



SOUTH WEST GEOTECHNICAL

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Our ref: 14840 Letter
Your ref:

Enviromena Project Management Ltd.
Via email

FAO Mark Harding

20 February 2023

Dear Sir,

Preliminary Coal Mining Risk Assessment- Grimethorpe, Barnsley

Further to your request for pre-application advice for a proposed solar park near Grimethorpe, Barnsley, we write to report as follows.

DEVELOPMENT PROPOSALS

The Grimethorpe site largely comprises agricultural land in a former coal mining region in the north Midlands. The proposed PV plant area spans an area measuring approximately 135 hectares (1.35 square kilometres), across three plots.

For large utility scale solar PV developments a driven pile/ anchor foundation solution framework for the ground mounted solar panels is typically considered preferable, as it is a relatively cost effective means of construction and fast to install. A number of factors must be considered when selecting this foundation solution from both design and logistical perspectives. These factors include design loads, pile drivability and corrosivity. It is noted that these considerations are largely dependent on the near surface ground conditions that the piles are to be driven into. In cases where driven piles cannot be used due to factors such as shallow bedrock or soft / organic soils, an alternative foundation solution has to be considered. Large solar farm developments are also likely to include infrastructure to connect with the national grid including transformers, substations, battery storage and switchrooms. These conventional structures are often confined to a relatively small area of any given site but consideration must be given to the design of their traditional style (strip, pad, pile) foundations.

This desk study has been commissioned by Enviromena project management Ltd. to provide a review of publicly available information, to assess the generic risks from historical coal mining to potential developments on the site and provide preliminary recommendations for designing the layout of the proposed development.

DESK STUDY

A Preliminary Coal Mining Risk Plan is attached, and highlights the locations of pertinent features discussed in the report.

Geology

The British Geological Survey (BGS) maps indicate that the site overlies geological units of Carboniferous age. The southwest of the site overlies the Pennine Middle Coal Measures Formation which comprises mudstone, siltstone and sandstone, arranged in cyclothems. This formation features a number of known economically-viable coal seams. The northeast of the site overlies the Pennine Upper Coal Measures Formation which comprises mudstone, siltstone and sandstone, arranged in cyclothems, which also features known economically-viable seams of coal.

The regional dip direction of the bedrock is approximately 2° east.

Faulting of the bedrock is common in the region. The BGS maps record both northeast-southwest and northwest-southeast trending faults, mostly restricted to the most eastern plot (see attached plan).

Three separate coal seams are recorded in the vicinity of the site, namely the Shafton Coal, Highgate Coal and the Brierley Coal. The Shafton coal seam outcrops immediately west of the western most part of the site, whilst the Highgate Coal runs approximately north south through the centre of the western part of the site. The Brierley Coal is shown to outcrop at surface in the far north east of the site.

Localised Superficial deposits of Alluvium mapped on site are restricted to the lower-lying areas, near to rivers, including in the western area of the southwest plot, and the eastern area of the central plot. These materials generally comprise of clay, silt, sand and gravel. These may have highly variable engineering properties within themselves and compared to soil profiles in surrounding areas.

Much of the site's vicinity hosts Made Ground recorded by the BGS. These are generally described on the BGS maps as 'Infilled Ground' or 'Made Ground' but are interpreted as being largely comprised of the backfill of opencast coal workings and of mine spoil, given the site's situation in a coal mining area of northern England. On the site itself, the BGS only record Made Ground in the west of the central plot.

Coal Mining-related Risks

Given the site is within a former coal mining region of the Midlands, a review of the Coal Authority interactive maps and other publically-available information has been undertaken. It indicates the site is surrounded by high risk development areas. In addition there are mine entry points mapped near to (within around 50m) the northwest and southeast boundaries. This confirms the former coal works pose a potential risk to the development.

The Coal Authority interactive maps show recorded mine openings- shafts or adits-within 50m both south and north of the southwestern plot. Although, no mine openings are recorded on the site itself.

Backfilled surface workings are mapped by the coal authority to underlie the site in the western and central area of the southwestern plot (see Mapped Surface Workings on attached Plan). Completion plans show that the excavations become deeper eastwards. Based on the present day topography of the site (having been broadly resorted to pre-extraction levels), the backfill materials may be as shallow as 2.0m in the west to possibly as deep as 45m in the far east of the excavated area. These materials may have variable engineering properties due to their reworked nature.

