# Springwell Solar Farm

## Environmental Statement

## Appendix 9.2: Geoarchaeological Deposit Modelling Report

Volume 3

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

EN010149/APP/6.3
November 2024
Springwell Energyfarm Ltd

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# 1. Introduction

## 1.1. Project Background

1.1.1. Headland Archaeology (UK) Ltd were commissioned by RSK on behalf of EDF Renewables (hereafter “the client”) to undertake a Desk Based Geoarchaeological Modelling Exercise of Ground Investigation (GI) data in advance of construction of the proposed 2,121-hectare Springwell Solar Farm (hereafter “the Site”).

1.1.2. The proposed development is a ground mounted solar PV generating station with a gross electrical output capacity exceeding 500MW. The generating station will be made up of; solar mounted PV modules, mounting structures, and Balance of Solar System (BoSS). The proposed development also includes an onsite Project Substation compound and a Battery Energy Storage System (BESS) compound. There will also be works to facilitate vehicular access to the site, construct ancillary infrastructure, create new public footpaths, improve amenities, manage habitat, and enhance biodiversity. A Development Consent Order (DCO) is being sought by the Client under the Nationally Significant Infrastructure Projects (NSIP) process.

1.1.3. The project incorporated preliminary GI works, undertaken between 24th April and 26th May 2023, in the form of dynamic sampled boreholes, trial pits and geotechnical testing **[Ref. 1].**

1.1.4. This report presents a review of the GI borehole and test pit logs across the scheme area **[Ref. 1]**, with the aim of characterising the superficial deposits present within the Site and assessing the potential for these deposits to influence apparent trends in past human usage of the site.

1.1.5. The assessment has been commissioned in response to data generated during a geophysical survey of the scheme area (**ES Volume 3, Appendix 9.4: Geophysical Survey Report [EN010149/APP/6.3]**). It is intended to augment the geophysical data, and to provide insights into the potential distribution of geoarchaeological and anthropogenic deposits at the site in order to inform forthcoming mitigation works.

# 2. Site description

## 2.1. Location

2.1.1. The 1280ha Site is located c.1km to the south of the village of Metheringham in the north and runs south-west to the village of Scopwick and over the A15. In total the Site measures c.10km from its north-eastern tip at National Grid Reference (NGR) TF 08641 60671 to the south-western end point at NGR TF 02905 52346. The Site sits in Lincolnshire, 15km south of Lincoln (central National Grid Reference TF056569), post code LN4 3JE (**Illustration 1**).

2.1.2. The Site is divided into three areas (Springwell East, Springwell Central and Springwell West) (**Illustration 2**), all of which are largely made up of agricultural fields. The area is generally flat with a slight incline to the south-west; Springwell West lies 48m above Ordnance datum (AOD), Springwell Central lies 21m AOD and Springwell East lies 19m AOD.

2.1.3. A summary of the description of the Proposed Development can be found in Section 3.1 of the **Environmental Statement (ES) Volume 1, Chapter 3: Proposed Development Description [EN010149/APP/6.1].** The terminology used in this document is defined in the **Glossary [EN010149/APP/6.1].**

2.1.4. For the purposes of this geoarchaeological assessment four areas have been used to examine the data – Area A1 and Area A2 broadly correspond with Springwell West, Area B with Springwell Central and Area C with Springwell East. These are labelled on **Illustration 3.**

## 2.2. Geological setting

2.2.1. The bedrock geology is composed of a sequence of stacked sedimentary middle Jurassic bedrocks that dip away from the sea in the east where the most recent bedrock geology is present. The earliest unit is the Lower Lincolnshire Limestone Member, which is overlain by the Upper Lincolnshire Limestone Member. This geology dominates the more elevated southern and western parts of Springwell West. The east of the Site towards Springwell Central is mapped as the Stamford Member and Rutland Formation, followed by the Blisworth Limestone Formation, Blisworth Clay Formation and Cornbrash Formation. The northeast quadrant of the Site, in the vicinity of Springwell East, covers the Kellaways Clay Member and Kellaways Sand Member, with the Oxford Clay Formation occurring to the east towards the scheme boundary **[Ref. 2].**

2.2.2. Superficial deposits have been mapped within the study area **[Ref. 2].** In the shallow valleys located in Springwell West, head deposits (clay, silt, sand and gravel), Sleaford Sand and Gravel (fluvial deposits of sand and gravel), and alluvium (clay, silt, sand and gravel) are present; and at the head of these valleys - outside Springwell West, to the south and west of the study area - there are local accumulations of windblown sand. Isolated accumulations of till (diamicton) are mapped on some raised areas to the east of Springwell West and Springwell Central, and more extensively to the north and east of Springwell East. To the north of Springwell East tidal flat deposits (clay and silt) are mapped overlying Quaternary glaciofluvial sheet deposits (sand and gravel) and till (diamicton). The areas of tidal flat deposits are flanked by Quaternary river terrace deposits (sand and gravel) **[Ref. 2].** A summary of these deposits is given in **Table 1.**

2.2.3. Variation is anticipated in the local distribution of geological units within the scheme area, in particular the superficial geology which is related to the evolution of the Late Pleistocene and Holocene riverine and coastal environment. Locally, deposits of till and fluvial material may be significant, especially if there are infilled depressions such as buried valleys or ice marginal features. Glaciofluvial deposits may also be identified and these may be of significance, having the potential to preserve Quaternary palaeoenvironmental records of past climate and vegetation change. Significant depths of 'made ground' are to be expected in areas subject to modern development: this may include deposits of recent age, but also historical reclamation deposits of potential archaeological interest.

## Table 1: Summary of superficial deposits mapped within the Site

| Deposit Type | Date | Description | Geoarchaeological potential |
|---|---|---|---|
| **Till** | Pleistocene | Poorly sorted sediments deposited directly by ice sheets. Unlikely to yield archaeological assemblages, but may seal deposits of archaeological and palaeoenvironmental interest | Low |
| **Glacio-fluvial sands and gravels** | Quaternary | Sands and gravels deposited by seasonal meltwater outwash at the edge of an ice sheet or as subglacial, englacial and supraglacial deposits of the ice sheet itself. May contain secondary archaeological assemblages or seal stratified deposits of archaeological and palaeoenvironmental interest such as kettle holes | Low |
| **River Terrace Gravel** | Quaternary | Sands and gravels deposited by fluvial mechanisms under cold climatic conditions that have been subsequently incised through and preserved as former floodplains. They are an important source of Lower and Middle palaeolithic artefacts (usually preserved in non-primary contexts) and can also seal organic sediments of palaeoenvironmental significance | High |
| **Head** | Pleistocene/ Holocene | Poorly sorted slope deposits deposited by solifluction in peri-glacial environments. Has the potential to bury sediments of geoarchaeological and palaeoenvironmental interest and may contain stratified secondary archaeological assemblages | Moderate |

