDSTONE		
							(4.50)			
							19.50	1. Coal seam (intact)		

<b>Remarks</b> 1. Driller's log description	<b>Scale (approx)</b>	<b>Logged By</b>
	1:50	FP
	<b>Figure No.</b> LKC 21 1081.RBH101	



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**Site**  
 Holden Fold, Darwen

**Borehole Number**  
**RBH101**

<b>Machine :</b>		<b>Casing Diameter</b>		<b>Ground Level (mOD)</b>		<b>Client</b>		<b>Job Number</b>	
<b>Flush :</b>		100mm cased to 3.00m				Blackburn with Darwen Borough Council		LKC 21 1081	
<b>Core Dia : mm</b>		<b>Location</b>		<b>Dates</b>		<b>Engineer</b>		<b>Sheet</b>	
<b>Method : Rotary Cored</b>				24/06/2021		LKC		3/3	

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							(1.50)			
							21.00	1. Light brown SANDSTONE		
							(9.00)			
							30.00			

<b>Remarks</b> 1. Driller's log description	<b>Scale (approx)</b>	<b>Logged By</b>
	1:50	FP
	<b>Figure No.</b> LKC 21 1081.RBH101	



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**Site**  
 Holden Fold, Darwen

**Borehole Number**  
**RBH102**

**Machine :**  
**Flush :**  
**Core Dia :** mm  
**Method :** Rotary Cored

**Casing Diameter**  
 100mm cased to 3.00m

**Ground Level (mOD)**

**Client**  
 Blackburn with Darwen Borough Council

**Job Number**  
 LKC 21 1081

**Location**

**Dates**  
 25/06/2021

**Engineer**  
 LKC

**Sheet**  
 1/3

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							0.15	TOPSOIL: Brown gravelly slightly silty SAND. Sand is fine to coarse. Gravel is fine to medium, angular to subangular comprised of mudstone, sandstone and coal.		
							0.75	1. Light brown CLAY		
							0.90	1. Light brown and light grey weathered MUDSTONE with frequent black shale bands		
							(13.60)			

**Remarks**  
 1. Driller's log descriptions.

**Scale (approx)**  
 1:50

**Logged By**  
 FP

**Figure No.**  
 LKC 21 1081.RBH102



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**Site**  
 Holden Fold, Darwen

**Borehole Number**  
**RBH102**

<b>Machine :</b>			<b>Casing Diameter</b>			<b>Ground Level (mOD)</b>		<b>Client</b>		<b>Job Number</b>	
<b>Flush :</b>			100mm cased to 3.00m					Blackburn with Darwen Borough Council		LKC 21 1081	
<b>Core Dia : mm</b>			<b>Location</b>			<b>Dates</b>		<b>Engineer</b>		<b>Sheet</b>	
<b>Method : Rotary Cored</b>						25/06/2021		LKC		2/3	

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							14.50	1. Light brown SANDSTONE		
							(5.50)			

<b>Remarks</b> 1. Driller's log descriptions.								<b>Scale (approx)</b> 1:50		<b>Logged By</b> FP	
								<b>Figure No.</b> LKC 21 1081.RBH102			



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Site  
 Holden Fold, Darwen

Borehole  
 Number  
**RBH102**

<b>Machine :</b> <b>Flush :</b> <b>Core Dia :</b> mm <b>Method :</b> Rotary Cored		<b>Casing Diameter</b> 100mm cased to 3.00m	<b>Ground Level (mOD)</b>	<b>Client</b> Blackburn with Darwen Borough Council	<b>Job Number</b> LKC 21 1081
		<b>Location</b>	<b>Dates</b> 25/06/2021	<b>Engineer</b> LKC	<b>Sheet</b> 3/3

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							20.00	1. Coal seam (intact)		
							(1.30)			
							21.30	1. Light brown SANDSTONE		
							(8.70)			
							30.00			

<b>Remarks</b> 1. Driller's log descriptions.	<b>Scale (approx)</b> 1:50	<b>Logged By</b> FP
	<b>Figure No.</b> LKC 21 1081.RBH102	



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**Site**  
Holden Fold, Darwen

**Borehole Number**  
**RBH103**

<b>Machine :</b>		<b>Casing Diameter</b>		<b>Ground Level (mOD)</b>		<b>Client</b>		<b>Job Number</b>	
<b>Flush :</b>		100mm cased to 3.00m				Blackburn with Darwen Borough Council		LKC 21 1081	
<b>Core Dia : mm</b>		<b>Location</b>		<b>Dates</b>		<b>Engineer</b>		<b>Sheet</b>	
<b>Method : Rotary Cored</b>				25/06/2021		LKC		1/3	

