Phoenix Center

The Phoenix Centre at Nottingham City | UK | December 2020

Phase 1 Environmental Assessment Desk Study

CHEE 2041
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Abstract

Location	Phoenix centre, located at south of Phoenix Park and about 2km west of River Leen.
History	The site was an industrial area that produced construct materials from 1880s to 1950s. The mine field operated from 1960s to 1980s. In the 1980s, factories were dismantled and tramways were built. Currently, the site is an area where mainly does service and retail industry.
Geology	Bedrock geology information was searched in form of a map with different rocks in different colour. Almost all of area within the boundary is man-made above the natural rock units. Other information like soil property, climate, mining, ecology, landfill was searched and evaluated.
Contamination	Hazards (former mine, building material, traffic, wastes produced by human activities) of the site, which have been evaluated detailedly.
Recommendations and Conclusion	Advice to hazards, and conclusion of this environmental assessment.

Content

1 Introduction

Group 4 has been entrusted by Dr. Yong Sun to accomplish a desk study at Pheonix Center, Nottingham, UK.

1.1 Objective

The main purpose of the phase 1 desk study is to check the history of the site, assess the site setting, determine the ground condition and identify the potential harzard associated with the site. And finally build a conceptual site model based on these informations, which would be used for development proposal in this area.

1.2 Scope of work

The following investigation work was done to achieve the above objectives:

- Identification of site location and setting based on satellite remote sensing images of this area
- Description based on review of available historical maps and existing reports of this area
- Description based on review of available geological and hydrological maps
- Identification of potential sources of contamination based on history and current environment
- A review of planning applications and restrictions
- A qualitative and quantitative risk assessment base on known information
- Recommendations based on report's findings

1.3 Liability statement

This report is based on desk study information and intrusive ground investigation data from third party. The Group 4 is not responsible for the accuracy of third-party information and disclaims any responsibility in respect of any matters outside the scope of this work.

2 Site information

2.1 Location

This site is an approximatelly area of 160,000 m^2 (16 ha) in nottinghamshire, UK. The northeast part of the site is in the charge of Nottingham City, and another part belongs to Broxtowe. See Figure A-1

The site is located on the south of Phoenix Park, and is bounded by two roads which are A610 on the southwest, Cinderhill Rd on the southeast. Besides, the west and northeast boundaries are Millennium Way and The Cliff respectively.

Table 1 Site Boundary Coordinates

Site											
Coordinates	Boundary Position	A	B	C	D	E	F	G	H	I	J
	Eastings	1°12′ 39.27″	1°12′ 42.00″	1°12′ 29.98″	1°12′ 15.10″	1°12′ 10.45″	1°12′ 08.64″	1°12′ 03.14″	1°12′ 11.36″	1°12′ 24.88″	1°12′ 34.36″

	Northings	52°59′ 21.29″	52°59′ 18.56″	52°59′ 14.52″	52°59′ 12.85″	52°59′ 13.82″	52°59′ 16.69″	52°59’ 21.56”	52°59′ 24.24″	52°59′ 23.17″	52°59′ 20.24″

Table 2 Surround Areas of the Site

Directions	Surroundings
North	Phoenix park
East	Quick I.T Repairs, Headstocks Public House
South	Cinderhill, Rosslyn Park Primary & Nursery School
West	Multi Packaging Solutions, The Nuthall

2.2 Description

Table 3 Description of the site

Site Name	Phoenix Centre
Site Address	Phoenix Pl, Nottingham NG8 6BA
Certificate of Title	Current Certificate of Title
Site Area	Approximately 160,000m^2 (16 ha)
Site Owner	Nottinghamshire, British land
Occupier/Operator	E-ON, Daisy Group, Michael Pavis Ltd. etc.

Local Government	Nottingham City Council
Current Zoning	Service and retail Industry
Proposed Zoning	No proposal
Locality Map	See Figure A-1

2.3 Current Land Use

Table 4 Current Land Use (See Figure A-2)

Number	Name	Description
1	Phoenix Park	Parking area for cars, have charging piles
2	Michael Davis Ltd	Merchants to plumbing &heating trades, warehouse and showroom of their products
3	Clip n Climb	A fun climbing court
4	Resource house	The office of MIES Building Service Ltd which worked on various mechanical and electrical projects
5	Avant Homes Ltd	The office of house builder company
6	Oaktree House Ltd & Peppermint Technology Ltd	The office of Oaktree House Ltd which focus on development of building projects and construction of domestic buildings; The office of Peppermint Technology Ltd which is a cloud software company
7	Daisy Ltd	The office of Daisy Ltd which is UK's #1 independent provider of IT, communications and cloud

8	E.on Ltd	The office of e.on Ltd which is a renewable electricity supplier
9		
10	unknown	
11	Nottinghamshire Local Medical Committee	The office of a association
12	NASUWT	The office of teacher association
13	British Red Cross First Aid Training	The office of red cross association
14	Helly Hanson Ltd	The office of a office accessories wholesaler
15	Computacenter Plc	The office of Computacenter plc which is a British multinational that provides computer services to public- and private-sector customers
16	StoreFeeder Ltd	The office of StoreFeeder Ltd which offers services about e-commerce solutions
17	Premier Inn Nottingham West Hotel	An 3-star hotel
18	Edmond Shipway LLP	The office of a consultant that provides cost consultancy, project management and M&E consultancy services
19	Phoenix Park Nursery	A children nursery
20	SF Recruitment Ltd	The office of SF Recruitment Ltd which is the leading specialist recruiter in the Midlands

21	Focus Consultants LLP	The office of Focus Consultants LLP which are experts in the art of strategy, funding, project development and delivery
22	Fittleworth Medical Ltd	A store of Fittleworth Medical
23	Multi Packaging Solutions	A packging supply store

3 Site history

A historical survey has been done by reference to historic maps sourced from Digimap.(See Figure B-1

Table 5 Site Historical Survey

Time	Scale	Description	Differences	Hazard
1880s	1:7500	Industrial area with a colliery, a brick work factory, and a gas work factory. Backward surroundings. Main traffic arteries already formed; a mineral railway formed. Two quarries and one farm at the north; one farm at the south	Lack of information	The soil may be polluted by coal and other industrial products.
1920s	1:7500	Basically the same as before.	Farm in the north was abandoned and instead of a railway	No special hazards.
1930s	1:7500	Basically the same as before.	The main The broad (Nottingham Road) was	No special hazards.

			broadened, more branch of roads was built	
1950s	1:7500	Living areas and supporting infrastructure were formed.	Terraced house was built at surrounding areas. The brick work and gas work factories were dismantled, an old slurry bed instead.	Facilities in early living areas may now age.
1960s	1:7500	Basically the same as before. Coal main equipment was upgraded.	Some ancillary buildings constructed among the railways. The slurry bed was converted into vacant lots.	The building on the slurry bed may have an unstable foundation.
1970s	1:7500	Basically the same as before. Redesign of the Nottingham road.	No significant differences.	Old data may not have been updated.
contemporary	1:7500	All industrial buildings and equipment are dismantled.	The mineral railway was converted to trams. New buildings were constructed. A park was built at the north.	The building on the old colliery may have an unstable foundation. Groundwater may seep at the area.

The earliest map available dates to 1880s, shows the site had been relatively developed into an industrial area whose main industries are one colliery called Cinderhill, also known as Babbington, and one brick work factory, and one gas work factory. The majority of the surrounding area was idle and undeveloped. The east and

south traffic arteries of the area have formed observed from the map and accompanied by a mineral railway. Two quarries were constructed at north ofthe site. A farm that called Hampshill plantation is located at north of the site about 400m. Another one name is Horse&Dale Farm is located about 200m south of the site. Furthermore, there were three fish ponds surrounded the site. The maps do not show significant differences in the site and surrounding areas until 1910s.

The Hempshill plantation was abandoned and instead of a railway above its position according to the map dated 1920s.

The main road (Nottingham Road) was broadened and more branch of roads were built from 1930s.

The map dated 1950s, shows the developments of the terraced house. Meanwhile, the brick work factory had been dismantled instead of an old slurry bed, the gaswork factory was also dismantled. Despite the absence of maps over the past 40 years, it is not difficult to infer the formation of living areas and supporting infrastructure, and the influx of people. Some ancillary buildings were constructed in 1960s among the railway, which is tentatively speculated to be upgrading of coal mine equipment. The slurry bed was converted into vacantlots at the same time. The map dated 1970s, shows a redesign of the Nottingham road and renamed as A610. The other area had no significant differences due to the map.

Since the absence of maps in the next 20 years, the contemporary map shows a huge difference. All industrial buildings and equipment are dismantled which consistent with the fact that Babbington Colliery was closed in 1986. Meanwhile, the mineral railway was converted to trams. New buildings were constructed on the site, while a park was built at the north of the site.

4 Environmental setting

4.1 Geology

4.1.1 Bedrock geology

The small grey part where code is PMCM is composed by pennine middle coal measures formation. This is a rock unit formed by siltstone, grey sandstone, mudstone and coal seams. The base of the rock is the mudstone layer that with marine fossils.

The orange area is Edlington Formation and code is EDT, which composed by red-brown mudstone, siltstone and greenish-grey sandstone. This rock is common this area in the form of dolomite, anhydrite.

The pink area at the top of the boundary is a unit called Lenton Sandstone Formation and code is LNS. According to BGS, itis composed of very fine to medium-grained sandstone, argillaceous, red-brownand grayish-yellow spots, red-brown mudstone, and conglomerate.

The pale green area is Cadeby Formation (CDF), which is mainly composed of dolomite. This rock is composed by mudstone, siltstone and sandstone, and is gray or pale yellow gray.

4.1.2 Made ground

Almost all of area within the boundary is man-made, whose code is MGR. This means the artificial ground is constructed above the natural rock units.

4.1.3 Superficial geology

No superficial deposits cover this area. However, an alluvium area, which code is ALV, is located at the west of the site in term of yellow color. Alluvium is a geological area that formed by gravel, sand, silt and clay. The forming reason of it is because the long-term impact of alluviation, and this is a powerful evidence for the existence of water.

4.2 Soil property

Table 6 Borehole Property

Borehole property						
No.	Grid Ref	Depth	Soils	Rocks	Foreign matter	Comment
SK54SW33_A	(453200, 343710)	384.35m (1260.99ft)	M, S, C	Co, Cl, B, I, D, CG, bat	Carbonicola	Foreign matter at 231.6m (760ft) and 232.3m (762ft)
					Non-marine lamellibranchs	Foreign matter at 240m (787ft 5*1/2in)
					Abundantant in bind lamellibranchs	Foreign matter at 264.7m (868ft 7in)
					Lamellibranchs in dark shale	Foreign matter at 265.7m (871ft 10in)
					Grey mudstone with isolated lamellibrans	Foreign matter at 278.9m (915ft 2in)
					Cannel Coal with fish scales	Foreign matter at 279m (915ft 4in)
					Lamellibranchs and ostracods	Foreign matter at 305.5m (1002ft 2in)
					Piper	Foreign matter at 305.8m (1043ft 66in)
SK54SW33_B	(453200, 343710)	35.05m (114.99ft)	C, L, M, S	Sh, B, Cl, Co, Ca	Carbonicola	Foreign matter at 7.24m (23ft 9in), 11.43m (37ft 6in), 19.96m (65ft 6in)
					Carbonaceous	Foreign matter at 30.73m (100ft 10in)
SK54SW31_A	(453313, 343659)	201.93m (662.5ft)	C, L, M, S	Br, iI, Co, Sh, Cl, LS		Much water was encountered at 57.6m (189ft 4in) and 58.2m (191ft 7*1/2in)
SK54SW31_C	(453313, 343659)	27.43m (89.99ft)	C, L, M, S	Co, Sh, Cl, B		
SK54SW180	(453590, 343640)	7m (22.97ft)	C, L, M, S	Magnesian LS, Ca		From 3.88m (12.73ft) to 7.20m (23.62ft) core reacts with diluted hydrochloric acid. At 4.46m (14.63ft) and 6.49m (21.29ft) cavity with calcite
SK54SW181	(453620, 343700)	9m (29.53ft)	C, L, M, S	CC, LS		Water struck at 6.3m (20.67ft). At 7.72m (25.33ft) and from 7.89m (25.89ft) to 7.97m (26.15ft) stylolite. At 8.35m (27.4ft) calcite filled cavity 2cms (0.787in) long
Note	Soils: M: mudstone; C: clay; S: sandstone; L: siltstone					
	Rocks: B: bind; Cl: clunch; I: ironstone; Sh: shale; D: dolomite; CG: conglomerate; Ca: calcite; Br: breccia; LS: limestone; CC: concrete					

According to the borehole report uploaded by BGS, a borehole that was noted as SK54SW31 was dug on the road where in the south-central part of the site. It belongs to the area whose geological code is CDF. The components of the point are magnesian, limestone, marl slates, breccia and coal. Water was encountered in black shale at 57.6m (189ft 4in) and 58.2m (191ft 7*1/2in).

Another borehole that was noted as SK54SW33 was dug at west of SK54SW31. It also belongs to CDF. The top ground is human-made. Below this level, the rocks are composed by coal, clunch with ironstone, bind in different colors, mudstone and etc. Some special foreign matters need to attention. For instance, carbonicola in grey mudstone at 231.6m (760ft) and 232.3m (762ft), dark bind with abundant lamellibranchs at 264.7m (868ft), cannel coal with fish scales at 278.9m (915ft 2in), coal and bat at 279.2m (916ft) and 317.91m (1043ft) and piper at 305.8m (1003ft 66in).

The third borehole that was noted as SK54SW180 was dug at the southeast corner. It belongs to the area whose geological code is PMCM. From the record, cavity with calcite encountered at 4.46m (14.63ft) and 6.49m (21.29ft), and other almost is mudstone. However, from 3.88m (12.73ft) to 7.20m (23.62ft) of the hole, the core of soil and rock reacts with diluted hydrochloric acid.

The fourth borehole that was noted as SK54SW181 was dug at north from SK54SW31. It also belongs to PMCM. The rocks in the hole composed by mudstone, limestone, calcite and etc. In addition, water struck at 6.3m (20.67ft).

This figure shows the representative profile of geological section underground, and the appendix line was marked at the top right corner. The site is marked in red colour within the map. Obviously, the site is near the appendix line, so the figure is suitable for study the geology of this area.

The site where is signed in red belongs to Cadeby Formation, it is mainly formed by magnesian limestone.

The figure indicates that no sand and gravel resource, and also no glacial sand and gravel resources within the site because two keys are not covering it.

The figure indicates that this site seems to belong to Lenton formation, and possibly to Nottingham Castle formation. Both of these are part of the geology.

The figure strongly indicates that the site belongs to Cadeby formation as mentioned above.

4.3 Climate, Hydrology & Hydrogeology

Since England is temperate marine climate,the temperature and precipitation are more stable than monsoonal climate. 50-75 mm/year on July and January(Ditu.Ps123.Net, no date) shows that precipitation is not an serious problem. There are four water bodies near the site. Three of them are lakes and one of them is a river. The smallest distance from the nearest large water body to the site is 2 km (1.24 mile). According to UK Centre of Ecology & Hydrology(no date), the source of River Leen is Nottinghamshire Golf Club Hollinwell, which locates on the north of the site and has a distance of about 11 km (6.84 mile). Therefore, the River Leen beside the site is a river with low level. Compared to the River Trent, its flow rate and scale is small. Although on the north-east of the site there are several incidents. Since the River Leen only have a width of 5 m (16.40 ft), the possibility and consequence of flooding is small.

Table 7 Water bodies near the site

Water body	Direction	Distance	Estimation
Unnamed lake	North to East 30°	345 m (1131.89 ft)	About 200 m^2 (0.02 ha) area
Unnamed lake	North to West 85°	752 m (2467.19 ft)	About 2500 m^2 (0.25 ha) area
River Leen	North to East 65°	823 m (2700.13 ft)	About 5 m (16.40 ha) width
Unnamed lake	North to West 85°	2 km (1.24 mile)	About 100,000 m^2 (10 ha) area

In terms of temperature, 2.5 ℃ and 17.5 ℃ shows that the average temperature of January and July separately will not lead to frozen disaster or high-temperature calamity. In combination with precipitation and temperature, forest fire will not be an hazard of this site.

In terms of hydrogeology, a hydrogeologic map from British Geological Survey shows that there are two different aquifers under the site, which are highly productive aquifer with significant intergranular and highly productive aquifer in which flow is virtually all through fractures and other discontinuities. Although these two types of aquifer have different origins, they both indicate that the ground water under the site is abundant.

4.4 Mining

In the site there are four development high risk areas(The Coal Authority, no date), which are all located at the south-west of the site. According to Development High Risk Area Matadata from The Coal Authority(no date), "New development in this defined area needs to demonstrate that the development will be safe and stable taking full account of former coal mining activities. This area was formally known as the Development Referral Area." In the coal mine map, Mine Entry Zones of Influence is highly coincident with development high risk areas, Mine Entry Zones of Influence Matadata shows that "The Zone of Influence (ZOI) highlights the area on the surface that could potentially be affected in the unlikely event a collapse was to occur." Therefore, it is worthy to investigate the former coal mine further in the following onsite investigation. Otherwise, the former coal mine may be a potential hazard to the human acitivies. Fortunately, there is no surface mining at the site currently. The smallest distance from the nearest coal mining to the site is 3 km (1.86 mile). Therefore, current mining activity is not a potential hazard to the site.

4.5 Ecology

In the north of the site, there is a Phoenix Park. According to Land Cover Map from UK Centre for Ecology & Hydrology(no date), the land in Phoenix Park is consisted of two parts, which are natural grassland and calcareous grassland. Although their composition is different since calcareous grassland have more calcium carbonate than natural grassland, their stability and function is similar, which is providing soil for plant to live in. In the park there will be also many animals and insects. Phoenix Park is the unique natural park near the site.

In addition, there are some farmland 1km from the site. Obviously, the ecosystem in Phoenix Park is much diverse than that in farmland.

According to Natural England Open Data(no date), "The Environmentally Sensitive Areas (ESA) were introduced in 1987 to offer incentives to encourage farmers to adopt agricultural practices which would safeguard and enhance parts of the country of particularly high landscape, wildlife or historic value." The ESA map of England shows that the whole area of Nottingham is not included in any ESA.

4.6 Landfill

Due to the landfill map sourced from government data, the nearest landfill located about 1km away from our site, which is a safe distance according to Danthurebandara et.al. (2013)

4.7 Odour

There was no special odour within the site.