| | | | |
|---|---|---|---|
| **Sleaford Sands and Gravels** | Pleistocene/ Holocene | Sands and gravels deposited by the River Slea and its tributaries. The earlier river terrace deposits of sand, gravel, and gravelly sand were deposited by braided rivers in a periglacial environment. Later alluvium and floodplain fine deposits may contain limited bodies of peat overlying the sands and gravels. Preserved organics throughout this sequence may be of palaeoenvironmental significance. | Moderate |
| **Tidal Flats Deposits** | Pleistocene/ Holocene | These include sand flat and fine unconsolidated mud flat deposits that form the marshy landscape in the intertidal zone. Shallow dendritic creeks are characteristic of this type of environment and may be visible in aerial photography. Raised tidal flat deposits may record historic sea level changes, and tidal flat deposits may also cap earlier deltaic deposits. They have the potential to preserve macrofossils that may be of palaeoenvironmental interest, as well as preserving deep sequences of wetland archaeology. | High |
| **Alluvium** | Holocene | Fine-grained sediments of Holocene date deposited by fluvial activity. Alluvial environments are a focus for human activity, and an effective trap for artefacts and ecofacts with good preservation potential. | High |
| **Wind Blown Sand** | Holocene | Fine grained sand particles that have transported by air (aeolian processes) | Low |

# 3. Geoarchaeological and archaeological background

## 3.1. Geoarchaeological background

3.1.1. The following geoarchaeological assets have been identified within, and in proximity to, the study area in the British Geological Survey (BGS) 1:50,000 mapping **[Ref. 2]**:

- River Terrace Gravel, including the Sleaford Sands and Gravels; generally sands and gravels are devoid of paleoenvironmental material, but occasional isolated patches of fine-grained sediments, including organic material representing fragments of isolated channels, may be of importance.
- Glaciofluvial sediments; these are of potentially of high geoarchaeological significance with the potential to reveal stratified sedimentary sequences with associated archaeological and environmental remains of Palaeolithic date.
- Peat deposits; these have been found locally north of Sleaford relating to the Fens and as part of the River Slea sequence of Holocene channel infill and sedimentation. These deposits are unlikely to be present in the study area but may be of palaeoenvironmental importance if encountered.

3.1.2. Previous borehole explorations reported in the geology memoirs for this area **[Ref. 3]** have also recorded the following:

- Interbedded Glaciolacustrine and Till Deposits up to 1.5m thickness on till capped ridges east-north-east of Ruskington, just to the south of Area A1 and Area A2. These deposits were possibly formed in an ice-dammed lake in a deltaic environment and have the potential to be of palaeoenvironmental importance to the Pleistocene climate record if encountered.
- Sands and Gravels of unknown origin with patches of finer grained sediments have been recorded at a topographically greater elevation than the Sleaford Sands and Gravels and 'Fen gravel' around Digby (to the east of the Site Area's B and A2, and south of Area C) and, dependant on their age and origin, these deposits may be of geoarchaeological significance. They have been estimated to be of Anglian to Devensian age (approximately 480,000–11,000 yr BP).

### Geophysical survey

3.1.3. The geophysical survey undertaken by Headland Archaeology (**ES Volume 3, Appendix 9.4: Geophysical Survey Report**

**[EN010149/APP/6.3]**) identified a very strong geological response to the magnetometer survey. This resulted in locations where the superimposition of various types of anomalies of natural and/or anthropogenic origin limited the degree of interpretation possible regarding of the nature, extent and any interrelationship (if present) between features recorded.

3.1.4. Perhaps the most enigmatic feature recorded by the survey was the extensive gridded pattern of weakly magnetically enhanced linear trend anomalies, aligned north-west/south-east that were identified in almost every field west of the B1191 constituting the western third of the Geophysical Survey Area. Trial trenching (**ES Volume 3, Appendix 9.5: Archaeological Trial Trenching Report [EN010149/APP/6.3]**) confirmed that these anomalies related to variations in the Upper Lincolnshire Limestone Member bedrock geology.

## 3.2. Archaeological background

3.2.1. The archaeological and historical background of the scheme area is presented in an archaeological desk based assessment (DBA) (**ES Volume 3, Appendix 9.1: Archaeological Desk-Based Assessment [EN010149/APP/6.3]**). The results of this DBA are summarised below.

### Prehistoric

3.2.2. There are 36 Historic Environment Records (HER) of Prehistoric date within the site boundary, the majority of which are cropmarks recorded during the National Mapping Programme. There is little evidence for activity before the late Neolithic, and the majority of evidence dates to the Bronze Age. There are nine HER records of Bronze Age date within the site boundary; six of these are barrows, the remaining three are findspots including the location of a cremation burial.

### Roman

3.2.3. Human activity within the Site and surrounding area continues into the Roman period, centred around the two Roman roads that run north-south through the study area (MLI60813; MLI86228). The area surrounding the study area shows a wealthy rural Roman landscape with a number of villas recorded alongside Roman settlements that show evidence for agricultural processing.

### Medieval

3.2.4. There is limited archaeological evidence for early medieval activity within the Site. A number of the surrounding settlements are recorded within the Domesday Book and likely originated in the early medieval period, but the only archaeological evidence of activity during this period are the

Scheduled Medieval Villages of Brauncewell (NHLE1018397), which sits just within the southern area of the study area, and Dunsby (NHLE1018395). While there is evidence for activity at these sites during the early medieval, neither of them prospered until the 12th and 13th centuries.

3.2.5. The evidence recorded by the HER and National Heritage List for England (NHLE) shows the medieval period as one of growth within the villages surrounding the study area, with sporadic agricultural activity surviving within the surrounding area. There are 11 heritage assets of medieval date recorded by the HER within the Site, three are findspots and have been removed, six are records of cropmark evidence for agricultural activity including ridge and furrow, one is evidence of a medieval parish boundary, and one is part of the Ashby de la Launde settlement boundary. The distribution of this evidence suggests that the parts of the study area closest to settlement activity were used for agriculture.

## Post-medieval

3.2.6. The desk-based assessment concluded that the Site and its surrounding area were farmed intensively during the post-medieval period. This is most notably seen in this historic map regression which shows the study area as a mixture of arable fields, pasture, and meadow from the 19th century. There are 23 heritage assets of post-medieval date recorded by the HER within the study area. These show that the study area was used for extraction as well as agriculture during this period; there are 11 heritage assets relating to extraction recorded. The remaining heritage assets form farmhouses as well as assets relating to the manor at Brauncewell and the park at Blankney.