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							0.10	TOPSOIL: Brown gravelly slightly silty SAND. Sand is fine to coarse. Gravel is fine to medium, angular to subangular comprised of mudstone, sandstone and coal.		
							(0.70)		1. Light brown CLAY	
							0.80	1. Weathered MUDSTONE		
							(17.20)			

<b>Remarks</b> 1. Driller's log descriptions.								<b>Scale (approx)</b> 1:50	<b>Logged By</b> FP
								<b>Figure No.</b> LKC 21 1081.BH3	



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**Site**  
 Holden Fold, Darwen

**Borehole Number**  
**RBH103**

<b>Machine :</b>		<b>Casing Diameter</b>		<b>Ground Level (mOD)</b>		<b>Client</b>		<b>Job Number</b>	
<b>Flush :</b>		100mm cased to 3.00m				Blackburn with Darwen Borough Council		LKC 21 1081	
<b>Core Dia : mm</b>		<b>Location</b>		<b>Dates</b>		<b>Engineer</b>		<b>Sheet</b>	
<b>Method : Rotary Cored</b>				25/06/2021		LKC		2/3	

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							18.00	1. Light brown SANDSTONE		

<b>Remarks</b> 1. Driller's log descriptions.	<b>Scale (approx)</b>	<b>Logged By</b>
	1:50	FP
	<b>Figure No.</b> LKC 21 1081.BH3	



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**Site**  
 Holden Fold, Darwen

**Borehole Number**  
**RBH103**

<b>Machine :</b>		<b>Casing Diameter</b>		<b>Ground Level (mOD)</b>		<b>Client</b>		<b>Job Number</b>	
<b>Flush :</b>		100mm cased to 3.00m				Blackburn with Darwen Borough Council		LKC 21 1081	
<b>Core Dia : mm</b>		<b>Location</b>		<b>Dates</b>		<b>Engineer</b>		<b>Sheet</b>	
<b>Method : Rotary Cored</b>				25/06/2021		LKC		3/3	

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							(12.00)	1. 75% Flush loss, no broken drilling no voids.		
							30.00			

<b>Remarks</b> 1. Driller's log descriptions.	<b>Scale (approx)</b>	<b>Logged By</b>
	1:50	FP
	<b>Figure No.</b> LKC 21 1081.BH3	

## **Appendix D**

# **Photographic Record – Mine Shaft Investigation**

# Mine Shaft 369423-003



**Photograph 1:**  
Trial trench along the boundary wall / fence line exposing the light coloured clay superficial deposits.



**Photograph 2:**  
Close up of the light coloured clay deposits in contrast to the topsoil seen in the side wall of the trial trench.



**Photograph 3:**  
Possible mine shaft saturated with groundwater exposed with made ground penetrating the natural clay.



**Photograph 4:**  
Side wall collapse showing made ground within the possible shaft comprises ash, clinker and colliery spoil..



**Photograph 5:**  
Illustrating the contrast between the possible shaft fill material and the natural clay surrounding the potential shaft.



**Photograph 6:**  
Illustrating the contrast between the possible shaft fill material and the natural clay surrounding the potential shaft.

**Mine Shaft 369423-011**



**Photograph 7:**  
Initial corner of concrete cap encountered.



**Photograph 8:**  
Trenching across the shaft cap showing loose reinforcement bar.



**Photograph 9:**  
Trenches perpendicular to one another



**Photograph 10:**  
Full width and length of the slab exposed east to west and north to south

# Mine Shaft 369423-012



**Photograph 11:**  
Orangish red superficial deposits over sandstone.



**Photograph 12:**  
Evidence of the former investigation works within the trial trenches.



**Photograph 13:**  
Potential evidence of a shaft exposed.



**Photograph 14:**  
Potential shaft fully exposed.

# Mine Shaft 369423-029



**Photograph 15:**  
Orangish red superficial deposits over sandstone.



**Photograph 16:**  
Extension of trial trenches in areas of soft or reworked natural.



**Photograph 17:**  
Example of reworked ground – likely to represent historic investigations for mine entries.



**Photograph 14:**  
View across the area investigated after 1 day.

Based across the UK with  
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