4.8 Visual &noise

name	Source	Description
Strong light	Vehicles like cars and trams	Because of a big car park and tram stops, there must be much light from vehicles in the evening
Fog	weather	The site is in temperate marine climate area, where is often foggy in winter.
Traffice noise	Vehicles like cars and trams	Because of a big car park and tram stops, there must be much noise from vehicles

4.9 Industrial archaeology

Year	Industry	Description
1880	brick works, quarry, railway, pit	Brick works at the east of the site, pit and quarry near the brick works, railway was located at north of them
1900	birck works, quarry, tramway, colliery, clay pit	A colliery took the place of the pit, tramways began to be built along the brick works. A clay pit occurred around the railway
1920	birck works, quarry, tramway, colliery, clay pit	
1930	birck works, quarry, tramway, colliery, clay pit	
1950	birck works, quarry, tramway, colliery	
1960	mine, mine railway, tramway	A mine area and mine railway occurred at north of the site
1970	babbington colliery	The railway was dismantled, and a colliery noted as babbinton occurred at the southeast corner
Contemporary	Service and retail industry	

5 Planning

5.1 Policy

Greater Nottingham Strategic Plan Sustainability Appraisal Scoping Report(2020) is a document which assess the strategic plan of government. Greater Nottingham consist of five parts, which are Broxtowe Borough Council, Erewash Borough Council, Gedling Borough Council, Nottingham City Council and Rushcliffe Borough Council respectively. According to Wikipedia, The Nottingham Urban Area includes Nottingham itself and the surrounding towns and villages, but is not officially an administrative area. When government make a strategic plan for Nottingham, not only Nottingham city but also its surroundings are considered.

On page 14 of this document, it mentions that there is an "Appendix A" seting out the review of all plans, policies and programmes considered relevant to the Greater Nottingham Strategic Plan. However, on the last page of this document, it also mentions that when the draft Greater Nottingham Strategic Plan is published, a Sustainability Appraisal report will also be published detailing the assessment of reasonable alternative options put forward and the proposed policies and site allocations. It will detail how the options were refined as part of the Sustainability Appraisal process. Therefore, it is inferred that this document only assesses the draft idea of government and the formal plan haven't been published by the end of the publishment of this document, which is July 2020.

The formal plan hasn’t been published yet. this document can be used to predict the formal plan since it is a assessment and guidance for government's plan. P15 to P27 is a table which includes the keywords of government's plan. Among these keywords, there are several aspects which are related to the assessment of the site. The table below shows the detailed estimation of these aspects.

Table 10 Predicted formal plan and estimation of the site

Keywords	Description	Potential affection
Promoting healthy and safe communities	More opportunities for walking and cycling, Improve access to open space and leisure opportunities.	The Phoenix Park which locates at the north of the site may be developed into a city park.

Promoting sustainable transport	More opportunities for individuals to live in a better environment and walk. Encouraging individuals take bus and tram.	The Phoenix Park will be built to provide a better place for individuals to walk and cycle.
Making effective use of land	Set goals to maximize the land use, and prioritize buildings and reuse land.	The Phoenix Park will be probably used to achieve this goal, such as build a commercial building.
Meeting the challenge of climate change and flooding	Strengthen flood defence measures. Recycling more energy like solar, wind, hydraulic energy to achieve the amount of using energy.	Making use of the energy from River Leen while constructing some defence measures such as increase of monitoring points.
Conserving and enhancing the natural environment	Protect the natural environment including animals and vegetations from people's demand, make a balance between them.	Researches are required before construction to avoid damages to natural environment.
Conserving and enhancing the historic environment	Protect and make use of local heritage.	Two heritages are found in our site.
Facilitating the sustainable use of minerals	Limits of land and resources use. Avoid soil loss and pollution.	Protect the open spaces of our site, more vegetations are preferred on the coal mine site.
Achieving sustainable and efficient approach to resource use and waste management	Achieve more rational ways like reduce, reuse, recycle to deal with waste.	Living or working wastes are supposed to be treated wisely, a disposing centre should be built if possible.

5.2 Heritage

Architectures in the list or in conservation areas are protected by British law, which stipulated that carrying out certain works to those architectures without the necessary consent is illegal. The conviction of it can lead to fines and even imprisonment. Therefore, owners, their contractors and consultants need to have a general grasp of what is permitted to do without consent, and when is the specialist advice needed.

Table 11 Heritage (A)

Name	Bulwell, Nottingham
Designation	Conservation area, 9 listed buildings
Condition	Very bad
Vulnerability	Low
Trend	Improving
Description	Phoenix centre have overlap with coverage of Bulwell town
Restriction	The Enterprise and Regulatory Reform Act 2013 stipulated that planning permission is required for the demolition of an unlisted building in a conservation area.

Table 12 Heritage (B)

Name	Capitol Bingo and Social Club, Churchfield Lane
Designation	Listed Place of Worship grade II
Condition	Very bad
Priority category	A (A)
Owner type	Religious organisation
Description	The location of the heritage is about 2km southeast of the site.
Restriction	The building is still in use as a place of worship usually fall outside the secular system of heritage protection, and most denominations have their own internal systems of control

Where,

Priority category A means: Immediate risk of futher rapid deterioration or or loss of fabric; no solution agreed. Note: the priority in the bracket is assessment of previous year.

Vulnerability: Three degrees to assess parks and gardens, conservation areas, wreck sites and battlefields are high, medium and low.

6 Preliminary conceptual site model & risk assessment

6.1 Principles

Risk consists of two parts, which are consequence and likelihood. Consequence indicates how serious a hazard is, sometimes it also be known as "Magnitude". Likelihood describe how often the hazard will happen, sometimes it also be known as "frequency". Risk is the product of these two terms. Only considering one aspect can not relate the hazard with the risk. Generally, risk assessment criteria will be in the form of a table, which shown in 6.3.

In addition, if a hazard is evaluated to be moderate or high risk. It can also be evaluated by Conceptual Site Model (CSM) which is more detailed. According to Simmonds and Bristow, "A Conceptual Site Model (CSM) is representation of the biological, physical and chemical processes that determine the ways that contaminants move from sources through the environmental media to environmental receptors. Environmental media includes soil, water and air that has the capacity to transport contaminants to sensitive receptors such as plants, animals and humans."

6.2 Contamination of potential concern

According to United States Environmental Protection Agency (EPA), "A Contaminant of Potential Ecological Concern (COPEC) or Contaminant of Potential Concern (COPC) is generally a contaminant which may or may not be causing risk or adverse effects to the plants and animals at a site. " Contamination is highly related to hazard of the site. Therefore, it needs to be evaluated detailedly and recognize all the potential hazard.

6.3 Identification of Potential Hazard Source

Table 13 On-site Hazard

Source	Description	Comment
Former mine	All the hazards of former mine come from two aspects, slag and pit. Slag contains heavy metal and it is easy for it to infiltrate into the ground and contaminate groundwater and soil. Slag also contribute to the dust. Pit maybe collaspe if no measure is done.	In the site there are four development high risk areas, which are all located at the south-west of the site. Slag should be properly disposed and pit should be reinforced or filled.
Building material	The main hazard of building material is asbestos. When asbestos is inhaled into the body, Mesothelioma, Asbestosis and other diseases may affected health and safety in a gradual process.	According to Health and safety executive, asbestos can be present today in any building built or refurbished before the year 2000. Specialized instrument can be used to quantify the accurate concentration of asbestos in the air.
Traffic	Most roads construction were rebuilt or expanded on the basis of the original road, there may be defects in road planning and design, resulting in unable to meet the requirements of traffic flow and people's safe passage. Meanwhile, the traffic attachs noise pollution and exhaust pollution of vehicle.	Our site locates at the intersection of densely populated office and living areas, which further intensify the traffic demand, risks of traffic accidents, and enfluence of the pollution.
Waste produced by human activities	These solid wastes are not harmful essentially, but they could become a hazard if there is no proper treatment.	There are many companies in the site. Their daily work will produce a lot of commercial and domestic waste, especially packaging company and warehouse. However, there is no landfill within 1km of the site.

Table 14 Off-site Hazard

Source	Description	Comment
Flooding	First, flooding can damage to buildings, traffic and other artificial facilities. Second, flooding mix human waste, which include industrial waste and domestic waste, with the natural soil. Soil may be contaminated by these waste.	According to Greater Nottingham Strategic Flood Risk Assessment Addendum(Nottingham City Council, 2017), there is no historic flooding incidents in the site reported to Nottingham City Council. In spite of the low possibility, it is worthy to monitor the flow rate of River Leen.

6.4 Preliminary Site Risk Assessment

Table 15 Preliminary Site Risk Assessment

Consequence(C)		Likelihood(L)		Risk Rating	Risk(CxL)
Very high	5	Very likely	5	Very intolerable	17 to 25
High	4	Probable	4	Intolerable	13 to 16
Medium	3	Likely	3	Substantial	9 to 12
Low	2	Unlikely	2	Tolerable	5 to 8
Very low	1	Negligible	1	Trivial	1 to 4

6.5 Conceptual site model

Table 16 Conceptual Site Model for Off-site Hazard

Potential source	Contaminants of Potential Concern (CoPC)	Potential receptor	Potential pathway	Likelihood	Consequence	Risk Rating
Flooding	None	Human	Affect traffic, park, road, railways, drown	3	4	12
		Animals and Plants	Drown	3	3	9
		Water body	Mix soil, dust with water, affect the water body(lake, groundwater) through infiltration	4	5	20
		Building	Distroy the foundation of buildings, corrosive to building materials	2	5	10

Table 17 Conceptual Site Model for On-site Hazard

Potential source	Contaminants of Potential Concern(CoPC)	Potential receptor	Potential pathway	Likelihood	Consequence	Risk Rating
Former mine	Exposed bedrock	Animals and plants	lack of soil, no plants can grow in bedrock	5	2	10

	Solid particles Slag, heavy metal	Ecological receptors, traffic	Vibration can lead to the raise of particles	4	3	12
		Groundwater, runoff, irrigation, soil	Contaminant dissolved, infiltration, water cycle	4	5	20
	None	Traffic, building, human activities	Mine landslide or collapse due to the steep gradient of the mine	3	5	15
Building material	Asbestos	Human	Inhalation and other exposure	4	5	20
		Groundwater, surface runoff, soil	Contaminant dissolved, infiltration, water cycle	5	5	25
		Ecologic receptors	Plants: soil contamination Animals: Inhalation and other exposure	3	4	12
Traffic	Noise	Individual	Sounds like honking from vehicle activities	5	2	10
	Exhaust (CO_2, SO_2 and NO_x)	Individual, environment	Exhaust emission from vehicle activities	5	3	15
	None	Individual	traffic accident	2	5	10

Waste produced by human activities	Leachate (some toxic substance)	Individual	stench volatilization	2	3	6
		Ground water	dissolved and infiltrated	2	4	8
		Ecological receptors	Poison flora and fauna through the food chain	2	4	8

6.6 Summary

Table 18 Summary of Conceptual Site Model

		Sources				
		Flooding	Former mine	Building material	Traffic	Waste produced by human activities
Receptors	Human's health	Substantial	Intolerable	Very intolerable	Substantial	Tolerable
	Traffic	Substantial	Intolerable	Negligible	Negligible	Tolerable
	Ecological receptors(plants and animals)	Substantial	Substantial	Substantial	Substantial	Tolerable
	Building	Substantial	Intolerable	Negligible	Negligible	Tolerable
	Water cycle and soil	Very intolerable	Very intolerable	Very intolerable	Substantial	Tolerable

7 Recommendation

7.1 Flooding

Rainfall excess can be calculated by the following equation:

Rainfall excess = precipitation-evaporation-transpiration-infiltration-interception-depression

In a specific area, rainfall excess can be reduced by adjusting the elements in the equation. Table below list the possible measures for reduce the rainfall excess.

Table 19 Hydrologic Element and Adjustment

Elements	Adjustment	Specific measures
Precipitation	Reduce	Cannot be adjusted
Evaporation	Increase	Cannot be adjusted
Transpiration	Increase	Increase the vegetation area of Phoenix Park and the site
Infiltration	Increase	Soften the soil, increase the vegetation so that the bedrock, which has low infiltration coefficient, will not be exposed
Interception	Increase	Cannot be adjusted
Depression	Increase	Change the former mine into a small lake. Increase the flood storage capacity of reservoirs and other artificial water conservancy facilities

According to Greater Nottingham Strategic Plan(2020), Strategic Green and Blue Infrastructre assets(GBI) can make an important contribution to the reduction in flood risk since it allows rainwater to infiltrate into the ground and reduce surface water runoff.

In addition to changing the hydrologic properties, early warning can be utilized to allow human to know the time, duration and magnitude of the rainfall. In this way, people can

prepare for the potential flooding well. The building material should also consider the flooding risk, which can prevent the main structure from being destroyed by flooding.

7.2 Former mine

All the hazards of former mine come from two aspects, slag and pit. There is many heavy metal, tiny solid particles in it, which are potential hazards to environment and human activities. Therefore, slag should be disposed properly. Transferring to specific landfills which have technology to disposed or recycle slag is a good way. Regularly using borehole and well to collect soil and water sample can monitor the environmental impact in real time. In terms of pit, it can be filled with water and form a small deep lake. In addition, reinforcing the pit, reduce large vibration from human activities nearby are other useful ways to prevent the pit from collasping.

7.3 Building material

According to Health and safety executive, asbestos can be present today in any building built or refurbished before the year 2000. Therefore, one of the possible ways is disposed the construction waste in time. In addition, when new buildings are planned to be built in the site, material that doesn't contain asbestos should be used in order to pretect the environment and life.

7.4 Traffic

The most convenient and economic way to reduce noise pollution from cars is to install sound barriers on both sides of the road. (Semedzhieva, Teodora, 2019) While there is no efficient way to reduce exhaust, but to call for people to drive less. For traffic accident, significant warning signs could be installed for both drivers and walkers to reduce the possibility of accident.

7.5 Waste produced by human activities

If excess waste cannot be treated by existed conditions, the following measures are recommended:

1 Arrange regular waste transportation from site to nearest landfill

2 Build a solid waste station for collection and recycle.

3 Promote the use of recyclable and environment-friendly packaging material.

8 Conclusion

Objective

The main purpose of the phase 1 desk study is to check the history of the site, assess the site setting, determine the ground condition and identify the potential hazard associated with the site. And finally build a conceptual site model based on this information, which would be used for development proposal in this area.

Site information

This site is a service and retail industrial park of 160,000 m^2 (16 ha) locates in the northwest of Nottingham City, and a part of land is in the charge of Broxtowe. There are many companies in the site, such as e.on, Michael Pavis Ltd etc.

Site history

According to historical map, this site used to be Cinderhill colliery in 1880s. Then, the colliery was abandoned in 1980s. Up to 21 century, all industrial buildings and equipment are dismantled. Finally, the Phoenix centre was built.

Environmental setting

The site was built on made ground. Besides, the strata under site almost consist of coal and mudstone. In the north of the site, there is a Phoenix Park which have a moderate vegetation coverage. Due to the temperate marine climate, the temperature difference here is normally small, and the water source is enough.

Planning

The coming implement of Greater Nottingham Strategic Plan may lead to some constructions that are conducive to sustainable development. Additionally, two heritages locate on or near the site have some restrictions by law.

Hazard & risk assessment

The summary of CSM provides a brief result of risk assessment. Waste and former mine are two relatively hazardous sources for all receptors. Flood and building material are two relatively moderate sources of hazard. Furthermore, traffic is relatively less hazard than other sources.

Recommendation

Based on Hazard & risk assessment, recommendations are provided to prevent these hazards from affecting human and environment. Feasibility, cost and government's plan should be considered in recommendation

9 References

British Geological survey., (no date), *GeoIndex*,[online], available at <http://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSHydroMap&_ga=2.219187545.1563745656.1606555436-808894957.1606555436> (06/12/2020)

British Geological Survey (BGS), [online] available at <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> (06/12/2020)

British Geological Survey (BGS), [online] available at <http://scans.bgs.ac.uk/sobi_scans/boreholes/228075/images/10433428.html> (06/12/2020)

British Geological Survey (BGS), [online] available at <http://scans.bgs.ac.uk/sobi_scans/boreholes/228078/images/10433444.html> (06/12/2020)

British Geological Survey (BGS), [online] available at <http://scans.bgs.ac.uk/sobi_scans/boreholes/228079/images/10433447.html> (06/12/2020)

British Geological Survey (BGS), [online] available at <http://scans.bgs.ac.uk/sobi_scans/boreholes/228237/images/10433675.html> (06/12/2020)

British Geological Survey (BGS), [online] available at <http://scans.bgs.ac.uk/sobi_scans/boreholes/228238/images/10433677.html> (06/12/2020)

British Geological Survey (BGS), [online] available at <http://scans.bgs.ac.uk/sobi_scans/boreholes/228076/images/10433435.html> (06/12/2020)

Danthurebandara, Maheshi & Passel, Steven & Nelen, Dirk & Tielemans, Yves & Van Acker, Karel., (2013). *Environmental and socio-economic impacts of landfills*. available at

https://www.researchgate.net/publication/278738702_Environmental_and_socio-economic_impacts_of_landfills (06/12/2020)

Digimap. [online], available at

<http://digimap.edina.ac.uk/roam/map/historic> (29/11/2020)

Digimap. [online], available at

<http://digimap.edina.ac.uk/roam/map/geology> (06/12/2020)

Ditu.Ps123.Net., (no date), [online], available at <http://ditu.ps123.net/world/2235.html> (06/12/2020)

Ditu.Ps123.Net., (no date), [online], available at <http://ditu.ps123.net/world/2236.html> (06/12/2020)

Ditu.Ps123.Net., (no date), [online], available at <http://ditu.ps123.net/world/2239.html> (06/12/2020)

Ditu.Ps123.Net., (no date), [online], available at <http://ditu.ps123.net/world/2240.html> (06/12/2020)

Greater Nottingham Plan Partnership., (2020), *Greater Nottingham Strategic Plan Growth Options Consultation.*

Greater Nottingham Plan Partnership., (2020), *Greater Nottingham Strategic Plan Sustainability AppraisalScoping Report.*

Health and Safety Executive., (no date), *Why is asbestos dangerous*, [online], available at <https://www.hse.gov.uk/asbestos/dangerous.htm> (06/12/2020)

Historic England., (2020), *Heritage at Risk,* [online], available at

<https://historicengland.org.uk/images-books/publications/har-2020-registers/mid-har-register2020/> (06/12/2020)

Historic Landfill Sites., (2020), [online] availible at

<https://data.gov.uk/dataset/17edf94f-6de3-4034-b66b-004ebd0dd010/historic-landfill-sites> (29/11/2020)

JONATHAN TAYLOR., (2014), *Heritage Protection in the UK*, [online], available at

.<https://www.buildingconservation.com/articles/uk-heritage-protection/uk-heritage-protection.htm> (06/12/2020)

Natural England, Environmentally Sensitive Areas (England)., (no date), [online], available at <https://naturalengland-defra.opendata.arcgis.com/datasets/cb955dbafe4848e0a987c5bad17c5df0_0?geometry=-4.404%2C52.315%2C2.314%2C53.475> (06/12/2020)

Nottinghamshire County Council., (2005), *Nottinghamshire Minerals Local Plan.*

Nottinghamshire Minerals Local Plan., (no date), *environmental sensitivity mapping sensitivity report*, [online],available at <https://www.nottinghamshire.gov.uk/media/2554/environmental-sensitivity-mapping-sensitivity-report-260713.pdf> (06/12/2020)

Simmonds & Bristow., (no date), *UNDERSTANDING CONCEPTUAL SITE MODELS*, [online], available at <https://www.simmondsbristow.com.au/understanding-conceptual-site-models-and-migration-pathways/> (06/12/2020)

Slavcheva – Semedzhieva, Teodora., (2019), *Location of noise barrier and their effect on road safety.* [online],available at

http://www.sea-acustica.es/fileadmin//INTERNOISE_2019/Fchrs/Proceedings/1305.pdf (06/12/2020)