## Modern

3.2.7. Evidence of the modern period is represented within the Site as WWI and WWII remains, principally concentrated around RAF Digby (MLI60621). Notably, in Area C there are two HER records relating to the Avro Lancaster Aircraft Crash Site (MLI125416) and Hawker Hurricane Aircraft Crash Site (MLI125417).

# 4. Aims and Objectives

## 4.1. Aims

4.1.1. This desk-based assessment has been undertaken to identify any geoarchaeological assets present within the study area and to inform the mitigation strategy for the project. Primarily this investigation aims to provide preliminary base-line data on the nature of the sub-surface sediment sequences and their geoarchaeological potential, and to identify any horizons within these deposits with the potential to preserve evidence of human occupation.

4.1.2. The scope of this work is to make a geoarchaeological assessment of the geotechnical logs generated from boreholes and trial pits undertaken as part of the GI works for the project.

## 4.2. Objectives

4.2.1. The principal objectives of this assessment are to:

- Assess the extent and depth of the Quaternary superficial deposit sequence and its potential for obscuring archaeological deposits;
- Identify whether there any deposits of significance that might preserve palaeoenvironmental/dating evidence contemporary with human occupation;
- Determine whether there is a geological reason for the apparent trend in eastern locations of human occupation seen in the geophysical survey of the site.

# 5. Methods

## 5.1. Data sources

5.1.1. The following data sources have been used in the preparation of this report:

- Palaeoenvironmental and geoarchaeological published studies,
- British Geological Survey mapping,
- British Geological Survey core logs,
- Project-specific GI data.

5.1.2. Data has been collected from the above sources for an area extending 200m beyond the draft order limits (as of July 2023). This is hereafter referred to as the “study area”.

5.1.3. An initial, rapid desk-based review of the geoarchaeological and palaeoenvironmental potential of the study area, including a review of geological records and other documentary sources, alongside former GI data, was carried out as part of the study. It gave an indication of key stratigraphic units and contact locations and depths below ground level across the site. These include the probable depth of the late Pleistocene-early Holocene land surface at the contact between the Sleaford Sands and Gravels and the underlying Pleistocene glacial deposits or near surface bedrock geology.

5.1.4. GI works comprised a total of 40-no. boreholes and excavation of 46-no. trial pits at 85-no. locations within the limits of the study area, of which 35-no. locations with full records were selected for review. The interventions selected for this report comprise 9-no. machine dug trial pits, 10-no. boreholes made utilising dynamic sampling and then rotary coring (with hand dug inspection pits to 1.2m below ground level), and 16-no. rotary-cored boreholes (with hand dug inspection pits to 1.2m bgl). Boreholes were undertaken to a maximum depth of 6.9m below ground level (bgl), with machine excavated trial pits undertaken to a maximum depth of 3m bgl **[Ref. 1].** A summary of the results is presented in **Table 2**, and their locations are shown in **Illustration 3**. A summary list of the locations is also presented in **Annex 1**.

5.1.5. A review of the geological and geotechnical data by a qualified geoarchaeologist formed the initial data set for a predictive model of sub-surface deposits (**Annex 1**). A sequence of commonly occurring lithological deposits has then been identified and correlated into stratigraphic units which define distinct depositional environments (e.g. head, tidal flat deposits, till, blown sand).

Table 2: Summary of technical GI work covered in this report (recreated from **[Ref. 1]**)

| Type | Quantity | Depth range (m) | Exploratory hole IDs |
|---|---|---|---|
| **Machine dug Trial Pits** | 9 | 0.0-3.0m<br>Mean (depth): 1.74m<br>Mode (depth): 1.50m | TP045, TP046, TP047, TP056, TP063, TP067, TP070, TP081, TP083, |
| **Hand dug Inspection Pits followed by dynamic sampling and rotary coring** | 10 | 0.0-6.9m<br>Mean (depth): 6.12m<br>Mode (depth): 6.0m | BH01, BH08, BH15, BH18, BH19, BH26, BH69, BH72, BH84, BH85 |
| **Hand dug Inspection Pits followed by rotary coring** | 16 | 0.0-6.8m<br>Mean (depth): 6.15m<br>Mode (depth): 6.0m | BH16A, BH17, BH34, BH39, BH42, BH44, BH49, BH52, BH57, BH61, BH62, BH64, BH66, BH71, BH80, BH82, |
| **Total** | 35 | | |

5.1.6. Deposit records have been entered into industry standard software (Rockworks™ v20.0) to visualize these stratigraphic units in the form of predictive transects (**Table 3**). Transects have been chosen as the most appropriate means to display data for this project due to both the linear nature of the project, and the need to assess the east-west variance in subsurface deposits. Transects are well-suited to constrained linear data sets, providing a representative cross section illustrating the range of deposits present within each area.

5.1.7. In total five transects were made as part of this study: one long transect with a NE-SW orientation called the 'North-South' transect, and four additional transects with mainly W-E orientations that cross the North-South transect, identified as the 'C-Area', 'Upper', 'Middle', and 'Lower' transects. A summary of the transects is presented in **Table 3** and their locations are shown in **Illustration 3.**

Table 3: Summary of transects covered in this review

| Transect | Orientation | Study area | Quantity | Exploratory hole ids (underlined ids appear in other transects) |
|---|---|---|---|---|
| **1 : North-South** | NE-SW | C, B, A2, A1 | 11 | BH01, BH08, BH15, BH26, BH34, BH39, BH44, TP063, BH66, BH72, BH80 |
| **2 : C-Area** | W-E | C | 5 | BH15, BH16A, BH17, BH18, BH19 |
| **3 : Upper** | W-E | A1, A2, B | 9 | BH57, TP056, BH49, BH52, BH44, BH42, TP047, TP045, TP046 |
| **4 : Middle** | WNW-ESE | A1, A2 | 8 | BH62, BH61, BH64, BH66, BH71, TP070, BH69, TP067 |
| **5 : Lower** | W-E | A1, A2 | 6 | BH80, BH85, BH84, TP083, BH82, TP081 |

5.1.8. Deposit modelling was undertaken following Historic England guidance [**Ref. 4**] and in compliance with industry best practice.

# 6. Results

## 6.1. Limitations of the data

6.1.1. The deposit model presented here relies entirely on deposit records from the GI works supplemented by pre-existing (historic) records. It extrapolates the thickness and elevation of deposits between these given data points. Where data points are sparse and widely spaced, there is lower confidence in the model. This may give an erroneous impression of the distribution of deposits between sampling points, especially for laterally constrained deposits such as alluvium. The distribution of interventions, and possible gaps in data, should be taken into account when considering the results, and it should be noted that future borehole and trial pit data may change the predicted distribution of deposits.