The Coal Authority holds abandonment plans for underground workings which underlie the east of the site, covering the entire northeastern plot and most of the central plot. The shallowest workings are those of the Shafton Coal Seam which are likely to be at a depth of around 40m beneath most of the site. This is supported by borehole records available on the BGS Geindex around the site which identify workable coal seams around 45m depth around the site. There is at least 65m of separation before the next economically-viable coal seam is encountered. Thus, workings deeper than the Shafton Seam are unlikely to pose a risk to surface developments or to disturb the abandoned workings of the Shafton Seam. Similarly, beneath the majority of the site, the Shafton Seam is expected to be present at a depth greater than 25m and so would not be expected to significantly impact the ground surface to a degree that could impact a solar farm. Whilst the dip of the bedrock strata implies that seams of coal shallower than the Shafton Seam could exist beneath the site, the boreholes available on the BGS Geindex (e.g. NE41 SW/23), suggest that they pinch out eastwards as no significant coal horizons are recorded above the Shafton. This would explain the absence of records of shallower workings.

The coal authority interactive maps show that there are unmapped/ probable shallow mine workings beneath the site area, particularly in the very far west of the site and in the centre of the southwestern plot. A review of publicly available literature suggests that these workings are likely to take the form of bell pits. It is these sort of workings that the adits and shafts abundantly mapped near the northwest boundary of the southwestern plot are likely to service. Although these workings are likely to be small in spatial extent, they pose the greatest risk to the proposed developments as they are near to the surface. Furthermore they are unmapped.

RECOMMENDATIONS FOR SOLAR FARM LAYOUTS

The solar farm layout should be adjusted take into account the potential risks posed by historic coal workings, beneath the site, identified in the desk study.

We recommend that:

Conventional structures (DNO, battery storage etc) should be sited in areas away from the coal seam outcrops, shallow surface workings, mapped surface workings, areas of made ground and areas of coal subsidence claims (see CON29M Coal Mining Report). These are located in the south western part of the site and the far north east. If these areas be avoided for the conventional structures, then engineered foundations/ mine remediation is unlikely to be necessary.

The area of backfilled surface workings should be a focus for future ground investigation works as it may pose a risk to even the ground-mounted solar panels. The near-surface materials in this area may have variable and poor geotechnical properties. If conventional structures are to be situated in the backfilled surface workings area then there is less likely to be a risk of underground mine collapse that could affect the surface, but there is potential for long term differential settlements of these materials, and allowance should be made for adjusting the panel tables over the design life of the structure.

FURTHER WORKS

In the first instance, site specific coal mining reports from the coal authority should be acquired to provide further detail on the potential coal risks.

Intrusive ground investigation works should be undertaken to quantify the ground conditions and provide geotechnical parameters for foundation design; essentially this is to profile the bedrock head and quantify the risks in the former coal working areas. The scope of this investigative work will be larger than a typical solar ground investigation due

to the coal mining risks (i.e. than a site with uniform favourable ground conditions), and should include the following items to account for the adverse ground conditions identified during the desk study:

Table 1: Intrusive ground investigation items

Technique	Purpose
Geophysics	Identify potential unrecorded/unidentified near surface workings on coal outcrops
Rotary percussive boreholes in the high risk areas (essentially close to coal outcrops and shallow workings,	Identify coals seams and voids/ worked seams
Trial Pitting / trenching	Identify coals seams and voids/ worked seams
Window sample boreholes with SPTs	Profile the near surface materials and allow geotechnical parameters to be determined
Dynamic probing (super heavyweight)	Profile the near surface materials, increase data coverage, assist with determining driveability issues
Geotechnical laboratory testing	Derive geotechnical parameters including corrosivity
Pile testing (once a framework supplier has been selected and specific design loads are known)	Establish site specific shaft adhesion/ friction values

Please do not hesitate getting in touch if you have any further questions.