The Coal Authority., (no date), *Interactive Map*,[online], available at <http://mapapps2.bgs.ac.uk/coalauthority/home.html> (06/12/2020)

UK Centre for Ecology & Hydrology., (2007), *Map viewer,* [online], available at <https://catalogue.ceh.ac.uk/maps#layers/987544e0-22d8-11e4-8c21-0800200c9a66> (06/12/2020)

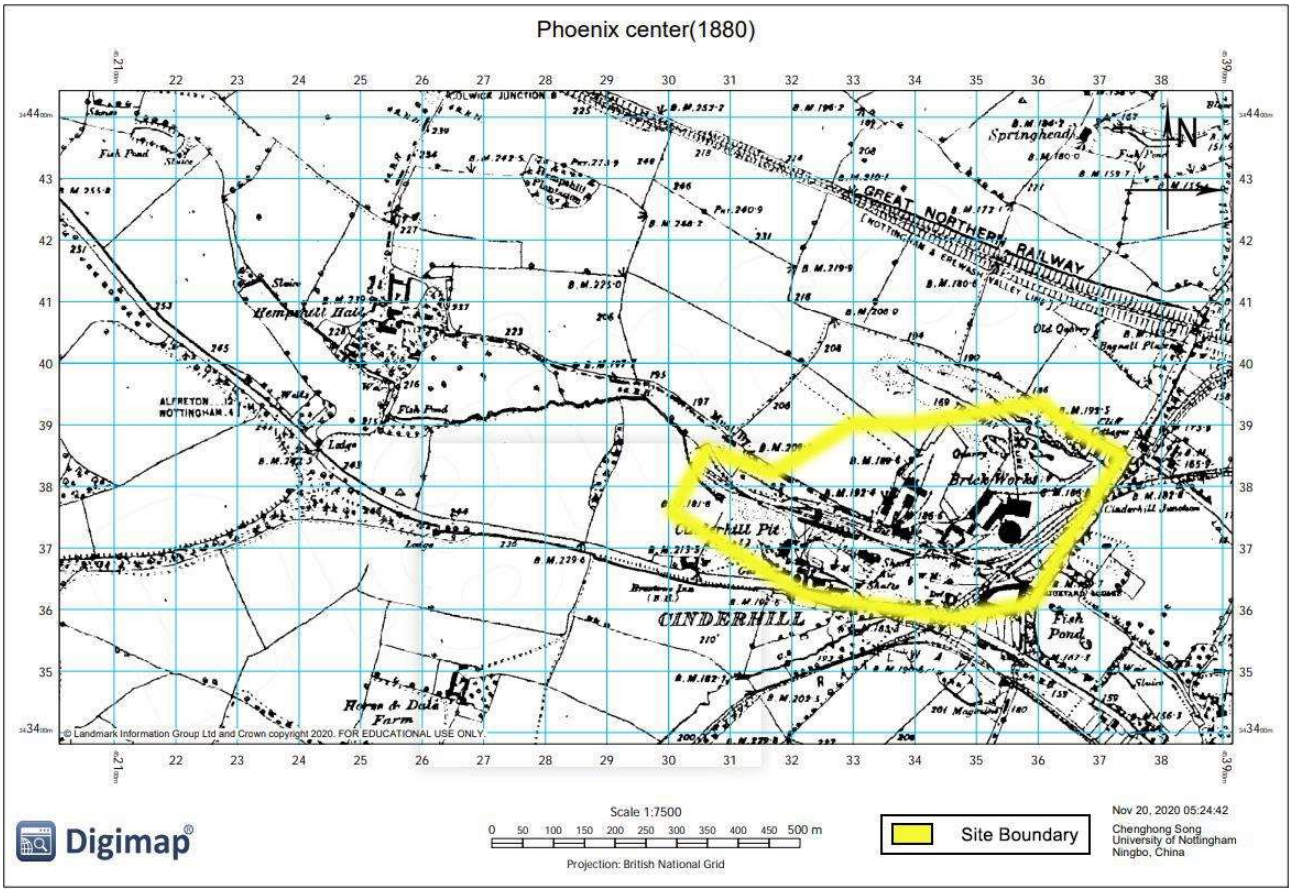
United States Environmental Protection Agency., (no date), [online], available at <https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Eco%20Risk%20Assessment%20Glossary> (06/12/2020)

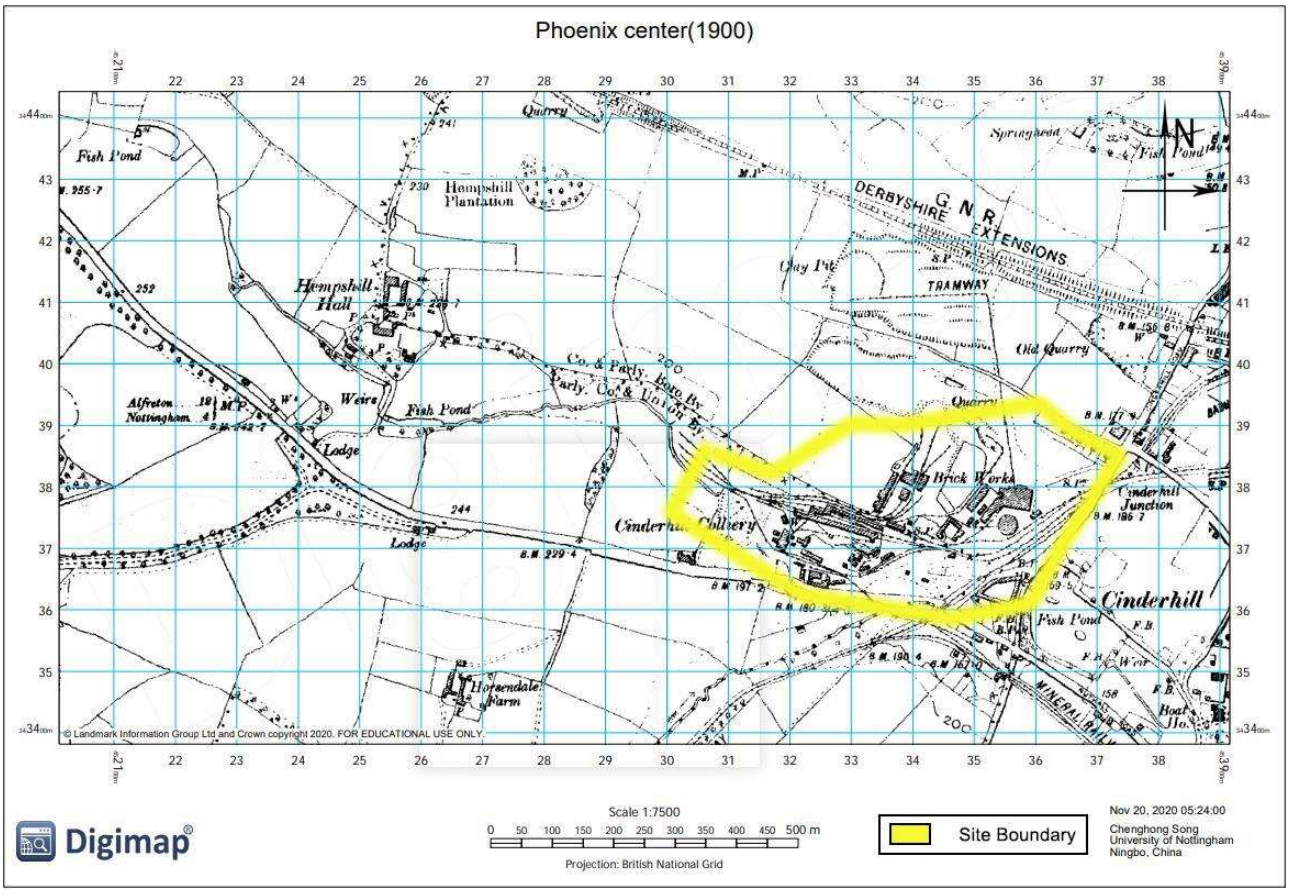
WIKIPEDEA., (no date), *Greater Nottingham*, [online], available at <https://simple.wikipedia.org/wiki/Greater_Nottingham> (06/12/2020)