6.1.2. This deposit model is based upon recording undertaken by geotechnical engineers during GI works, and thus records of any superficial deposits overlying the bedrock may contain less detail than would be achieved during a geoarchaeological field survey. This is of particular note in this assessment as previous land surfaces showing human occupation will have most likely been upon these superficial deposits and thus it is possible that modelling may overlook deposits of potential archaeological significance.

6.1.3. There are also a significant number of voids in the dataset at the point of contact between the bedrock geology and superficial geology and so confidence in the depth of this contact is low. Assumptions have therefore been made about the nature of missing units based upon the GI records, which would be subject to revision if new data is presented.

6.1.4. In addition, there is a notable lack of borehole records for any of the small valleys, present in Area A1 and A2, that have been mapped as containing superficial deposits in the BGS 1:50,000 mapping **[Ref. 2].** Valleys are areas where complex deposits of potentially high geoarchaeological significance are likely to be present.

6.1.5. Confidence in the results of deposit modelling within a given area can be improved by increasing the number of available boreholes and improving their geographical spread in relation to relevant superficial deposits.

## 6.2. Summary of stratigraphic sequence

6.2.1. An initial review of the GI sequences, including a review of geological records and other documentary sources identified the broad stratigraphic sequence. This is summarised as follows, in order of deposition:

- Lower Lincolnshire Limestone Member (oldest)
- Upper Lincolnshire Limestone Member

- Stamford Member
- Rutland Formation
- Blisworth Limestone Formation
- Blisworth Clay Formation
- Cornbrash Formation
- Kellaways Clay Member
- Kellaways Sand Member
- Oxford Clay Formation
- Glaciolacustrine Deposit
- Till / Boulder Clay
- Glaciofluvial Deposits
- Head
- Sleaford Sands and Gravels / Sand and Gravel Superficial Deposit
- Tidal Flat Deposit
- Blown Sand
- Topsoil
- Made ground, including that with archaeological potential (youngest).

## 6.3. Transect 1: north-south transect (Area's A1, A2, B & C)

6.3.1. This is the longest transect and comprises ten boreholes and one trial pit covering an area of over 9km in length. It is orientated NE-SW. The deposit model is presented as a single transect and covers all four areas of the site, and crosses Transects 2–5 (**Illustration 3, Illustration 4, Deposit Model Transect 1**).

6.3.2. Broadly, boreholes in this transect were found to include the expected stacked Jurassic geology to the base of the bores, with the oldest geological units present to the south of the study area, and the youngest to the north. The sole exception to this was BH15, which contained a significant depth of superficial deposits and did not reach the bedrock.

6.3.3. The oldest bedrock geology, the Upper Lincolnshire Limestone Member, was found in all of the reviewed locations in areas A1 and A2 (BH80-BH44), as well as in BH26 (Area B). Above this unit a weaker limestone was encountered, which contained frequent voids and was commonly recovered as gravel. This is likely the transition from the Upper Lincolnshire Limestone Member to the Stamford Member which occurs at the base of the Rutland Formation. This weakness appears to be consistent with this transition, and also occurs at the base of BH39 (Area B).

6.3.4. The Rutland Formation was present in boreholes BH39-34 and BH08-BH01 as a strong dark grey limestone interbedded with dark grey calcareous marine mudstone, and was present beneath the Blisworth Limestone Formation, a pale yellow-grey limestone, in the north and central parts of the transect.

6.3.5. Superficial deposits comprising laminated, likely glaciolacustrine, clays were present above the bedrock in BH08 at 15.73–16.83m AOD, and in BH15 between 16.87–18.87m AOD. They are likely to represent a proglacial lake in the glacial foreground that was constrained by the rising elevation of the geology to the south of these boreholes. These deposits are thought to be the relict remains that were not eroded by the subsequent glacial advancement that deposited Till in BH15, or Tidal Flat deposits from the rising sea level in BH08. The downward trend in elevation of these deposits suggests that the lake itself may have been deeper north of the transect. This is potentially a deposit of palaeoenvironmental significance.

6.3.6. The sequences encountered in the southern and central boreholes are fairly uniform, with sands and gravels generally overlying the bedrock with a thickness of between 0.3–0.9m. These units are likely to be either the Sleaford Sands and Gravels or a sand and gravel deposit relating to the Palaeo-Trent terraces.

6.3.7. To the north (BH01-BH15, Area C) Tidal Flat deposits are found overlying the bedrock with a thickness of between 0.8–1.5m. This drape of deposits, found to a maximum of 22.47m AOD at BH15, is representative of the maximum relative sea level in this area in the late Pleistocene-Holocene.

6.3.8. The uppermost unit found across this part of the scheme is topsoil, apart from at BH72 where made ground with buried rubble was found. The topsoil was generally sandy and gravelly to the south and clayey to the north.

## 6.4. Transect 2: C-Area transect (Area C)

6.4.1. This is the most northerly W-E orientated transect and is at the lowest elevation. It comprises five boreholes covering an area of just over 2km in length. The deposit model is presented as a single transect and crosses Area C of the Site (**Illustration 3, Illustration 5, Deposit Model Transect 2**).

6.4.2. The broad sequence of deposits here was bedrock geology overlain by Tidal Flat deposits and Topsoil. Glacial Till and Glaciolacustrine deposits were present on the more elevated topography to the west of the transect, where these units underlay the Tidal Flat deposits.

6.4.3. Bedrock is at its shallowest in this transect in boreholes 16A, 17, and 18, beginning at 1.2m below ground level (BGL). The bedrock encountered in these sequences varies due to the stacked nature of the local geology. The strong grey limestone unit encountered at the base of BH16A and BH17 is likely to be the Rutland Formation, overlain by the shell-fragmented Blisworth Limestone and then what is possibly the Blisworth Clay in BH16A. The sequence in BH18 and BH19 is slightly younger, dating to the latter part of the Middle Jurassic, with the grey basal limestone likely to be the Cornbrash Formation, which is then overlain by the Kellaways Clay Member. This unit had localised thin beds of sandstone, as seen in BH19.

6.4.4. Voids were noted in the drilling record at the top of the bedrock sequence in BH16A and BH17. A lower void was recorded in BH18 within a unit described as limestone recovered as silty sand.