Kind regards,

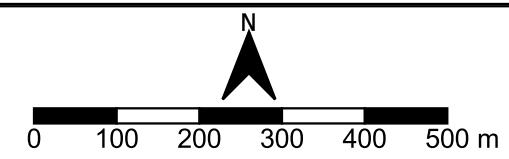
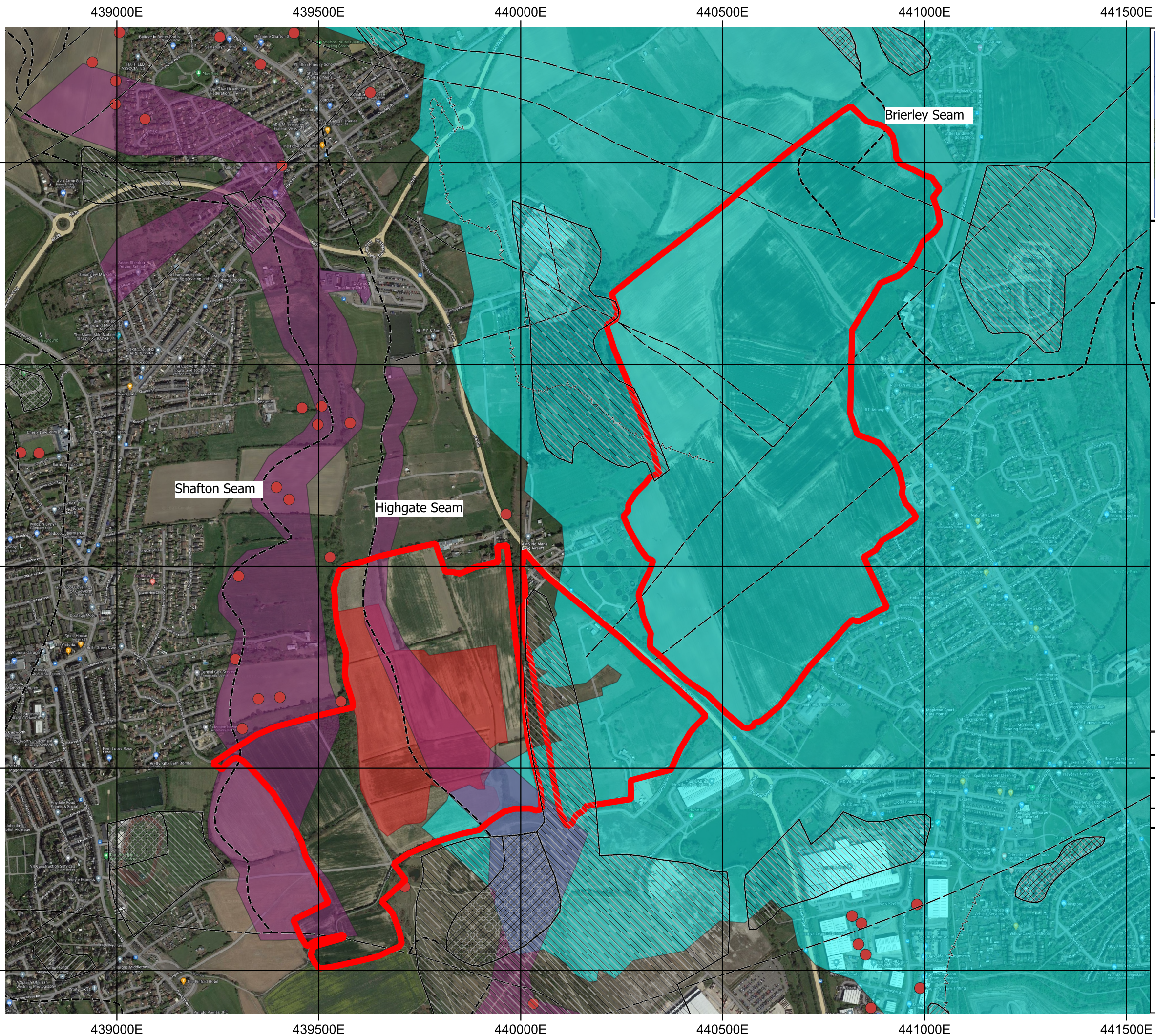
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References:

BGS. (2022). GeoIndex Onshore. Retrieved from <https://www.bgs.ac.uk/>

Coal Authority. (2022). Coal Authority Interactive Map. Retrieved from <https://www.gov.uk/>



Plan Legend:

- Site Outline
- Recorded Mine Openings
- Mapped Underground Workings
- Probable Shallow Workings
- Mapped Surface Workings
- BGS Mapped Made Ground
- Recorded Coal Outcrop
- Recorded Faults

Grimethorpe, Barnsley			
Preliminary Coal Mining Risk Plan			
SIZE: A3	JOB NO: 14840	DWG NO: Fig No. 1	REV: 1
SCALE: 1:9,000	17/02/2023	SHEET 1 OF 1	

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