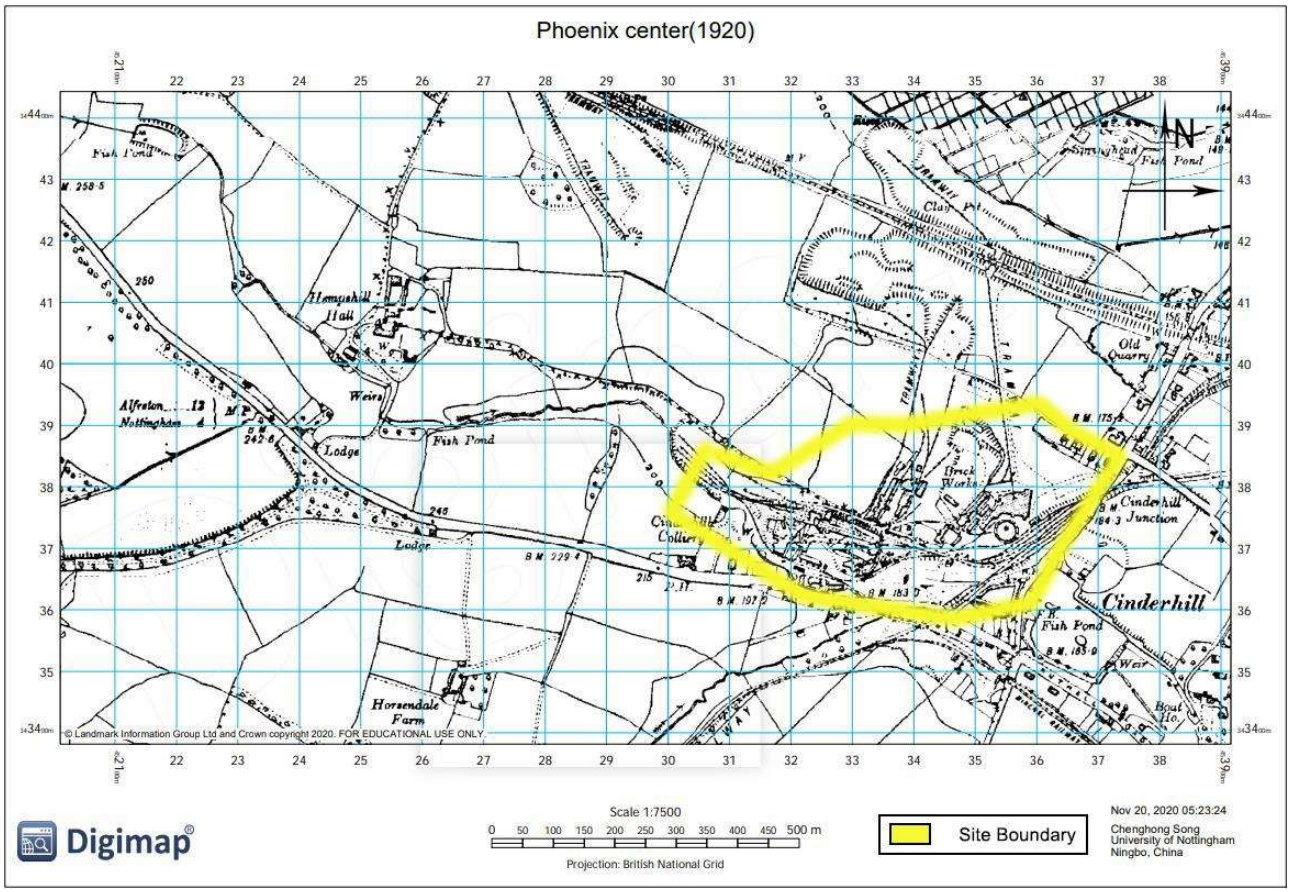
10 Appendix

Appendix A Site

Appendix B History



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Lodge
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Alfreton 13
Nottingham 4
Horsendale Farm
Brick Works
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Cinderhill
Old Quarry
Clay Pit
TRAMWAY
Weir
Boat Ho.
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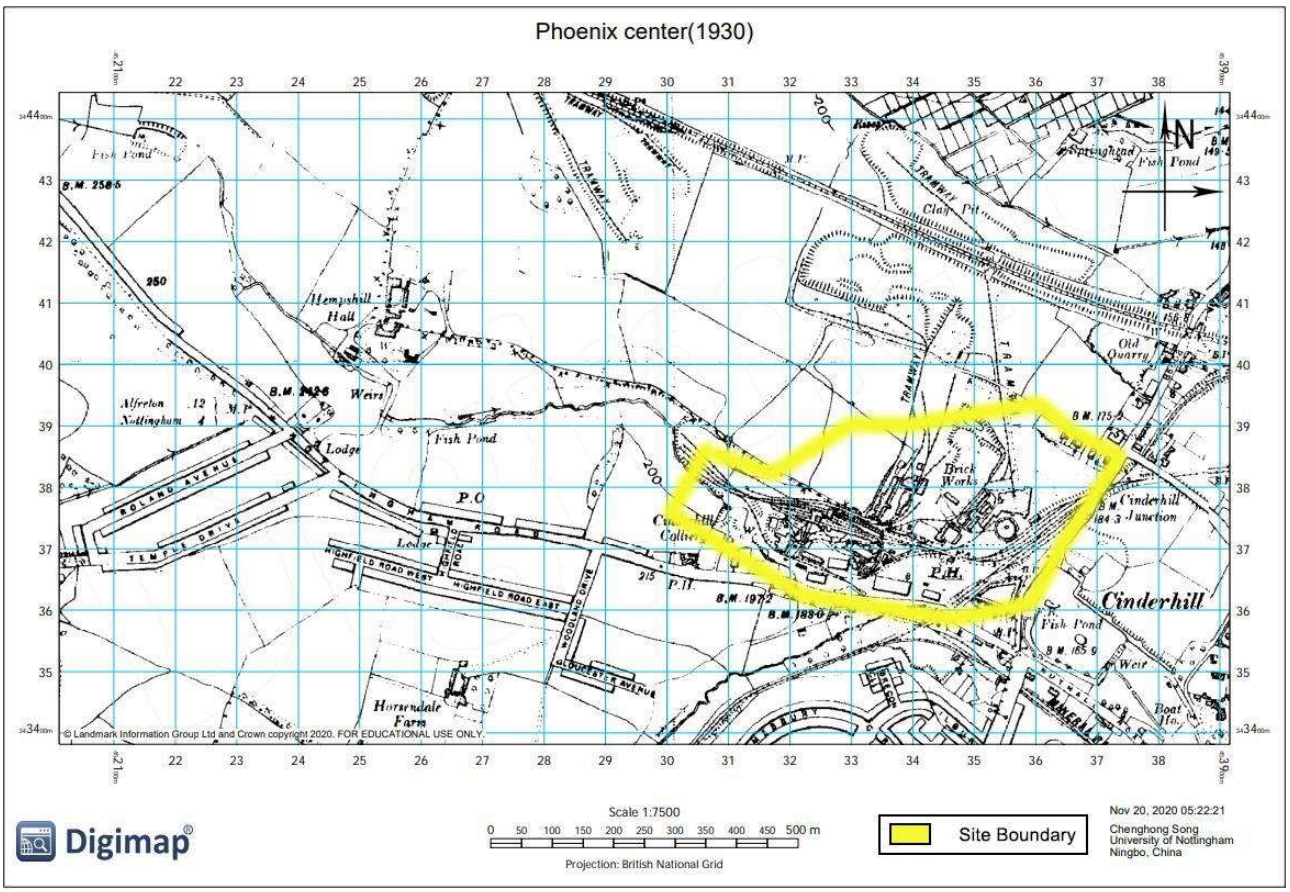
University of Nottingham
Ningbo, China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Cinderhill
Old Quarry
Clay Pit
TRAMWAY
Weir
Boat Ho.
P.O
P.H.
ROLLAND AVENUE
TEMPLE DRIVE
HIGHFIELD ROAD WEST
HIGHFIELD ROAD EAST
WOODLAND DRIVE
GLOUCESTER AVENUE
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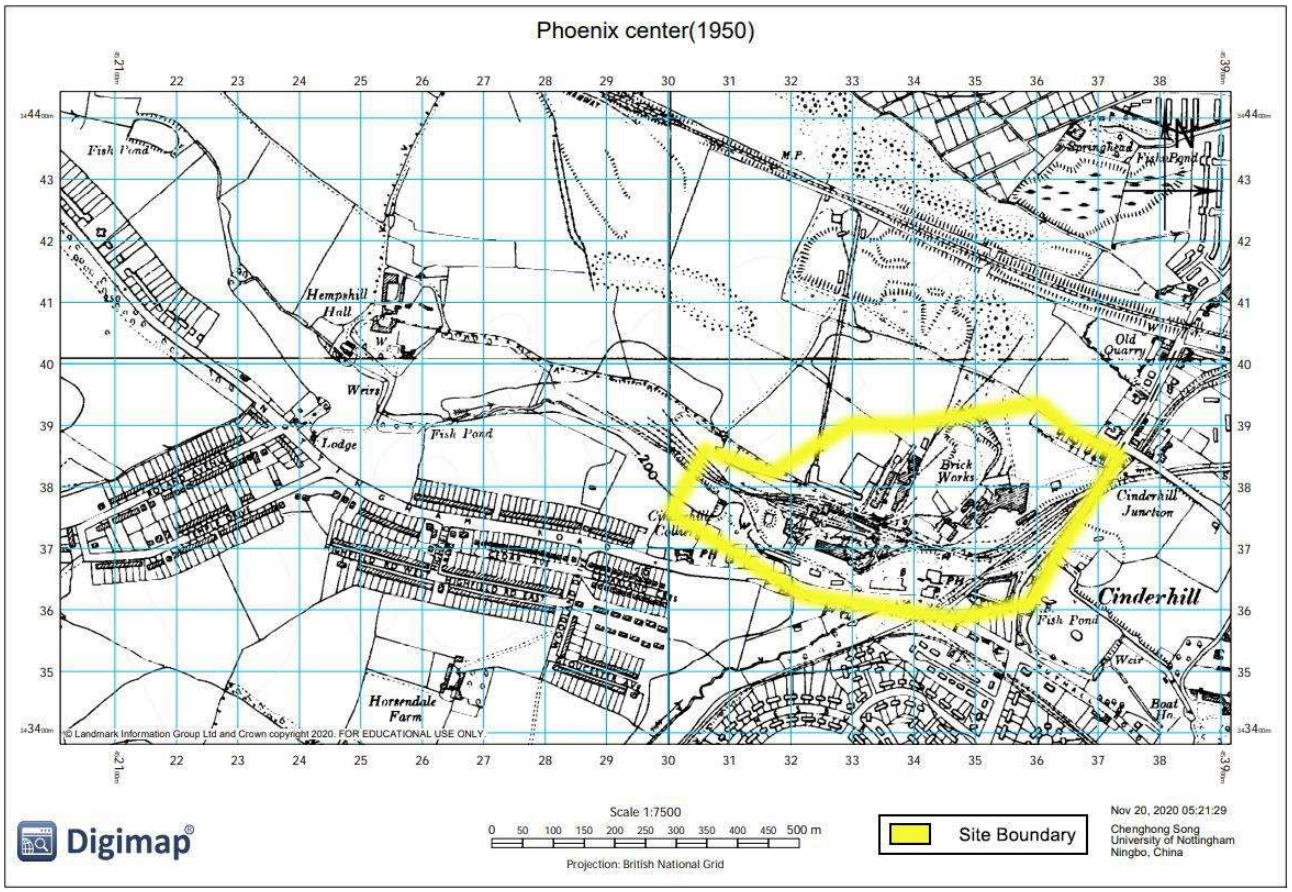
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Lodge
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Springhead
Fish Pond
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Cinderhill
Fish Pond
Weir
Boat Ho
Horsendale Farm
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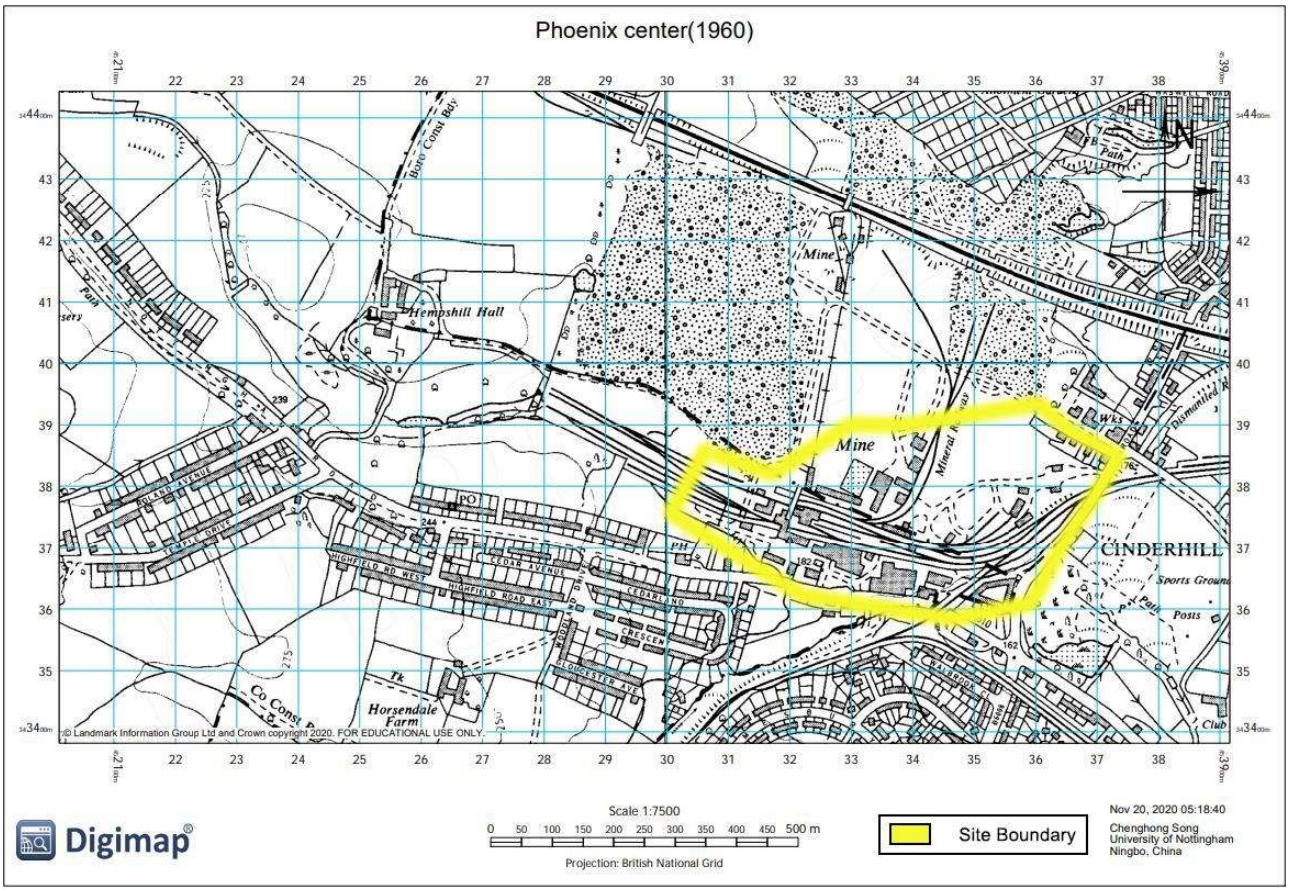
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Hempshill Hall
Mine
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CINDERHILL
Sports Ground
Horsendale Farm
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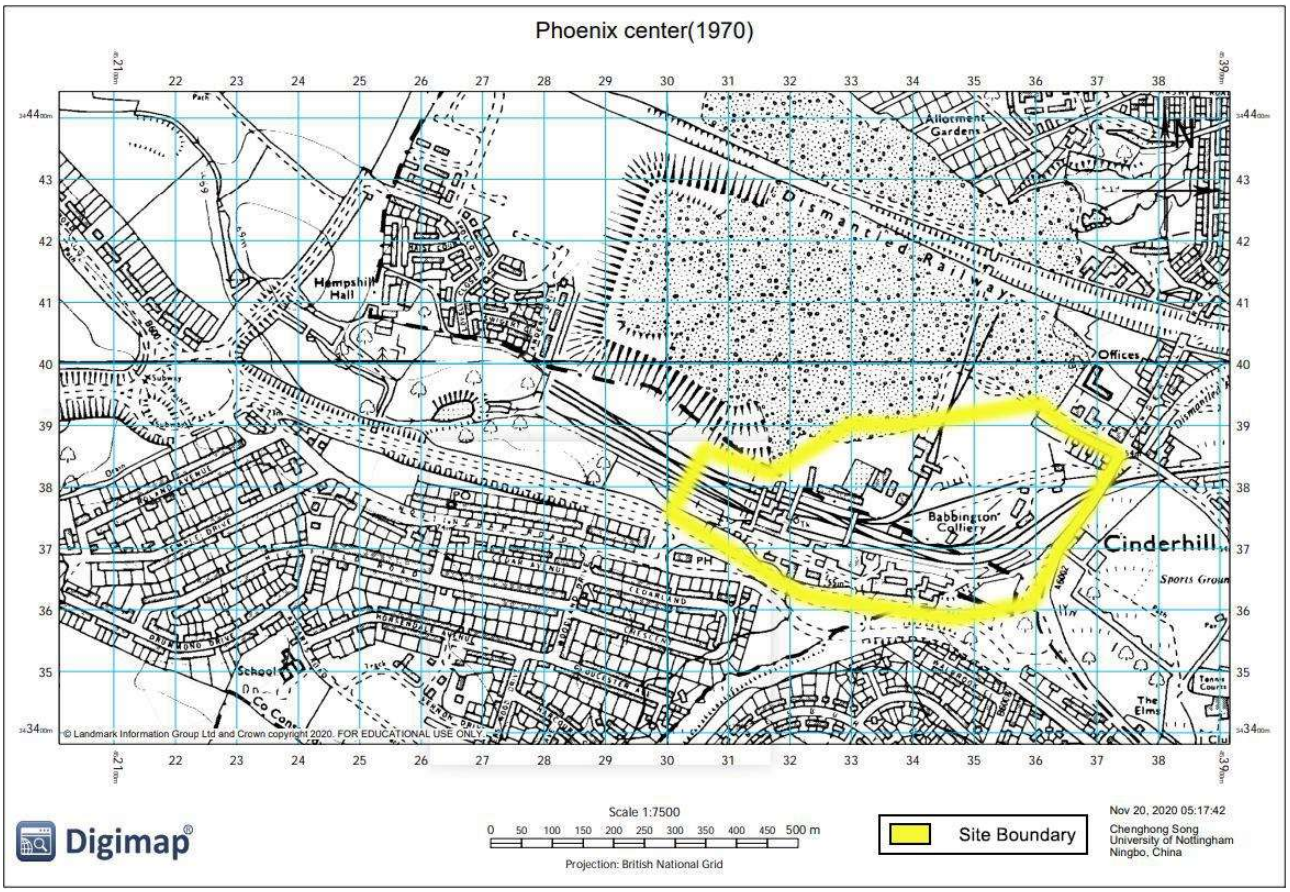
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Hempshill Hall
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Babbington Colliery
Cinderhill
Sports Ground
The Elms
Tennis Courts
PH
PO
School
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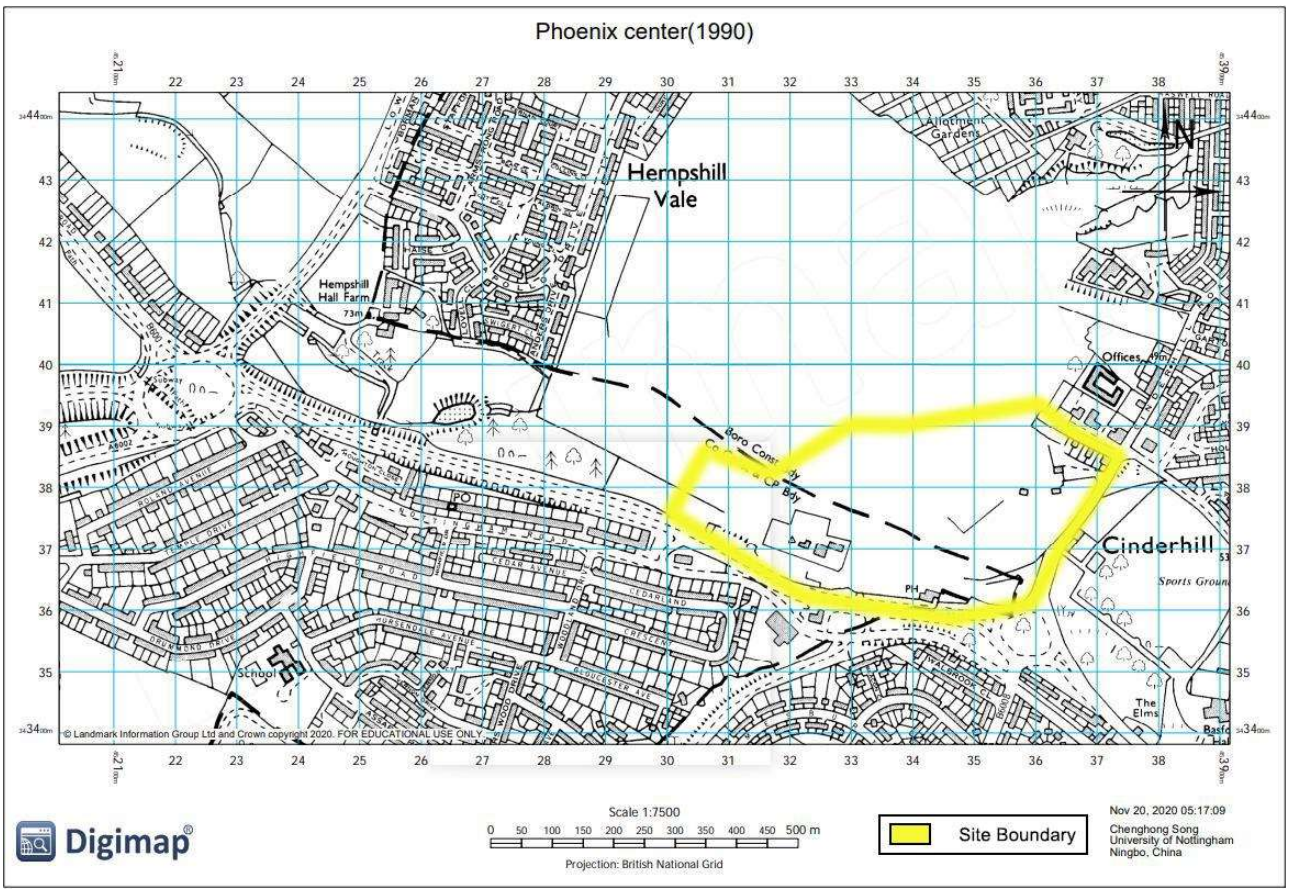
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Allotment Gardens
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Boro Const
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Sports Ground
The Elms
PH
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School
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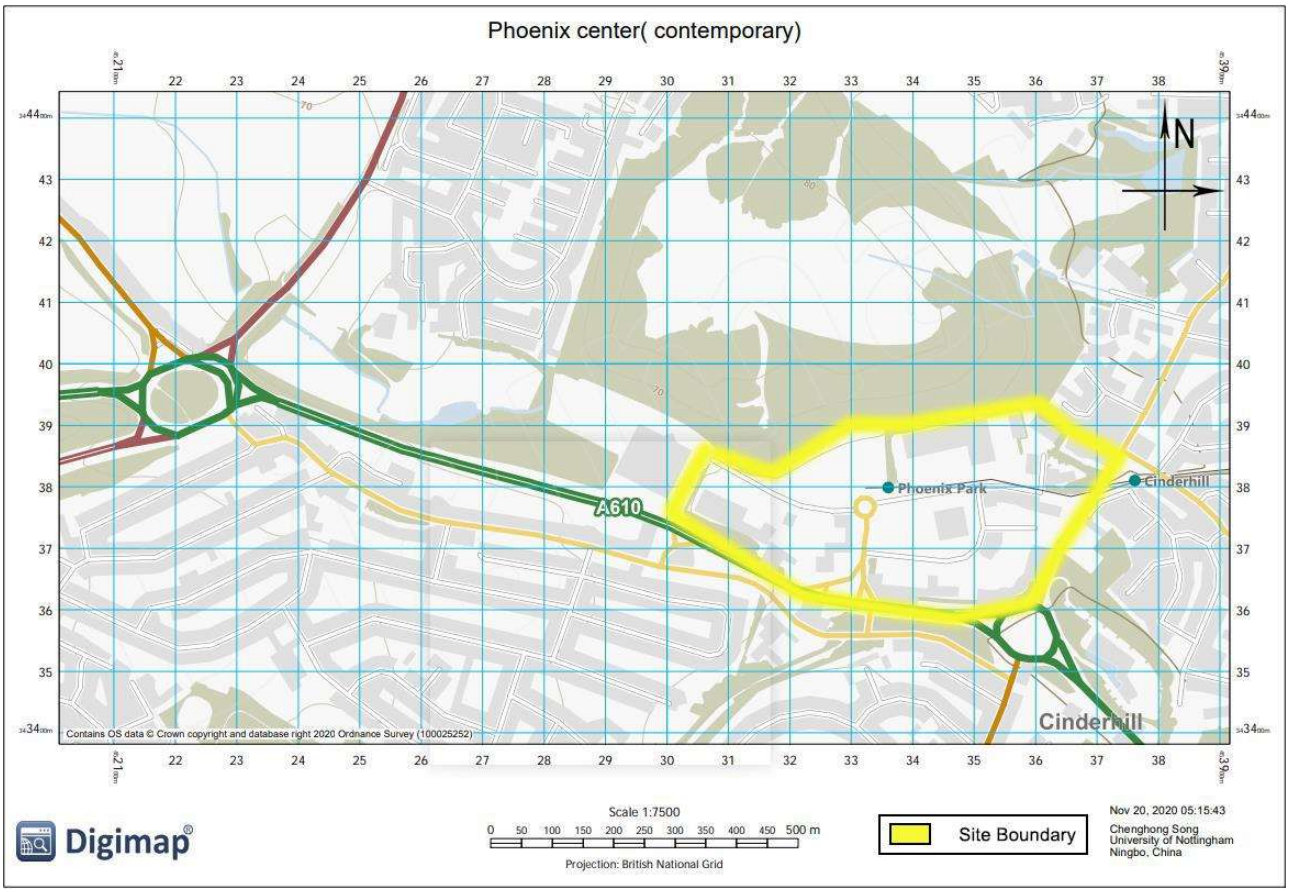
Phoenix center(contemporary)
N
A610
Phoenix Park
Cinderhill
Cinderhill
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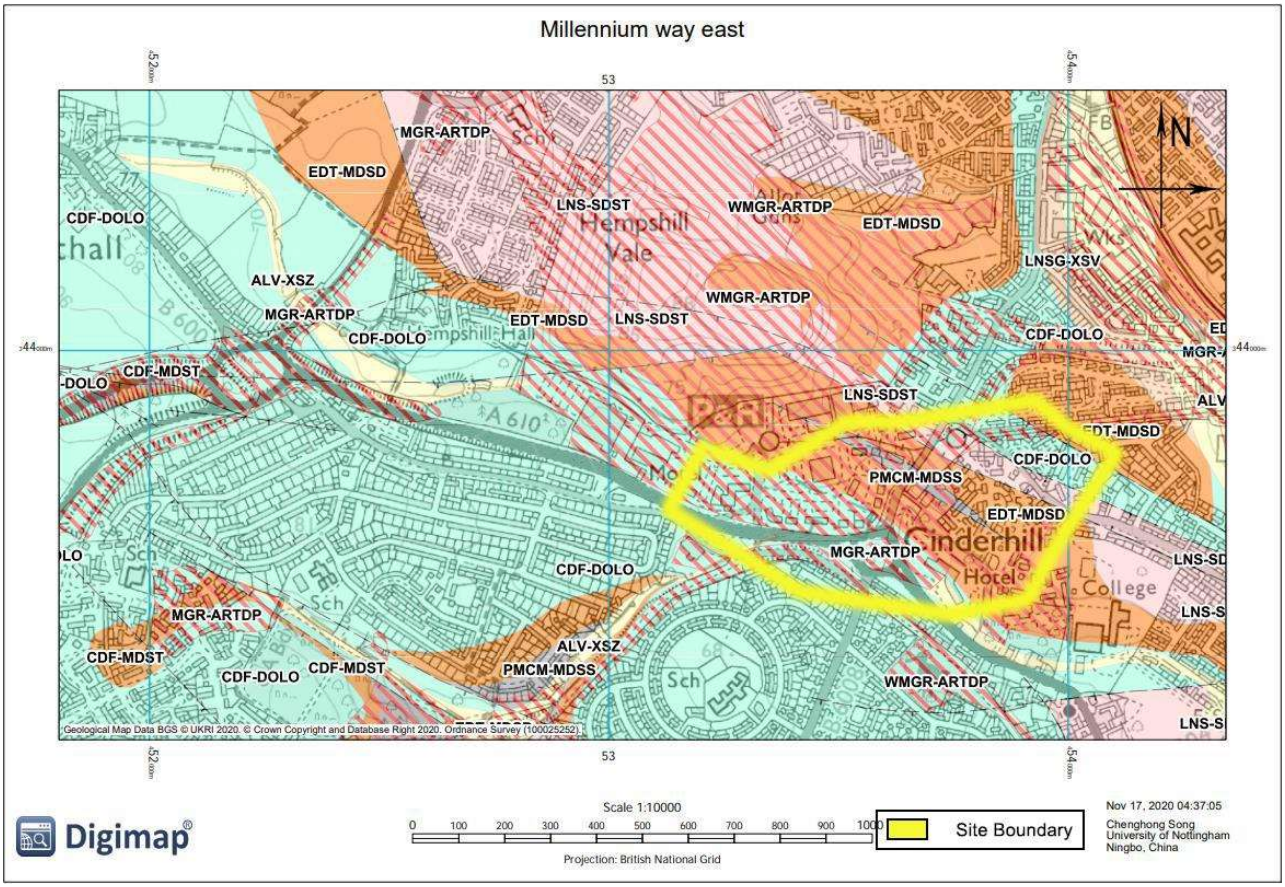
Appendix C Geology