6.4.5. The superficial deposits in the more elevated BH15 and BH16 are thought to be initially glacial in origin. A stiff laminated clay was found at the base of BH15 between 6-4.6m BGL (18.27–16.87m AOD), overlain by a firm slightly gravelly or sandy clay which was also present in BH16. As the maximum extent of the most recent glaciation during MIS 2/3 (approximately 20,000 yr BP) did not reach this far south and inland, it is likely that these deposits represent either outwash deposits from the glacial foreground or relicts of a previous glacial phase such as the Wolstonian Stage/ MIS 5–8 (between 374–130,000 yr BP), which is known to be present in this location **[Ref. 5].**

6.4.6. Of particular interest in this transect is the laminated glaciolacustrine nature of the superficial deposits present in BH15, also referred to in section 6.2.6. There was no bedrock geology recorded here to the maximum bore depth of 6m BGL.

6.4.7. Overlying this was tidal flat deposits in BH15, BH17 and BH19, which are indicative of a marine adjacent environment. These were identified as soft, mainly clay deposits, typical of generally unconsolidated mudflat sediments. Of interest is the elevation of these sediments in relation to modern sea level. The drape of the tidal flat deposits over the rising topography from east to west is indicative of the past relative sea level changes that have occurred since the last glacial maximum (approximately 20,000 years ago), as well as perhaps the more recent drainage of the Lincolnshire Fens that reduced the tidal limits of the River Witham, which now drains through the Palaeo-Trent basin **[Ref. 6].**

6.4.8. There is a high potential for the misinterpretation of sand deposits using boreholes alone in cases where the full nature, such as bedding, cannot be observed. The deposition mechanism of the sands and gravels discovered in BH18 and BH19 is therefore unable to be concluded with certainty, though here they are thought to represent possible sand flat or beach deposits due to their proximity in the transect to other marine/estuarine deposits.

6.4.9. A topsoil occurring between 0.0–0.4m BGL then capped the upper parts of all the boreholes in this transect.

## 6.5. Transect 3: Upper transect (Area A1, A2, B)

6.5.1. Transect 3 is the longest W-E orientated transect, with five boreholes and four test pits covering an area just over 5km in length. The deposit model is presented as a single transect, and covers three site areas: A1, A2, and B (**Illustration 3, Illustration 6, Deposit Model Transect 3).**

6.5.2. The broad sequence of deposits between BH57-BH44 (Area 1, A2, beginning of Area B) is uniform moving west to east where the bedrock geology is the ooidal Upper Lincolnshire Limestone Member.

6.5.3. This is overlain by a poorly consolidated unit broadly described as ‘limestone’ in the GI logs for which recovery was low across the selected boreholes. This is not identified as ooidal limestone in the logs, and thus it is assumed to be the interface with the overlying Stamford Member which forms the lower part of the Rutland Formation. It may equally be a highly weathered continuation of the Upper Lincolnshire Limestone Member, or a void caused by unconsolidated sands and gravels found in the overlying unit. Further GI would be necessary to establish the reason for this consistent pattern of voids found in the bedrock geology – superficial geology boundary across the study area.

6.5.4. The geology is markedly different towards the eastern end of the transect area, illustrated by the composition of the sequence in BH42, located in Area B. The basal bedrock found at this location is likely the Rutland Formation, described as a strong grey limestone, overlain by a yellowish cream limestone between 2.80–2.65m BGL (30.82–30.67m AOD) that is likely from the Blisworth Limestone Formation. This unit is also present in the base of TP046 (between 32.20–29.70m AOD).

6.5.5. Throughout the west and central part of this transect (BH57-BH42) sands and gravels are found overlying the bedrock deposits. These sands and gravels reach their greatest thickness to the east in BH42 with 2.35m recorded, which may be indicative of river terrace formation at this location. Sands and gravels are much shallower upslope and to the west, recorded as only 0.2m at the thinnest point (BH57). These are likely to be either the Sleaford Sands and Gravels or sand and gravel deposits from the Palaeo-Trent terraces.

6.5.6. Deposits of firm sandy clay (TP045) and gravelly clay with common shell fragments (TP047) at 26.6–25.9m AOD are thought to most likely be of glaciofluvial origin and, and due to the angularity of the clasts, are likely to have only been transported a short distance from their source. Alternatively, they could represent a later fine fluvial deposit that is more alluvial in nature, relating to the river Sleaford Sands and Gravels/ Palaeo-Trent terraces. Further GI would be necessary to ascertain their exact origin.

6.5.7. Capping the entire transect was a topsoil layer, which was present to between 0.3–0.5m from the surface.

6.5.8. Clayey deposits such as those found in the topsoil and superficial geology of TP047, TP045, and TP046 have a comparatively fine particle size and would have retained more water and organic material when compared to those present in other the superficial deposits to the west of the transect, where sands and gravels are more prevalent. As a result, the clayier topsoil in the west of Area B will have had a higher water holding capacity and may have been more fertile for agriculture, making this area a more favourable site for occupation in the landscape **[Ref. 7] [Ref. 8].**

## 6.6. Transect 4: Middle transect (Area A1, A2)

6.6.1. Transect 4 is oriented WNW-ESE and includes data from seven boreholes and one test pit covering an area just over 3km in length. It contains BH62, which has the highest elevation of any of the boreholes included in this study. This transect was selected for its potential to cross features of mapped bedrock geology and its proximity to mapped superficial geology. The deposit model is presented as a single transect, and covers two site areas: A1, and A2 (**Illustration 3, Illustration 7, Deposit Model Transect 4**).

6.6.2. The sequence of deposits was, again, broadly uniform across this transect. The ooidal Upper Lincolnshire Limestone Member bedrock, found in the GI boreholes, was present from the west of the transect at BH62 to TP070 on the eastern end (**Illustration 7**). This correlates with the extent of the Upper Lincolnshire Limestone Member shown in the BGS 1:50K bedrock mapping **[Ref. 2].**

6.6.3. Overlying this was a generally weaker geology, similar to that seen in the Upper Transect (**Illustration 6**), which has been poorly recovered across these boreholes. This unit has been broadly described as ‘limestone’ in the GI logs and is assumed for the purposes of this model to be the interface with the overlying Stamford Member which forms the lower part of the Rutland Formation. It may however, as previously stated, also be a continuation of the Upper Lincolnshire Limestone Member that is highly weathered or reflect patchy retention of poorly consolidated superficial deposits. Limestone is particularly prone to the formation of voids as it is soluble in water. Further GI would be necessary to establish the possible reasons for the consistent pattern of voids found at the bedrock geology – superficial geology boundary across the study area.

6.6.4. The eastern-most sequences in Transect 4, as with those in Transect 3 and 5, displayed some variance from the general superficial stratigraphic trends identified in the western and central part of the transect, and in BH69 the basal geology is overlain by a stiff silty clay. A grey slightly gravelly sandy clay was also seen in TP067 between 0.1–3m BGL or 24.11–21.21m AOD. These are both thought to represent a depositional till, possibly reworked by meltwater, that has deposited here at the lower eastern elevation of the transect.

6.6.5. Otherwise, the general trend across the transect was for sand and gravel either draped directly atop the bedrock geology or over the Till deposit. This unit is of generally consistent depth below the ground surface (0.4–1.2m BGL), although occurs at a higher elevation in BH71 (0.2–0.4m BGL), and slightly deeper in TP070 (0.4-1.7m BGL). These deposits are likely to represent either the Sleaford Sands and Gravels or the sand and gravel deposits from the Palaeo-Trent terraces.

6.6.6. It is of interest that the topsoil that caps each of the examined sequences also displays a west-east variance, with the western topsoil sandier and the topsoil of TP070, BH69 and TP067 clayier.

## 6.7. Transect 5: Lower transect (Area A1, A2)

6.7.1. Transect 5 is the most southerly of the transects created in this exercise and is a W-E orientated transect constructed using data from five boreholes and one test pit covering an area just of 2.5km in length. The deposit model is presented as a single transect, and covers two site areas: A1, and A2 (**Illustration 3, Illustration 8, Deposit Model Transect 5**).

6.7.2. The broad sequence of bedrock deposits here is consistent across the transect and comprises initially limestone bedrock of the ooidal Upper Lincolnshire Limestone Member and Lower Lincolnshire Limestone Member. Limestone bedrock was present to between 1.5m BGL (TP083) and at minimum 0.6m BGL (BH82).

6.7.3. Apart from in BH82 the bedrock was generally directly overlain by sand and gravels of between 0.2–1.2m thickness, likely relating to the river Sleaford Sands and Gravels/Palaeo-Trent terraces. A shallow accumulation of probable weathered Head deposits was found in BH82 between 29.74 and 29.54m AOD.

6.7.4. At the easternmost end of the transect in TP081 a slightly gravelly, slightly sandy, silty clay was found between 27.44 and 26.34m AOD and is thought to also be associated with river Sleaford Sands and Gravels which has local accumulations that are finer grained due to the fluvial periglacial conditions under which they were deposited.

6.7.5. Overlying the sands and gravels in BH85 was an isolated deposit of blown sand which is probably dates to the Holocene.

6.7.6. The sequence across this part of the study area was sealed by topsoil, which was present in all trial pits and boreholes from the ground surface to between 0.3–0.5m BGL, with again a divide in sandy topsoil to the west (BH80, BH85, BH84: Area A1 and A2), and more clayey topsoil to the east (TP083, BH82, TP081: Area A2).

# 7. Discussion

7.1.1. This Desk Based Modelling Exercise of GI data from Springwell Solar Farm has mapped the broad extent and depth of the Pleistocene and Holocene deposit sequence across the study area. There have been several geoarchaeological assets identified across the Site which include:

- Tidal Flat deposits in Area C with the potential for sealing palaeoenvironmental and archaeological evidence of significance, in particular the potential raised beach deposits (BH18) which could have palaeolithic potential;
- Head deposits in Area A2 with the potential to seal archaeological and palaeoenvironmental evidence of significance;
- Glaciofluvial deposits with the potential to seal deposits relating to the Pleistocene palaeoenvironment;
- Glaciolacustrine deposits in BH15 and BH08 (Area C) with the potential to seal deposits relating to the Pleistocene palaeoenvironment;
- Rare accumulations of greater depth of superficial sediments above the bedrock geology. These are likely to represent infills created by earlier glacial episodes (BH15. Area C) and accumulated river terrace deposits (BH42, Area A2), and may seal significant deposits relating to the Pleistocene palaeoenvironment.

7.1.2. This report has also reviewed the relationship between the identified stratigraphic units and the apparent shift in the amount of potential archaeology between the west and east sides of the long pit alignment, as observed in the geophysical survey (western areas of Area A1, A2 and B). There are several potential explanations for this occurrence:

7.1.3. The southern and western parts of the Site are of a slightly higher elevation than the northern and eastern parts of the area: the higher elevation not only corresponds with the incidence of limestone bedrock geology (which has influenced the topsoil formation), the elevation has also played a role in directing the formation and extent of more recent superficial deposits, e.g., river terraces and tidal flat deposits. The elevation may have also had a causal impact on human activity, as these areas are likely to be further from coastal resources and slightly more exposed to wind.

7.1.4. Topsoil characteristics in the study area vary in line with the northerly and easterly changes in elevation. Soils to the east are generally clayier, with sandier soil to the west: clayier soils are generally present below 35m AOD in the A1 and A2 site areas. The clay content of the soil may have had an influence upon the degree of fertility and water retention. The clayier eastern and lower elevation, soils have a higher water carrying capacity and potentially higher fertility ([**Ref. 7**]; [**Ref. 8]**), and thus may have been preferred for certain types of arable agriculture.

7.1.5. From an archaeological perspective, the local landscape would also have been very different historically from what it is today. The eastern and northern parts of the study area potentially provided easier access to tidal areas of the River Witham valley and Fens that were, until the middle ages, a source of peat and other resources. In the first millennium BC the tidal limit extended as far north as Branston, with sea level also higher at this time. Although the Romans connected the River Witham with Lincoln, the canalisation and drainage of Lincolnshire fens did not finish until much later in the 18th and 19th century and would have led to significant depletion of the peatland resource ([**Ref. 9**]). The patterns of settlement and industry in the area will have been influenced by the local landscape, and so the trend seen in the archaeology for increasing activity in the area from the Medieval period onwards should perhaps be seen together with these environmental changes. The relative wealth of the earlier Roman agricultural landscape is perhaps indicative of a greater access to labour during this period.

7.1.6. Additionally, the less fertile, shallow sandy and gravelly soil deposits in upland areas may have been instead preferred for pastoral grazing activities that would have left lesser marks upon the landscape, particularly in the period before the introduction of enclosure.

# 8. Conclusion and Next Steps

8.1.1. A review of the 2023 geotechnical data has shown a sequence with generally shallow superficial deposits and therefore apparently limited potential for deeply buried deposits of archaeological significance. The caveat of this assessment is that the distance between boreholes and trial pits means that it is not yet possible to fully confirm whether the absence of archaeological features noted to the west in the geophysics is due to the superficial geology obscuring such deposits, or whether these deposits are genuinely absent from this area of the scheme.

8.1.2. It is proposed that the next steps of the project involve:

- A re-evaluation the preliminary geophysical data, taking into consideration the trends identified in this report, in order to assess the archaeological potential of the Site areas.
- To identify the need and scope for further purposive geoarchaeological boreholes and test pits to evaluate deposits across the study area to clarify the nature of the sub-surface environment.
- Assess anomalous areas with further purposive geoarchaeological boreholes and test pits to clarify site formation processes, in particular the superficial geology – bedrock geology horizon which produced significant voids in the current phase of GI works.