Geology 1:10 000

Bedrock

- Nottingham Castle Sandstone Formation - Sandstone(NTC-SDST)
- Cadeby Formation - Dolostone(CDF-DOLO)
- Pennine Middle Coal Measures Formation - Mudstone, Siltstone And Sandstone(PMCM-MDSS)
- Lenton Sandstone Formation - Sandstone(LNS-SDST)
- Cadeby Formation - Mudstone(CDF-MDST)
- Edlington Formation - Mudstone And Sandstone(EDT-MDSD)

Superficial Deposits

- Leen Sand And Gravel - Sand And Gravel(LNSG-XSV)
- Alluvium - Sand And Silt(ALV-XSZ)

Artificial Ground

- Infilled Ground - Artificial Deposit(WMGR-ARTDP)
- Made Ground (Undivided) - Artificial Deposit(MGR-ARTDP)
- Worked Ground (Undivided) - Void(WGR-VOID)

Mass Movement

Linear Features

Alteration Areas

Faults

- Normal fault, observed
- Normal fault, inferred

Fold Axes

Fossil Horizons

Landforms

Mineral Veins

Rock Units

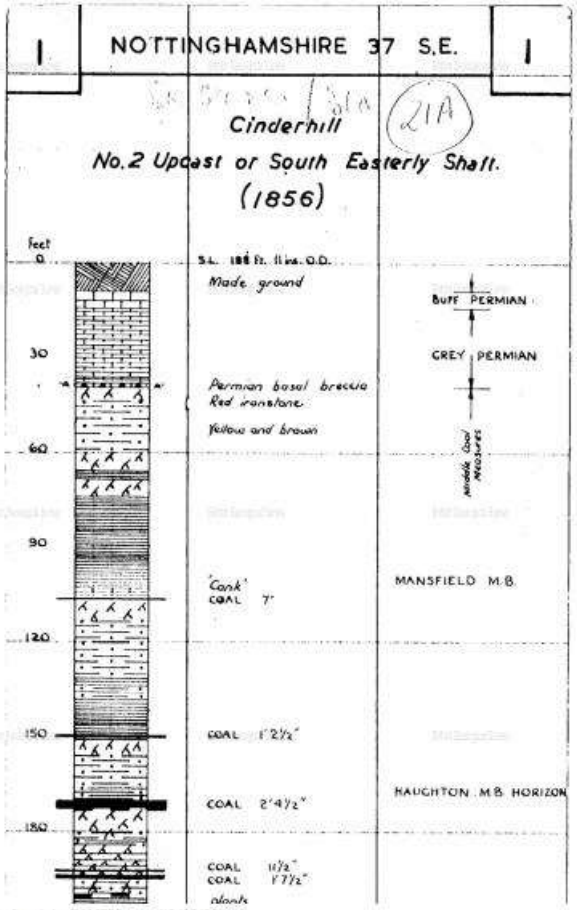
- Coal seam, inferred
- Coal seam, observed

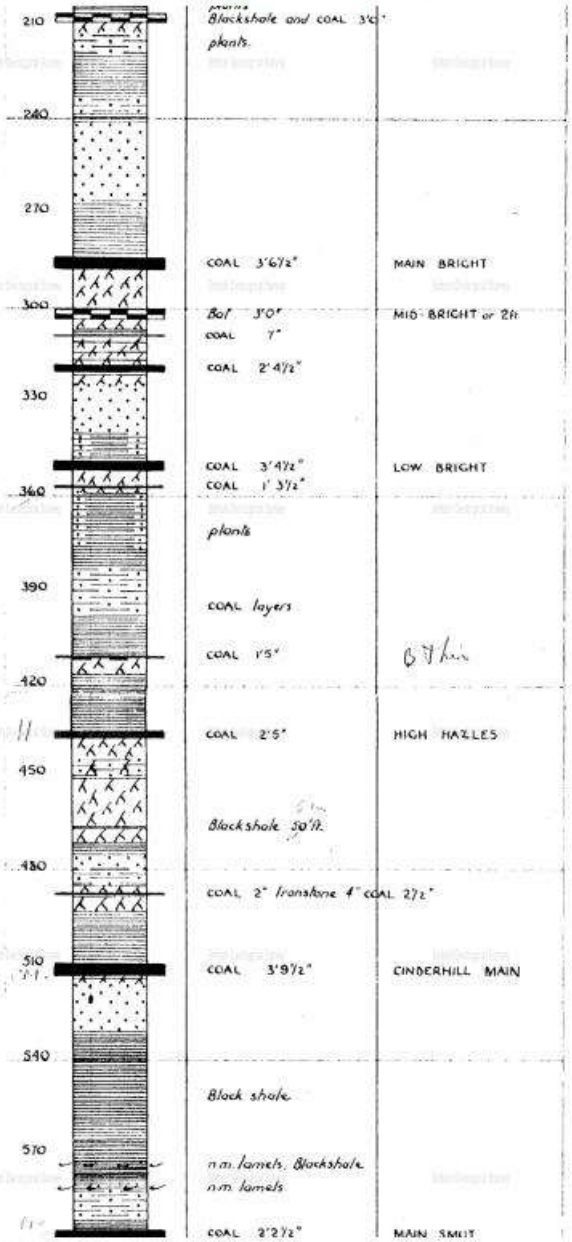
Borehole Scan Viewer

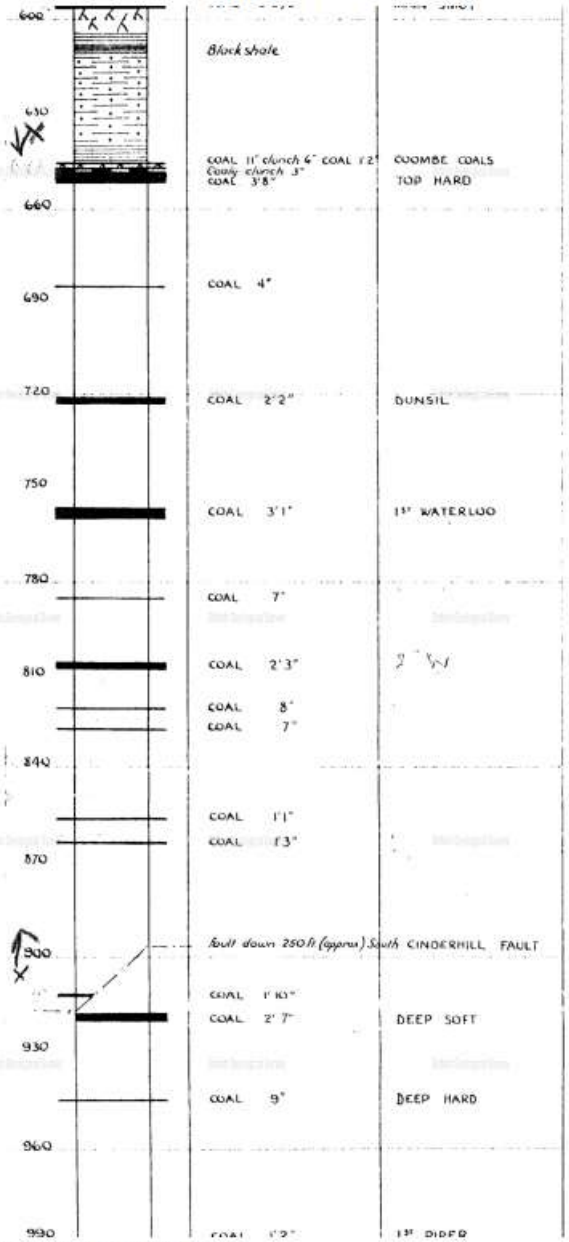
BGS ID: 228075 : BGS Reference: SK54SW31/A
British National Grid (27700) : 453313,343659

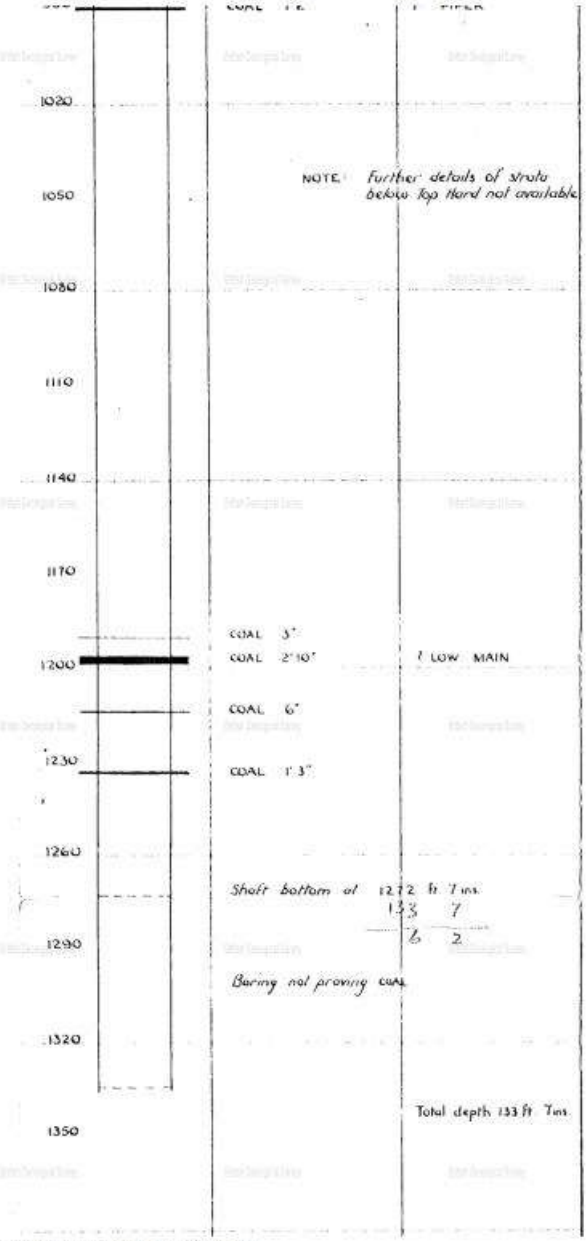
<< < Prev Page 1 of 7 Next > >>

Report an issue with this borehole




210
Blackshale and COAL 3'0"
plants.
240
270
COAL 3'6½"
MAIN BRIGHT
300
Bat 3'0"
MID BRIGHT or 2ft
COAL 7"
COAL 2'4½"
330
COAL 3'4½"
LOW BRIGHT
360
COAL 1' 3½"
plants
390
COAL layers
COAL 1'5"
420
COAL 2'6"
HIGH HAZLES
450
Blackshale 50ft.
480
COAL 2" Ironstone 4" COAL 2½"
510
COAL 3'9½"
CINDERHILL MAIN
540
Black shale
570
n.m. lamels. Blackshale
n.m. lamels
COAL 2'2½"
MAIN SMUT


600
630
660
690
720
750
780
810
840
870
900
930
960
990
Black shale
COAL 11" clinch 4" COAL 12" Clay clinch 3" COAL 3'8"
COOMBE COALS
TOP HARD
COAL 4"
COAL 2'2"
DUNSIL
COAL 3'1"
13" WATERLOO
COAL 7"
COAL 2'3"
COAL 8"
COAL 7"
COAL 1'1"
COAL 13"
fault down 250ft (approx) South
CINDERHILL FAULT
COAL 1'10"
COAL 2' 7"
DEEP SOFT
COAL 9"
DEEP HARD


1020
1050
1080
1110
1140
1170
1200
1230
1260
1290
1320
1350
NOTE. Further details of strata below top Hard not available
COAL 3"
COAL 2'10"
COAL 6"
COAL 1'3"
LOW MAIN
Shaft bottom at 1272 ft 7 ins
133 7
6 2
Boring not proving coal
Total depth 133 ft 7 ins

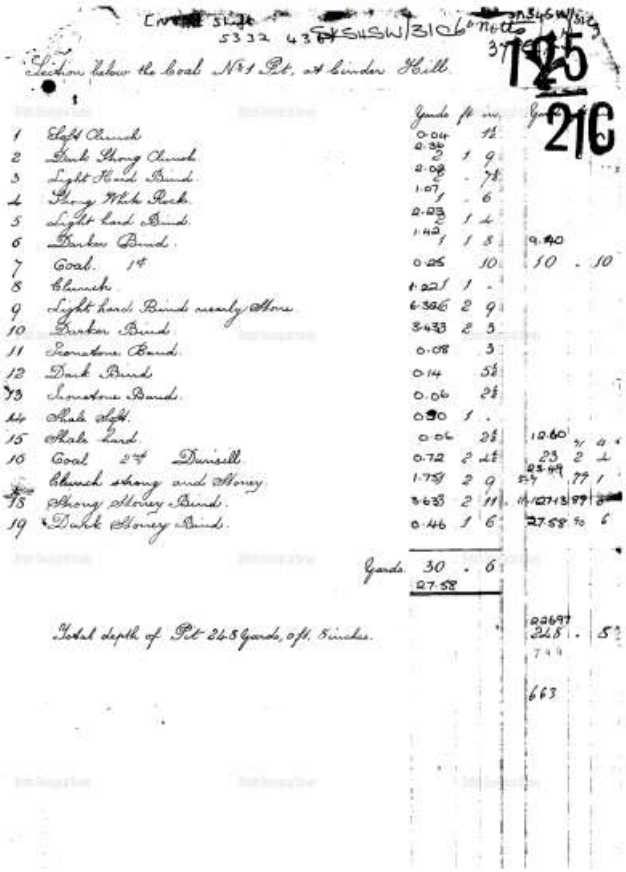
Bulwell.

Section of Shaft at Cinderhill Colliery.
One-inch Map (N.S.) 125. Six-inch Map 37 SE.
Communicated by Mr. G. Fowler. Date of sinking, 1841–3.
Height above O.D. about 250 feet.?

			Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Permian.		Raised bank	8	3	8	3
	Magnesian Limestone.	Red limestone	5	4	13	7
		Light brown stone in beds	9	3	22	10
	'Marl Slates.'	Blue stone with layers of blue bind	11	5	34	3
		Dark pink bind	3	8	37	11
		Dark grey stone		4	38	3
	Breccia.	Red conglomerate	1	0	39	3
		on Coal Measures to			657	6
		Very white clunch with red stone...	1 ft. 9 ins.			
		Soft pink do. with hard bind	1 „ 6 „			
		Dark brown and yellow gritty bind	17 „ 6 „			
		etc., etc.,				
		to Top Hard Coal at 654 ft.				

Much water was encountered in black shale at 189 ft. 4 ins.; also at 191 ft. 7½ ins.

For details of the Coal Measures *see* 'Country around Nottingham,' *Mem. Geol. Surv.*, 1880, 2nd edit., pp. 3–4.



Section taken above the Coal No 1 Pit, at Linder Hill.

		Yards	ft	ins.	Yards	ft	ins.
1	Soft Church	0.04		12			
2	Dark Strong Church	0.36	1	9			
3	Light Hard Bind	0.08		7½			
4	Strong Mixt Rock	1.07		6			
5	Light hard Bind	2.03	1	4			
6	Darker Bind	1.42	1	5	9.40		
7	Coal 1ft	0.25		10	10	.	10
8	Church	1.221	1	.			
9	Light hard Bind nearly Stone	6.396	2	9			
10	Darker Bind	3.433	2	5			
11	Sandstone Bind	0.08		3			
12	Dark Bind	0.14		5½			
13	Sandstone Bind	0.06		2½			
14	Shale light	0.90	1	.			
15	Shale hard	0.06		2½	12.60		
16	Coal 2ft Dunsill	0.72	2	4½	23	2	1
17	Church strong and Stony	1.759	2	9	54	79	1
18	Strong Stony Bind	3.633	2	11	23.99		
19	Dark Stony Bind	0.46	1	6	27.58		6
	Yards	30	.	6			
		27.58					

Total depth of Pit 248 Yards, 0ft. 5 inches.

248 . 5½

SHAFT Cinderhill Shaft Widening (Babbington No.4)

125/21 SK54SW/33 A

Section continued below the Top Hard Coal.

Coal 56in. Top Hard Coal	1·48	4ft. 8in.	682ft. 10in.	
Strong clunch with Ironstone	2·59	6ft. 6in.	689ft. 4in.	
Strong grey bind (Sandy mudstone)	6·22	20ft. 5in.	681ft. 9in.	
Coal 12in.	0·30	1ft. 0in.	682ft. 9in.	
Clunch	1·91	6ft. 3in.	689ft. 0in.	
Grey bind with Ironstone nodules (Grey mudst.)	1·96	6ft. 5in.	696ft. 5in.	
Grey sandstone	4·90	16ft. 1in.	711ft. 6in.	
Grey bind with Ironstone nodules (Grey mudst.)	2·91	9ft. 3in.	727ft. 9in.	
Coal Dunsil 26in.	0·88	2ft. 8in.	729ft. 11in.	
Clunch	1·13	3ft. 8in.	733ft. 7in.	
Clunchy bind with Ironstone nodules	1·20	4ft. 3in.	737ft. 10in.	
Stone bind (Blocky sandy mudstone)	4·00	13ft. 2in.	751ft. 0in.	
Grey bind (Grey mudstone. Carbonicola at 760 and 762ft.)	3·36	11ft. 0in.	762ft. 0in.	
Coal Waterloo 37½in.	0·95	3ft. 1½in.	765ft. 1½in.	
Hard clunch	1·03	3ft. 4½in.	768ft. 6in.	
Stone bind (Laminated sandy mudstone)	3·98	13ft. 0in.	781ft. 6in.	
Grey bind	0·51	1ft. 10in.	783ft. 4in.	
Cank (Ironstone cemented mudstone)	0·10	4in.	783ft. 8in.	
Dark bind (Non-marine lamellibranchs at 787 5½in.)	1·48	5ft. 6in.	789ft. 2in.	
Coal 3½in.	0·00	3½in.	789ft. 5½in.	
Clunch	1·22	4ft. 0in.	793ft. 5½in.	
Stone bind (Laminated sandy mudstone)	1·67	5ft. 6in.	798ft. 11½in.	
Grey sand rock (Laminated sandstone)	3·18	10ft. 5in.	809ft. 4in.	
Stone bind (Laminated sandy mudstone)	0·53	1ft. 9in.	811ft. 1in.	
Coal 22in.	0·52	1ft. 10in.	812ft. 11in.	
Clunch	3·68	9ft. 11in.	822ft. 10in.	
Grey bind with Ironstone (Grey mudst.)	0·81	2ft. 8in.	825ft. 6in.	
Dark shale with lamellibranchs and Lepidodendron	0·44	2ft. 1in.	827ft. 7in.	
Coal 11in.	0·27	11in.	828ft. 6in.	
Hard clunch	1·38	4ft. 4in.	833ft. 10in.	
Coal(poor) 7in.	0·18	7in.	834ft. 5in.	
Hard clunch	0·71	3ft. 0in.	838ft. 5in.	
Stone bind (Laminated sandy mudstone)	1·76	5ft. 7in.	842ft. 0in.	
Grey bind (Grey mudstone) seen to 14ft. 4in.	4·37			
FAULT			856ft. 4in.	
Strong bind seen to 7ft. 3in.			863ft. 4in.	
Dark bind (mudstone) with lamellibranchs	0·76	6½in.	863ft. 10½in.	
Cank (Ironstone)	0·76	6½in.	864ft. 5in.	
Dark bind (Dark grey mudstone)	0·33	1ft. 1in.	865ft. 6in.	
Cank (Ironstone)	0·05	2in.	865ft. 8in.	
Dark bind (Dark grey mudstone) with abundant lamellibranchs)	0·89	2ft. 11in.	868ft 7in.	
Cank (Ironstone)	0·15	5in.	868ft. 0in.	
Dark shale with lamellibranchs	0·86	2ft. 10in.	871ft. 10in.	
Coal 1in.	0·02	1in.	871ft. 11in.	
Clunch	1·35	5ft. 9in.	877ft. 8in.	
Strong grey bind (Sandy mudstone)	1·88	6ft. 2in.	883ft. 10in.	
Coal 4½in.	0·12	4½in.	884ft. 2½in.	
Clod (Dark grey slickensided clunch)	0·65	2ft. 1½in.	886ft. 4in.	
Grey sandstone	5·16	16ft. 9in.	903ft. 1in.	
Stone bind (Laminated sandy mudstone)	3·20	10ft. 8in.	913ft. 9in.	
Strong grey bind (Grey mudstone with isolated lamellibranchs)	0·43	1ft. 5in.	915ft. 2in.	
Cannel Coal with fish scales	0·05	2in.	915ft. 4in.	
Coal and bat	0·38	1ft. 0½in.	916ft. 4½in.	
Clunch	1·11	3ft. 7½in.	920ft. 0in.	
Strong grey bind (Grey mudstone)	4·72	15ft. 6in.	935ft. 6in.	
Coal Deep Soft 3½in.	0·30	2ft. 2½in.	938ft. 1½in.	
Strong clod (Dark slickensided clunch)	0·42	1ft. 4½in.	939ft. 6in.	
Fireclay (slickensided)	0·02	7in.	942ft. 1in.	
Clod (slickensided clunch)	0·71	1ft. 4in.	943ft. 5in.	