8.1.3. It would also be of potential palaeoenvironmental interest to retrieve samples from the suspected glaciolacustrine deposits in BH15 and BH08.

# 9. References


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- **Ref. 5:** Gibson SM, Bateman MD, Murton JB, Barrows TT, Fifield LK & Gibbard PL (2022) Timing and dynamics of Late Wolstonian Substage 'Moreton Stadial' (MIS 6) glaciation in the English West Midlands, UK Royal Society. open sci. 9:220312. 220312. Available online: https://doi.org/10.1098/rsos.220312 Accessed 10/09/2024
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- **Ref. 7:** Newman ACD (1984) The significance of clays in agriculture and soils. Philosophical Transactions of the Royal Society of London Series A, Mathematical and Physical Sciences. (311):375–389
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# Annex 1: Borehole/ Trial Pit Locations

# Geoarchaeological Deposit Modelling Report

# Annex 1: Borehole/ Trial Pit Locations

| Borehole | Transect | Easting | Northing | Elevation | Total depth |
|---|---|---|---|---|---|
| **BH01** | 1 | 507708.1 | 360396.2 | 11.91 | 6.3 |
| **BH08** | 1 | 507011.5 | 359462.5 | 18.83 | 6 |
| **BH15** | 1, 2 | 506985.5 | 358852.7 | 22.87 | 6 |
| **BH16A** | 2 | 507551.6 | 358952.8 | 17.76 | 6 |
| **BH17** | 2 | 508024.5 | 358960.1 | 12.63 | 6.1 |
| **BH18** | 2 | 508749.5 | 359051.9 | 11.22 | 6.9 |
| **BH19** | 2 | 509010.6 | 359251.7 | 7.64 | 6 |
| **BH26** | 1 | 506590.7 | 358150 | 20.29 | 6 |
| **BH34** | 1 | 506067.7 | 357130.1 | 28.38 | 6 |
| **BH39** | 1 | 505779.9 | 356673.3 | 29.23 | 6.1 |
| **BH42** | 3 | 505412.6 | 356164.4 | 33.47 | 6 |
| **BH44** | 1, 3 | 504695.4 | 355940.1 | 31.06 | 6 |
| **BH49** | 3 | 503940.6 | 356354.3 | 35.51 | 6 |
| **BH52** | 3 | 504073.9 | 356080.8 | 34.8 | 6 |
| **BH57** | 3 | 501640.6 | 356349.5 | 47.68 | 6 |
| **BH61** | 4 | 502633.6 | 355236.1 | 47.53 | 6.5 |
| **BH62** | 4 | 502074.8 | 355127.5 | 52.47 | 6.5 |
| **BH64** | 4 | 503023.3 | 355093.4 | 43.9 | 6.2 |
| **BH66** | 1, 4 | 503374.2 | 354614.7 | 39 | 6 |
| **BH69** | 4 | 504484.5 | 354297.5 | 26.25 | 6 |
| **BH71** | 4 | 503471.8 | 354321.1 | 34.03 | 6 |
| **BH72** | 1 | 502963.4 | 354242.4 | 39.89 | 6 |

| Borehole | Transect | Easting | Northing | Elevation | Total depth |
|---|---|---|---|---|---|
| **BH80** | 1, 5 | 502538.1 | 353430.6 | 41.98 | 6.8 |
| **BH82** | 5 | 504167.8 | 353340.1 | 31.04 | 6.2 |
| **BH84** | 5 | 503404.9 | 353141 | 38.27 | 6 |
| **BH85** | 5 | 503028.2 | 353136.1 | 42.89 | 6 |
| **TP045** | 3 | 506040.7 | 355942.3 | 26.9 | 1 |
| **TP046** | 3 | 505915.4 | 355727.9 | 32.7 | 3 |
| **TP047** | 3 | 505563.2 | 355960.3 | 31.3 | 0.95 |
| **TP056** | 3 | 502313.4 | 356554.1 | 40.13 | 1.5 |
| **TP063** | 1 | 503584.4 | 354926 | 37.77 | 1.6 |
| **TP067** | 4 | 504676.6 | 354508.6 | 24.21 | 3 |
| **TP070** | 4 | 504199 | 354290.3 | 31.15 | 1.7 |
| **TP081** | 5 | 504771.7 | 353331.2 | 27.74 | 1.4 |
| **TP083** | 5 | 503938.7 | 353054 | 35.07 | 1.5 |
| **TP086** | 5 | 503564.3 | 352939.8 | 36.65 | 1.6 |

# Annex 2: Lithology Deposit Data (adapted from GI Report: Central Alliance, 2023 [Ref. 1])

# Geoarchaeological Deposit Modelling Report

# Annex 2: Lithology Deposit Data (adapted from GI Report: Central Alliance, 2023 [**Ref. 1**])

| Borehole | Depth1 | Depth2 | Keyword |
|---|---|---|---|
| **BH01** | 0 | 0.5 | Sandy Clay |
| **BH01** | 0.5 | 1.2 | Gravelly Clay |
| **BH01** | 1.2 | 1.8 | Sandy Clay |
| **BH01** | 1.8 | 3.15 | Void |
| **BH01** | 3.15 | 3.3 | Gravel |
| **BH01** | 3.3 | 6.3 | Bedrock |
| **BH08** | 0 | 0.3 | Sandy Clay |
| **BH08** | 0.3 | 1.2 | Sandy Clay |
| **BH08** | 1.2 | 2 | Sandy Clay |
| **BH08** | 2 | 3.1 | Sandy Clay |
| **BH08** | 3.1 | 3.3 | Bedrock |
| **BH08** | 3.3 | 3.7 | Sandy Clay |
| **BH08** | 3.7 | 4.7 | Bedrock |
| **BH08** | 4.7 | 6 | Sandy Clay |
| **BH15** | 0 | 0.4 | Sandy Clay |
| **BH15** | 0.4 | 0.7 | Sandy Clay |
| **BH15** | 0.7 | 1.2 | Sandy Clay |
| **BH15** | 1.2 | 2.7 | Sandy Clay |
| **BH15** | 2.7 | 4 | Sandy Clay |
| **BH15** | 4 | 4.6 | Clay |
| **BH15** | 4.6 | 5.1 | Clay |
| **BH15** | 5.1 | 6 | Clay |
| **BH16A** | 0 | 0.3 | Gravelly Clay |
| **BH16A** | 0.3 | 1.2 | Gravelly Clay |
| **BH16A** | 1.2 | 2.12 | Void |
| **BH16A** | 2.12 | 2.49 | Gravelly Clay |
| **BH16A** | 2.49 | 2.7 | Sandy Clay |
| **BH16A** | 2.7 | 3.5 | Clayey Sand |
| **BH16A** | 3.5 | 4.9 | Bedrock |
| **BH16A** | 4.9 | 6 | Bedrock |
| **BH17** | 0 | 0.2 | Gravelly Clay |
| **BH17** | 0.2 | 1.2 | Gravelly Clay |
| **BH17** | 1.2 | 1.7 | Void |
| **BH17** | 1.7 | 2.19 | Clay |
| **BH17** | 2.19 | 5 | Bedrock |
| **BH17** | 5 | 6.1 | Bedrock |