SK54 SW/33a 125/21A

Hard clunch		974ft. 11in.	
Dark shale with coal streaks		977ft. 3in.	977ft. 4in.
Sandstone,flaggy with thin vein of sphalerite and dolomite		977ft. 8in.	977ft. 9in.
Stone bind (Laminated sandy mudstone)	7ft. 7in.	984ft. 7in.	984ft. 7in.
Strong grey bind	16ft. 6in.	1001ft. 1in.	
Clod (Dark slickensided clunch)	5in.	1001ft. 6in.	
Hard black shale with squashed lamellibranchs and ostracods	2in.	1001ft. 8in.	1002ft. 2in.
Coal Piper	1ft. 2in.	1003ft. 4in.	
Hard very sandy clunch	4in.	1003ft. 8in.	1003ft. 11in.
Grey sandstone,partly laminated and shaley	14ft. 4in.	1018ft. 3in.	
Stone bind (Laminated sandy mudstone)	3ft. 11in.	1026ft. 3in.	
Grey bind	3ft. 0in.	1029ft. 3in.	
Dark bind with lamellibranchs in the lower part	2in.	1031ft. 4in.	
Grey bind with occasional lamellibranchs	11ft. 5in.	1043ft. 9in.	
Coal and bat	9in.	1043ft. 6in.	
Clunch	3ft. 2in.	1047ft. 8in.	
Grey sandy mudstone	43ft. 4in.	1090ft. 0in.	
Strong grey sandstone with thin irregular conglomerate at base (?Washout Rock)	38ft. 9in.	1128ft. 9in.	
Grey sandy mudstone very slickensided somewhat clunchy and greenish in colour	7ft. 9in.	1136ft. 6in.	
Coal ?Tupton 3/4 11in.	11in.	1137ft. 5in.	
~~Sandy clunchy~~			
Sandy clunchy	8ft. 1in.	1137ft. 6in.	
Grey sandy mudstone	6ft. 10in.	1144ft. 4in.	
Grey flaggy sandstone	7ft. 10in.	1152ft. 2in.	
Grey bind	12ft. 2 in.	1164ft. 4in.	
Dark bind	13ft. 6in.	1177ft. 10in.	
Clunch	2ft. 10in.	1180ft. 8in.	
Dark bind with sandy lenses up to 18in.	26ft. 8in.	1207ft. 4in.	
Stone bind (Laminated sandy mudstone)	3ft. 1in.	1210ft. 5in.	
Sandstone	4ft.10in.	1215ft. 3in.	
Gray sandy mudstone	14ft. 3in.	1229ft. 6in.	
Strong grey sandstone seen to	31ft. 7in.	1261ft. 0in.	

Bottom of Shaft

A further 115ft. 6in. was drilled below the bottom of shaft not examined by me.

	Carbonicola at 33ft. 9in.		1294ft. 9in.
	" at 37ft. 6in.		1298ft. 6in.
Coal,bad	7in. at 40ft. 10in. ?Yard		1301ft. 10in.
Coal	8in. at 56ft. 6in.		1312ft. 6in.
	Carbonicola at 63ft.		1324ft.6in.
Coal	4in. at 101ft. 8in. ?Blackshale		1368ft.8in.
	Bottom of hole at 115ft. 6in.		1376ft. 9in.

J J Shirley January 1945

SK54SW/33a 125/21A

Dips in the Cinderhill Shaft

At 381ft. 4in. Low Bright coal	1 in 7
At 434ft. 8in. Low Hazel coal (High Mansels)	1 in 6.3
At 516ft. 1in. Cinderhill Main coal	1 in 5.1
At 601ft. 6in. ?Main Smut coal	1 in 4.3
At 730ft. Dunsil	1 in 3.2
At 813ft.	1 in 3.7
Immediately above the fault at about 850ft.	1 in 2.1
At 938ft.	1 in 17.8

Direction of dips approximately N.E.

Plane of the fault at 856ft. dips at 37½ degrees from the horizon in direction S 11½ degrees W.

SK 54 SW/33 B

(For Survey use only)
1-inch Map Registered No.

RECORD OF SHAFT OR BORE FOR MINERALS

Name and Number of Shaft or Bore CINDERHILL COLLIERY
No 4 pit. Boring in pit bottom.

For Messrs.
Town or Village
County Six-inch quarter sheet
Exact site

6-inch Map Registered No. SK54SW/33

Attach a tracing from a map, or a sketch-map, if possible.

Purpose for which made
Level at which shaft / bore commenced relative to O.D. −1075. 5.327.79 State if shaft / bore is up, down, horizontal or inclined; in latter cases give angle of inclination and direction
Made by
Information from Date of Sinking
Specimens

Additional Notes in Space Overleaf

(For Survey use only) Geological Classification	NATURE OF STRATA	Thickness			Depth		
	Shale (not cored).	3·65	12	0	3·65	12	0
	Sst, fine grained.	2·09	7	6	5·74	19	6
	Bind, black clunchy, sealy	0·40		4	6·04	19	10
	Bind, clunchy grey & dk grey.	0·97	3	2	7·01	23	0
	" , light grey.	0·10		4	7·11	23	4
	Shale, black w. Carbonicola.	0·13		5	7·24	23	9
	Bind, light grey w. calcite.	1·60	5	3	8·84	29	0
	Sst. w. calcite.	0·91	3	0	9·75	32	0
	Bind, sandy.	0·69	2	3	10·44	34	3
	" , dark w. Carbonicola.	0·99	3	3	11·43	37	6
	Shale, black.	0·84	2	9	12·27	40	3
	& RIBD. COAL, bad 7in.	0·18		7	12·44	40	10
		at	1302'		4 396·95		
	Bind, clunchy.	1·04	3	5	13·49	44	3
	Sst, greenish 1' 9": sdy. bind 5'9"	1·68	5	6	15·16	49	9
	Bind, dark	0·32	1	3	15·54	51	0
	Bind & sdy. bind w. 2" sst.	1·47	4	10	17·02	55	10
	" , dk. clunchy.	0·15		6	17·32	56	4
	COAL 2in	0·05		2	17·22	56	6
		at	1518'		0"401·73		
	Bind, dk. clunchy.	0·10		4	17·30	56	10
	Sst. & sdy. bind.	1·32	4	4	18·64	61	2
	Bind, grey Carbonicola at 18"	1·32	4	4	19·96	65	6
	" , sdy. 1': Sst. fine-grained 5'6"	5·03	16	6	24·99	82	0
	" " 8': bind, grey 12' 6"	5·64	18	6	30·63	100	0
	Shale, dk. grey 2" shale, black carbonaceous 2"		010	4	30·73	100	10

SK 54 SW/33 B

For Survey use only: GEOLOGICAL CLASSIFICATION	NATURE OF STRATA (Continued)	THICKNESS Ft.	In.	DEPTH Ft.	In.
				120	10
	B.F.				
	(BLACK SHALE COAL + ir.	0 10	4	31 11	101 2
	at 1502'			8" 415 84	
	Clunch.	0 94	3 1	31 77	104 8
	Bind, sdy & sst, greenish.	3 43	11 5	35 20	115 6
	at 1371'			0 419 71	

ADDITIONAL NOTES

Borehole Scan Viewer

BGS ID: 228237 : BGS Reference: SK54SW180 British National Grid (27700) : 453590,343640

<< < Prev Page 1 of 3 Next > >>

Report an issue with this borehole

GEO-RESEARCH LTD.

B.H. No.: S /80

CONTRACT : NUTHALL ROAD SURFACE WATER SEWER PHASE II

LOCATION : NOTTINGHAM

Sheet No.: 1

No. of Sheets: 2

CLIENT : NOTTINGHAM CITY COUNCIL DEPARTMENT OF TECHNICAL SERVICES

CASING P1 2.950

Ground Level :

Commenced : 4/4/80

Completed : 5/4/80

Weather : FAIR

Scale : 20mm to 1m

DRILLING METHOD SHELL AND AUGER WITH COUNTY TRACTOR MOUNTED PILCON 150 TO 3.500. ROTARY CORING FROM 3.500 TO 7.200.

STRATUM	Depth m	Sample No.	Blow Count (in)	Legend	W/C %	Type of Test	C_u kN/m²	STRATUM	WATER REMARKS
Friable clay and rubble = FILL	0.00								
	1.52	P1	30/4/3,3,3,4, (13)						
	1.80	1.80							
Clayey sand = FILL									
	2.50	P2	4/3,3,3,4, (13)						Wet
	2.95								
Red and grey SILTSTONE/MUDSTONE									Water
	3.50								
Borehole Incomplete									OC of Boring @ 3.500, Cas @ 2.950, Rotary Coring commenced @ 3.500.

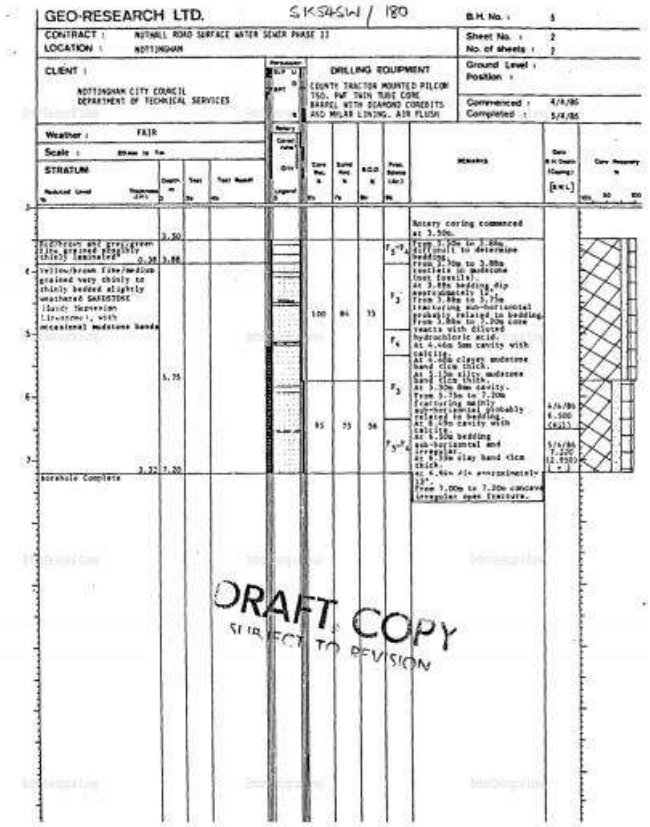
DRAFT COPY SUBJECT TO REVISION

Borehole Scan Viewer

BGS ID: 228237 : BGS Reference: SK54SW180 British National Grid (27700) : 453590,343640

« < Prev Page 2 of 3 Next > »

Report an issue with this borehole



GEORESEARCH LTD.

B.H. No.: 6 SK54SW/181

CONTRACT : NUTHALL ROAD SURFACE WATER SEWER PHASE II

LOCATION : NOTTINGHAM

Sheet No. : 1

No. of Sheets : 2

CLIENT : NOTTINGHAM CITY COUNCIL DEPARTMENT OF TECHNICAL SERVICES

CASING

Ø 4.500

Ground Level :

Commenced : 1/5/86

Completed : 2/5/86

Weather : FAIR

Scale : 20mm to 1m

DRILLING METHOD

SHELL AND AUGER WITH COUNTY TRACTOR MOUNTED PILCON T50 TO 5.300. ROTARY CORING FROM 5.300 TO 9.350.

WATER

REMARKS

STRATUM

Depth (m)	Sample No.	Blow Count (m) LL/ML/PI	Legend	Water	Remarks
Clay and rubble with large pieces of concrete - FILL	0.00				
1.40	1.40				
Silty CLAY (Possible FILL)	1.52	P1	2/2,3,3,4. (12)		
2.40	2.00				
Red clayey SILTSTONE/ MUDSTONE with sands of grey siltstone/ mudstone and traces of sandstone	2.30	P2	8/3,6,5,5. (21)		
	3.30	P3	10/8,7,7,5. (27)		
	4.30	P4	8/7,8,9,9. (33)		
5.30	5.30	P5	10/6,8,9,11 (34)		OC of Boring @ 5.300, Csg @ 4.500. Rotary Coring commenced @ 5.300.
Borehole Incomplete					

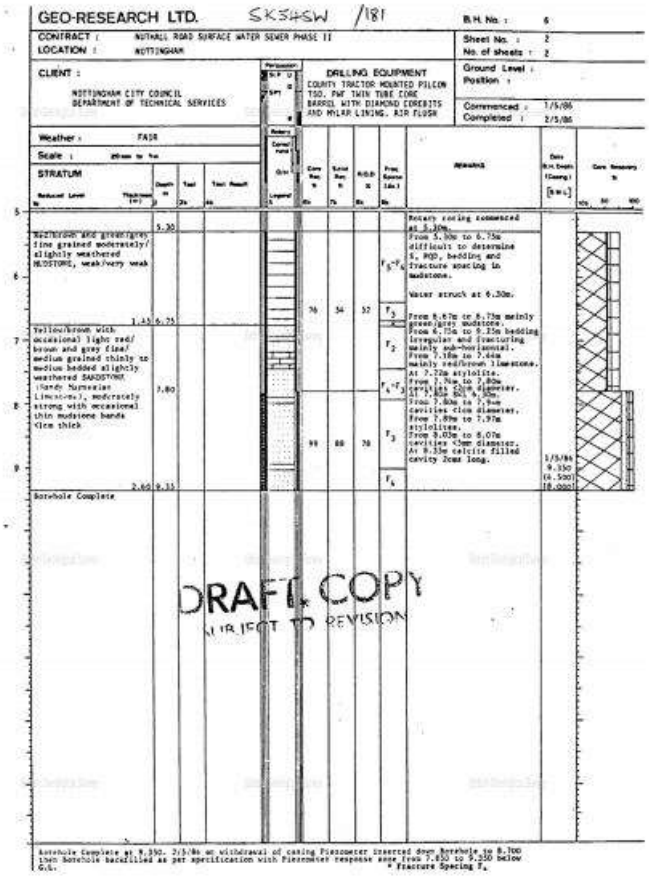
DRAFT COPY SUBJECT TO REVISION

Borehole Scan Viewer

BGS ID: 228238 : BGS Reference: SK54SW181 British National Grid (27700) : 453620,343700

<< < Prev Page 2 of 3 Next > >>

Report an issue with this borehole



GEO-RESEARCH LTD. SK54SW /181

B.H. No. : 6

CONTRACT : NUTHALL ROAD SURFACE WATER SEWER PHASE II

LOCATION : NOTTINGHAM

Sheet No. : 2

No. of sheets : 2

CLIENT : NOTTINGHAM CITY COUNCIL DEPARTMENT OF TECHNICAL SERVICES

DRILLING EQUIPMENT: COUNTY TRACTOR MOUNTED PILCON TSD. PW TWIN TUBE CORE BARREL WITH DIAMOND COREBITS AND MYLAR LINING. AIR FLUSH

Ground Level : Position :

Commenced : 1/5/86 Completed : 2/5/86

Weather : FAIR

Scale :

STRATUM

Rotary coring commenced at 5.30m.

5.30 Mottled brown and green/grey fine grained moderately/slightly weathered MUDSTONE, weak/very weak

From 5.30m to 6.75m difficult to determine T, RQD, bedding and fracture spacing in mudstone.

Water struck at 6.30m.

76 54 52

From 6.67m to 8.73m mainly green/grey mudstone.

1.45 6.75 Yellow/brown with occasional light red/brown and grey fine/medium grained thinly to medium bedded slightly weathered SANDSTONE (Hardy Formation Limestone), moderately strong with occasional thin mudstone bands 10cm thick

From 6.75m to 9.25m bedding irregular and fracturing mainly sub-horizontal.

From 7.18m to 7.44m mainly red/brown limestone.

At 7.22m stylolite.

From 7.74m to 7.80m cavities 2cm diameter.

At 7.80m dri 9.25m.

From 7.80m to 7.94m cavities 10cm diameter.

From 7.89m to 7.97m stylolites.

From 8.03m to 8.07m cavities 4mm diameter.

At 9.33m calcite filled cavity 2cm long.

99 88 78

2.66 9.33

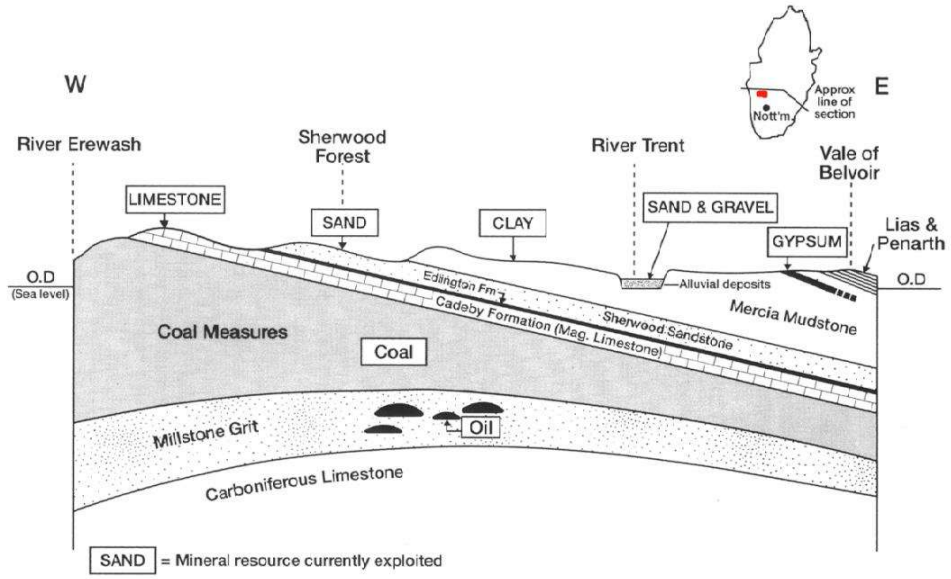
Borehole Complete

1/5/86 9.330 (6.500) (8.000)

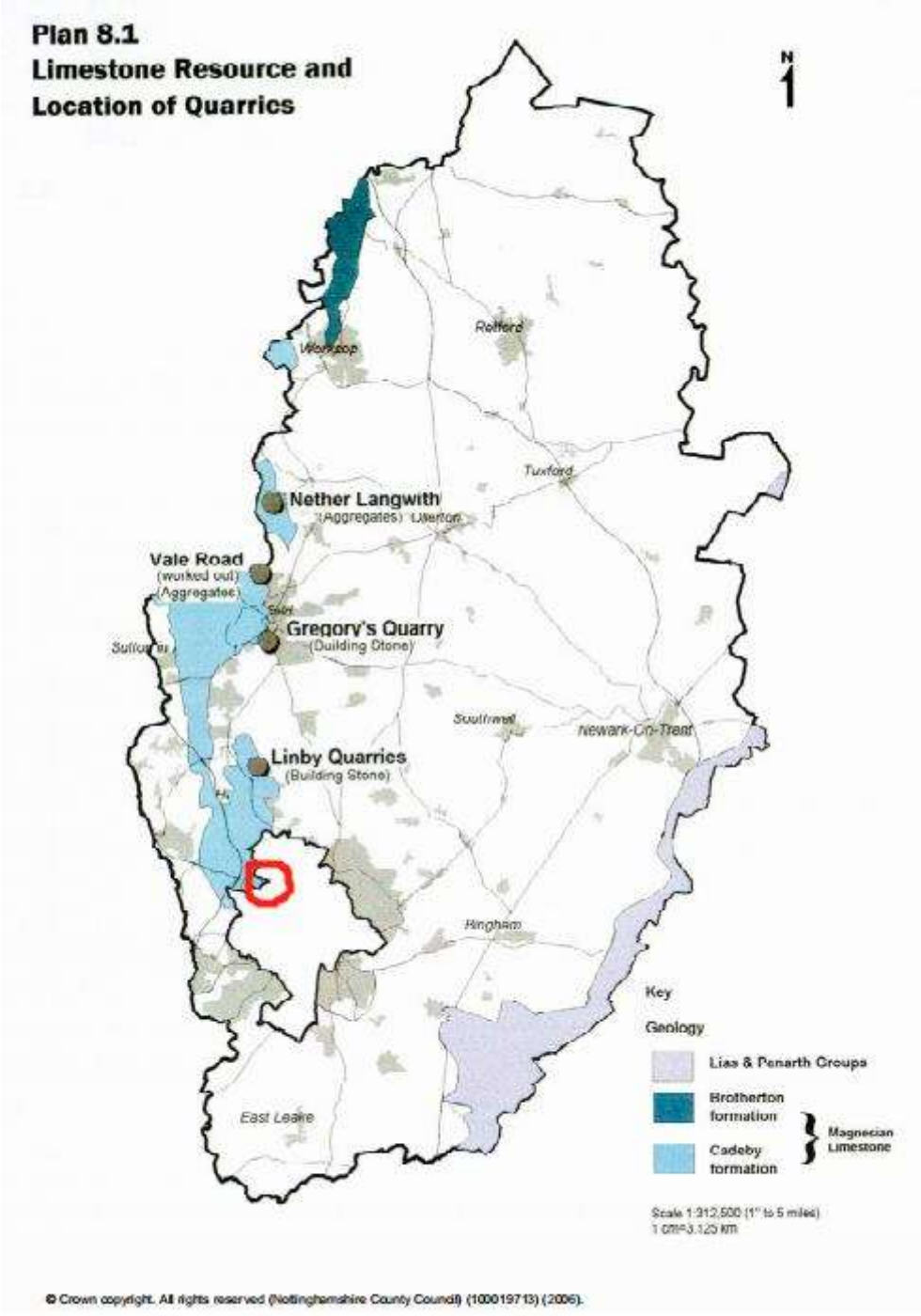
DRAFT COPY SUBJECT TO REVISION

Borehole Complete at 9.330. 2/5/86 on withdrawal of casing Piezometer inserted down borehole to 8.700 then borehole backfilled as per specification with Piezometer response zone from 7.930 to 5.330 below G.L.

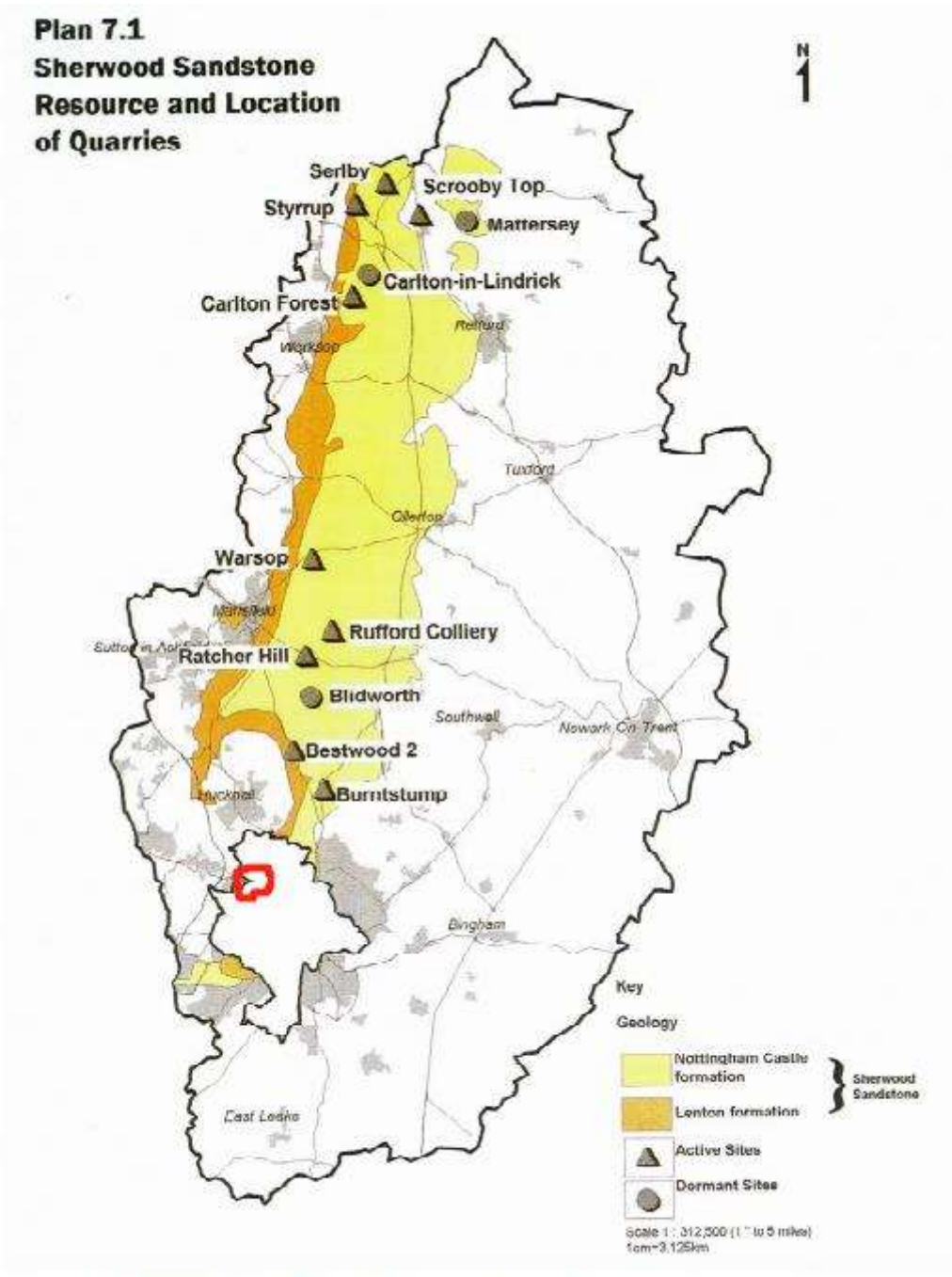
* Fracture Spacing F4

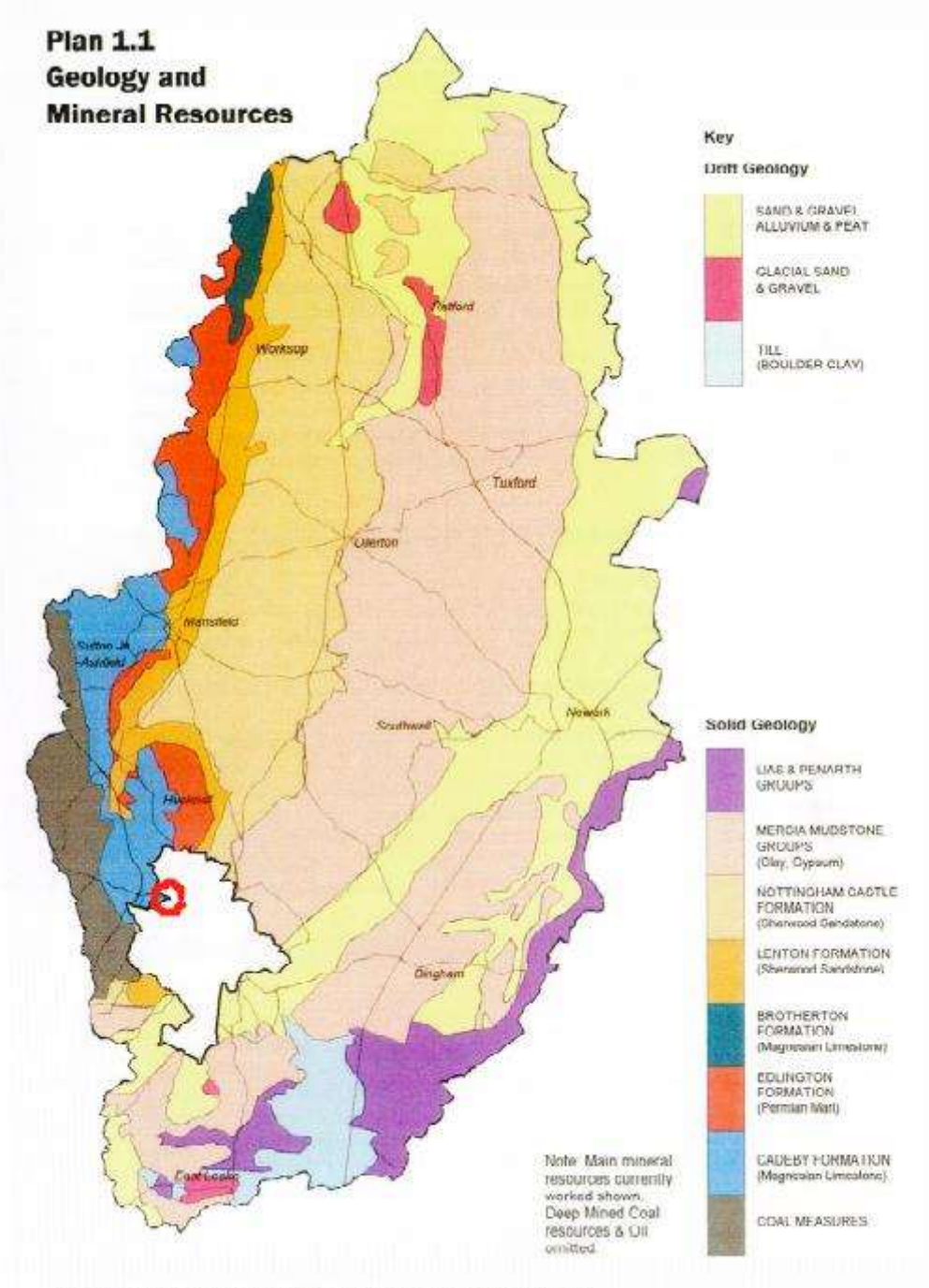


Note :
Horizontal Scale : 2cm = 3km approx.
Vertical Scale : not to scale but greatly exaggerated. Surface to base of Millstone Grit 1.5-2kms. approx.
Relative thickness & distribution of each geological unit schematic. Faults omitted

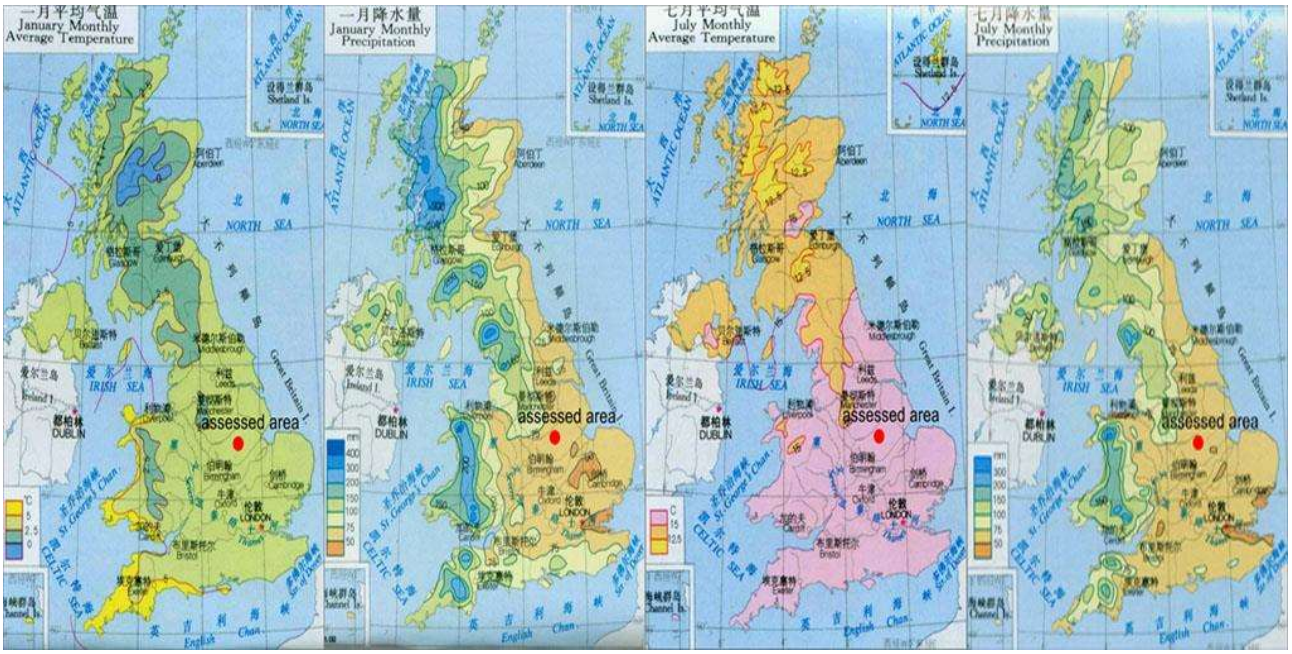


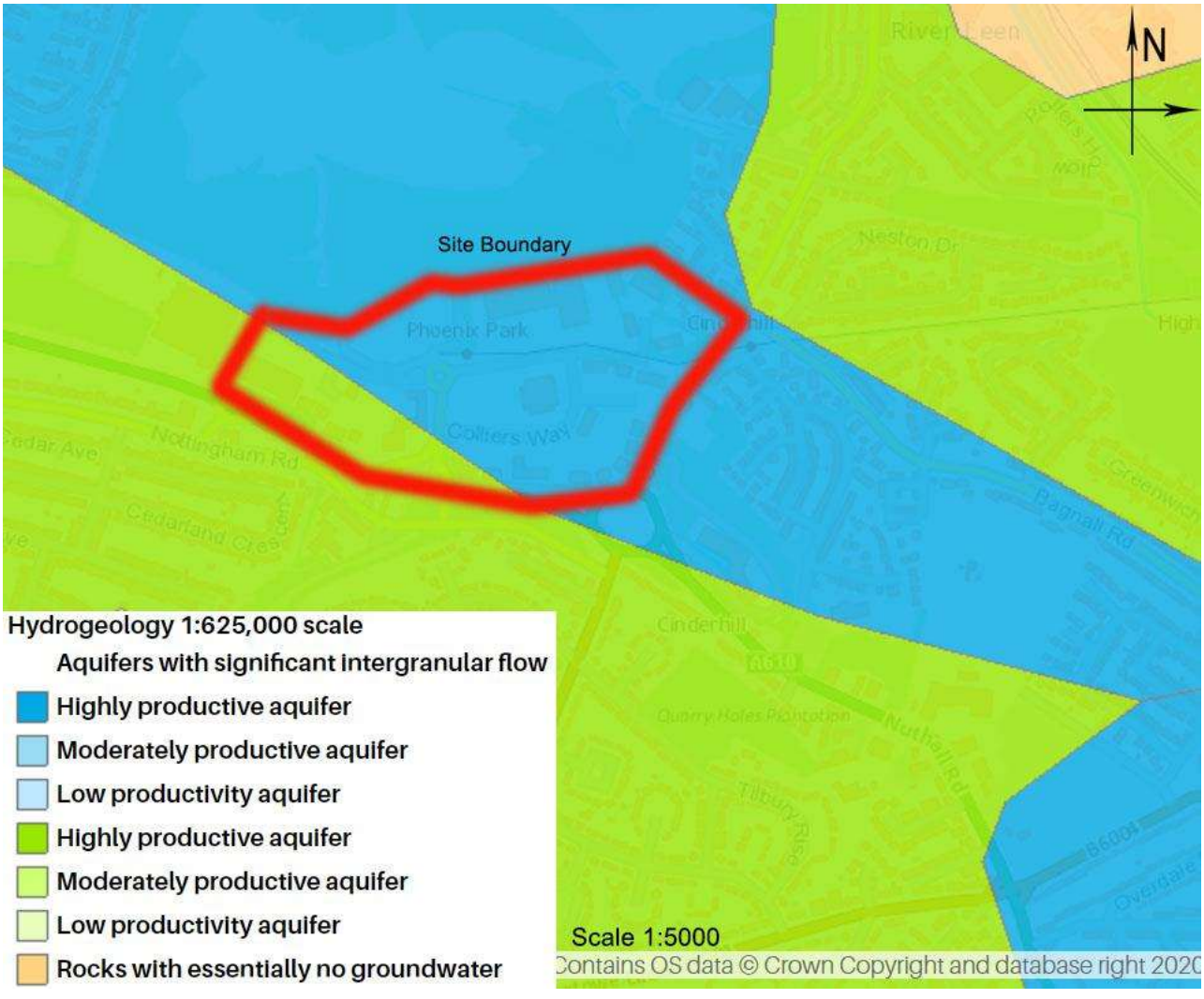
Plan 7.1
Sherwood Sandstone Resource and Location of Quarries

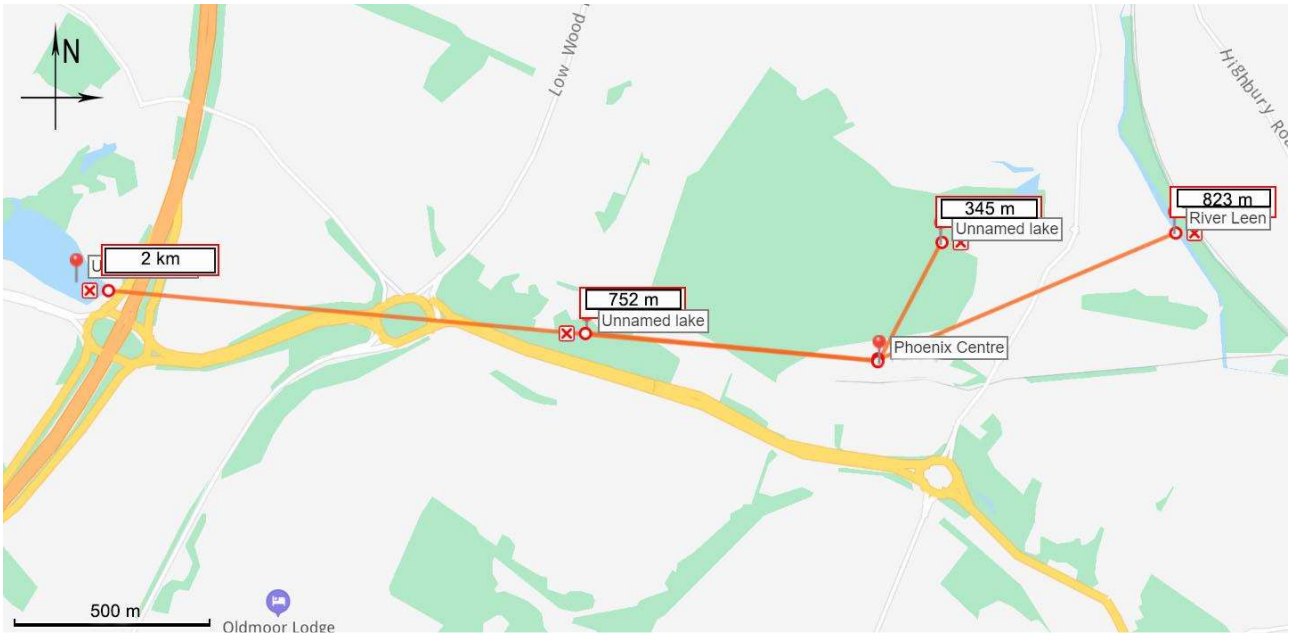


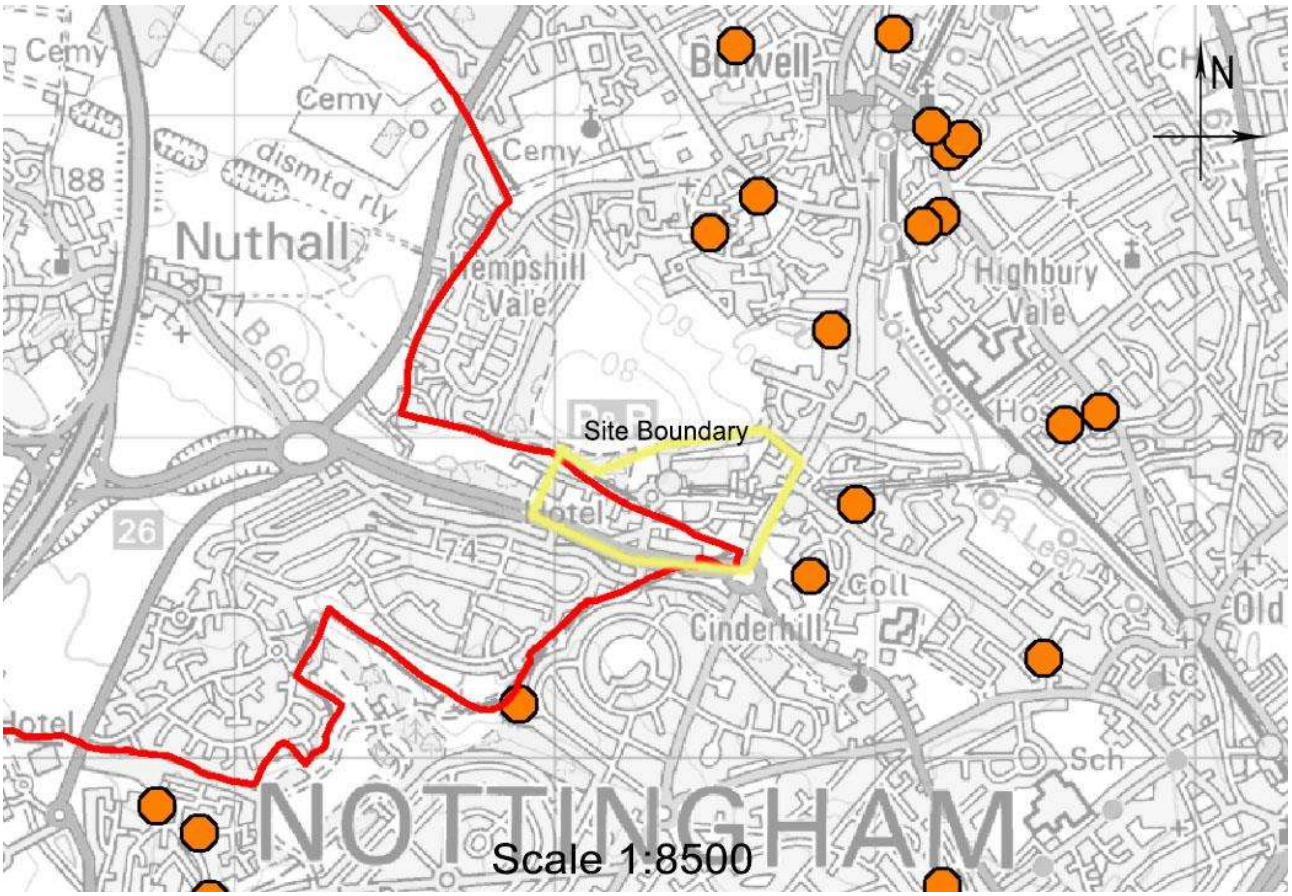


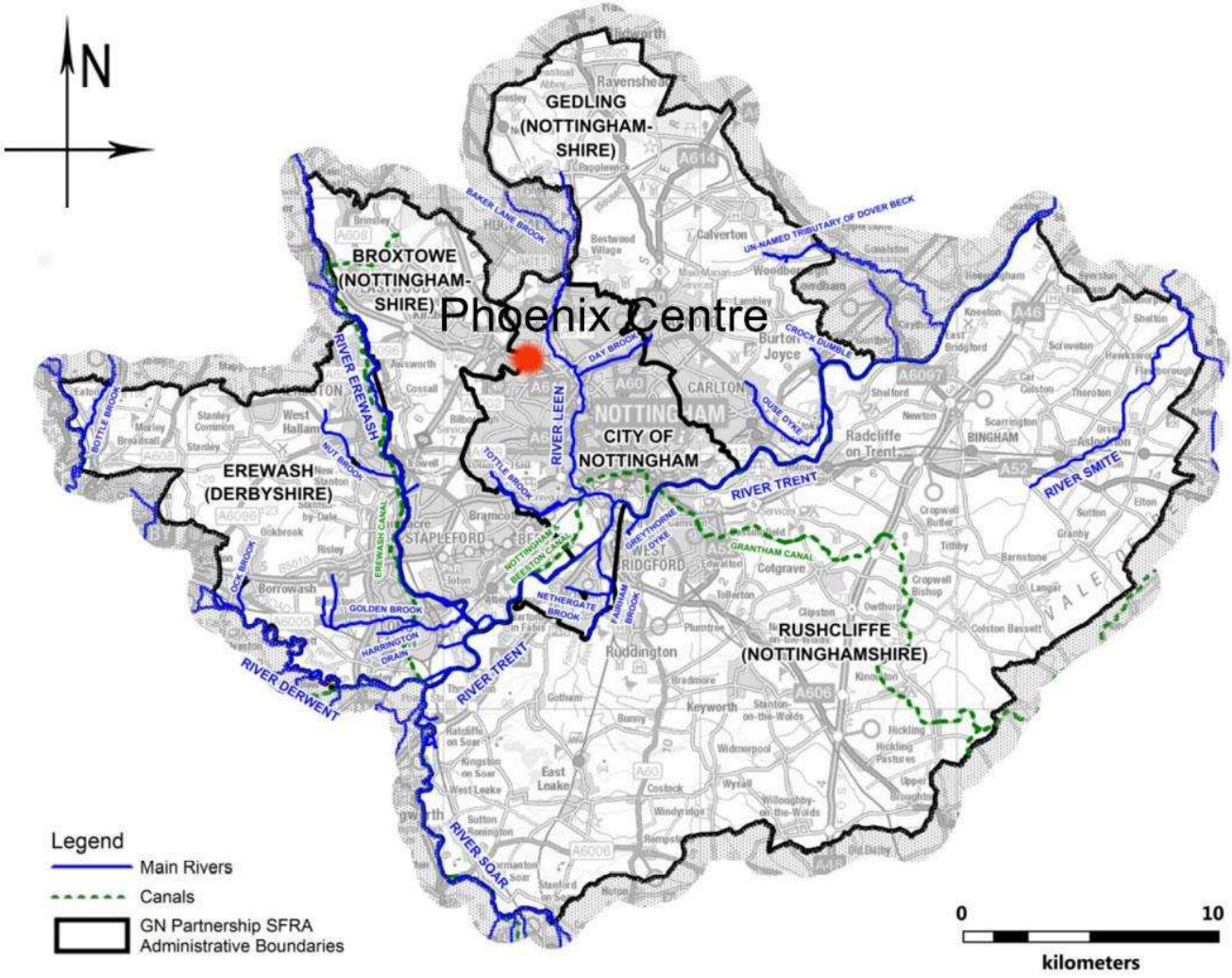
Appendix D Hydrology



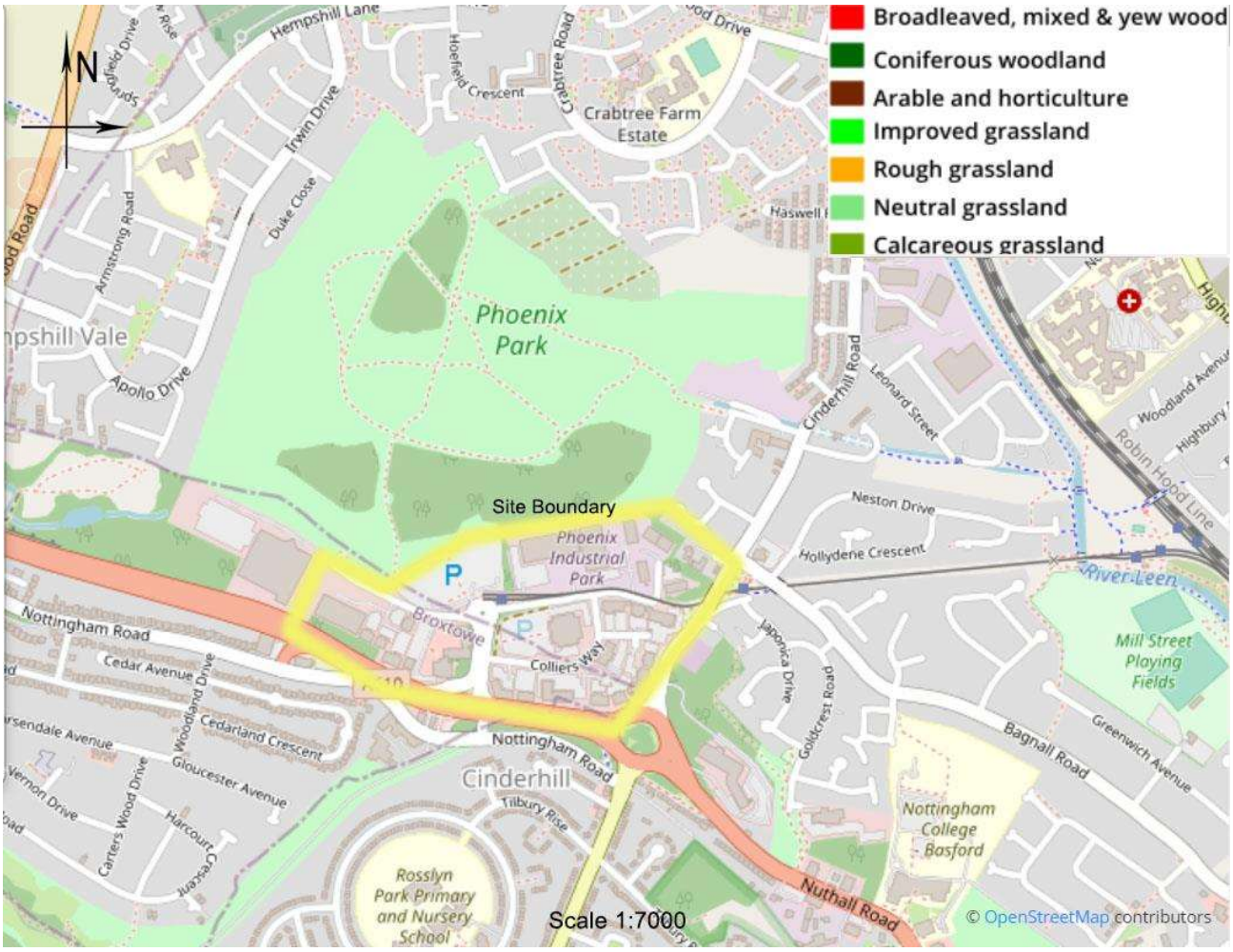



N
2 km
752 m
Unnamed lake
345 m
Unnamed lake
823 m
River Leen
Phoenix Centre
500 m
Oldmoor Lodge

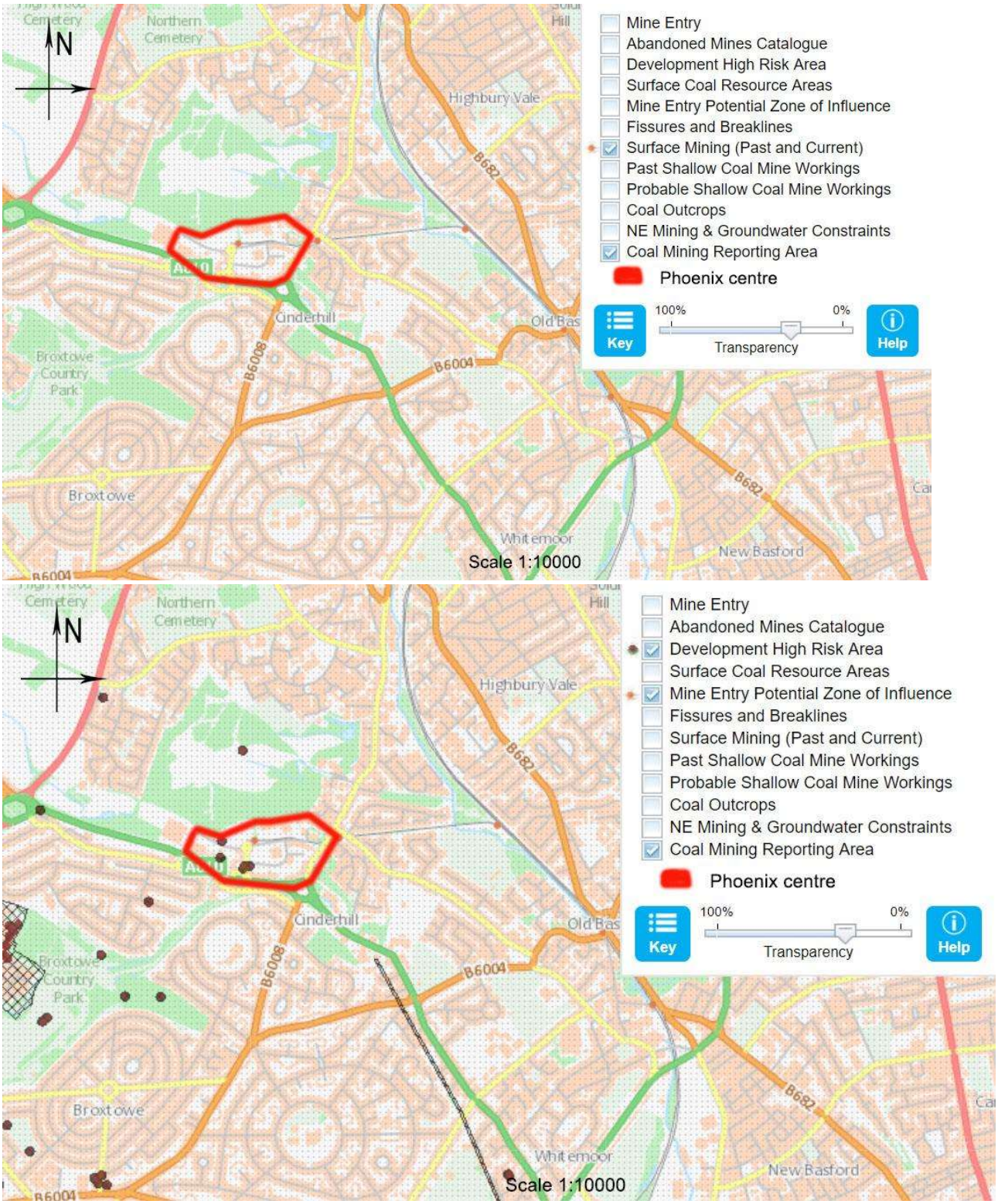

N
Site Boundary
Nuthall
Bulwell
Highbury Vale
Hempshill Vale
Cinderhill
NOTTINGHAM
Scale 1:8500


N
GEDLING (NOTTINGHAM-SHIRE)
BROXTOWE (NOTTINGHAM-SHIRE)
Phoenix Centre
EREWASH (DERBYSHIRE)
CITY OF NOTTINGHAM
RUSHCLIFFE (NOTTINGHAMSHIRE)
RIVER TRENT
RIVER LEEN
RIVER EREWASH
RIVER DERWENT
RIVER SOAR
RIVER SMITE
BAKER LANE BROOK
UN-NAMED TRIBUTARY OF DOVER BECK
DAY BROOK
CROCK DUMBLE
QUBE DYKE
TOTTLE BROOK
BOTTLE BROOK
NUT BROOK
EREWASH CANAL
NOTTINGHAM BEESTON CANAL
GREYTHORNE DYKE
GRANTHAM CANAL
NETHERGATE BROOK
FARNHAM BROOK
GOLDEN BROOK
HARRINGTON DRAIN
COCK BROOK
Legend
Main Rivers
Canals
GN Partnership SFRA Administrative Boundaries
0
10
kilometers

Appendix E Ecology



Appendix F Mine



Appendix G Lindfill