| Borehole | Depth1 | Depth2 | Keyword |
|---|---|---|---|
| **BH18** | 0 | 0.3 | Gravelly Sand |
| **BH18** | 0.3 | 1.2 | Clayey Sand |
| **BH18** | 1.2 | 4 | Sand |
| **BH18** | 4 | 5.65 | Void |
| **BH18** | 5.65 | 6.9 | Clay |
| **BH19** | 0 | 0.3 | Sandy Clay |
| **BH19** | 0.3 | 1.2 | Sandy Clay |
| **BH19** | 1.2 | 1.7 | Clay |
| **BH19** | 1.7 | 2 | Sand |
| **BH19** | 2 | 3.5 | Sandy Clay |
| **BH19** | 3.5 | 4.2 | Sand |
| **BH19** | 4.2 | 4.5 | Bedrock |
| **BH19** | 4.5 | 6 | Sand |
| **BH26** | 0 | 0.3 | Gravelly Sand |
| **BH26** | 0.3 | 1.2 | Sandy Gravel |
| **BH26** | 1.2 | 1.8 | Sandy Gravel |
| **BH26** | 1.8 | 2.48 | Void |
| **BH26** | 2.48 | 2.79 | Gravel |
| **BH26** | 2.79 | 6 | Bedrock |
| **BH34** | 0 | 0.4 | Gravelly Sand |
| **BH34** | 0.4 | 1.65 | Void |
| **BH34** | 1.65 | 2.62 | Gravel |
| **BH34** | 2.62 | 3.6 | Bedrock |
| **BH34** | 3.6 | 4.45 | Gravel |
| **BH34** | 4.45 | 6 | Bedrock |
| **BH39** | 0 | 0.5 | Clayey Sand |
| **BH39** | 0.5 | 0.9 | Clayey Gravel |
| **BH39** | 0.9 | 1.2 | Void |
| **BH39** | 1.2 | 1.6 | Gravel |
| **BH39** | 1.6 | 2 | Void |
| **BH39** | 2 | 2.2 | Bedrock |
| **BH39** | 2.2 | 2.46 | Gravel |
| **BH39** | 2.46 | 4.27 | Bedrock |
| **BH39** | 4.27 | 5.35 | Gravel |
| **BH39** | 5.35 | 5.68 | Bedrock |
| **BH39** | 5.68 | 6.1 | Gravel |
| **BH42** | 0 | 0.3 | Clayey Sand |
| **BH42** | 0.3 | 1.2 | Gravelly Sand |
| **BH42** | 1.2 | 1.65 | Void |

| Borehole | Depth1 | Depth2 | Keyword |
|---|---|---|---|
| **BH42** | 1.65 | 2.65 | Gravelly Sand |
| **BH42** | 2.65 | 2.8 | Gravel |
| **BH42** | 2.8 | 6 | Bedrock |
| **BH44** | 0 | 0.3 | Sandy Gravel |
| **BH44** | 0.3 | 1.1 | Sandy Gravel |
| **BH44** | 1.1 | 1.2 | Gravelly Sand |
| **BH44** | 1.2 | 1.9 | Void |
| **BH44** | 1.9 | 2.26 | Gravel |
| **BH44** | 2.26 | 2.64 | Bedrock |
| **BH44** | 2.64 | 2.84 | Gravel |
| **BH44** | 2.84 | 4.2 | Bedrock |
| **BH44** | 4.2 | 4.6 | Gravel |
| **BH44** | 4.6 | 6 | Bedrock |
| **BH49** | 0 | 0.3 | Gravelly Sand |
| **BH49** | 0.3 | 0.6 | Sandy Gravel |
| **BH49** | 0.6 | 1.2 | Sandy Gravel |
| **BH49** | 1.2 | 2 | Void |
| **BH49** | 2 | 6 | Bedrock |
| **BH52** | 0 | 0.3 | Gravelly Sand |
| **BH52** | 0.3 | 1.2 | Sandy Gravel |
| **BH52** | 1.2 | 1.9 | Void |
| **BH52** | 1.9 | 2.2 | Sandy Gravel |
| **BH52** | 2.2 | 2.5 | Bedrock |
| **BH52** | 2.5 | 2.7 | Void |
| **BH52** | 2.7 | 3.1 | Sand |
| **BH52** | 3.1 | 3.33 | Bedrock |
| **BH52** | 3.33 | 4.06 | Bedrock |
| **BH52** | 4.06 | 6 | Bedrock |
| **BH57** | 0 | 0.3 | Gravelly Sand |
| **BH57** | 0.3 | 0.5 | Gravelly Sand |
| **BH57** | 0.5 | 1 | Void |
| **BH57** | 1 | 1.5 | Gravel |
| **BH57** | 1.5 | 3.5 | Bedrock |
| **BH57** | 3.5 | 5 | Bedrock |
| **BH57** | 5 | 6 | Bedrock |
| **BH61** | 0 | 0.4 | Clayey Sand |
| **BH61** | 0.8 | 1.2 | Gravelly Sand |
| **BH61** | 1.2 | 2.02 | Void |
| **BH61** | 2.02 | 2.5 | Gravel |

| Borehole | Depth1 | Depth2 | Keyword |
|---|---|---|---|
| **BH61** | 2.5 | 2.7 | Void |
| **BH61** | 2.7 | 3.63 | Bedrock |
| **BH61** | 3.63 | 4 | Bedrock |
| **BH61** | 4 | 4.5 | Void |
| **BH61** | 4.5 | 5.5 | Bedrock |
| **BH61** | 5.5 | 6.02 | Void |
| **BH61** | 6.02 | 6.12 | Bedrock |
| **BH61** | 6.12 | 6.5 | Void |
| **BH62** | 0 | 0.4 | Clayey Sand |
| **BH62** | 0.4 | 1.2 | Gravelly Sand |
| **BH62** | 1.2 | 1.4 | Void |
| **BH62** | 1.4 | 2.15 | Silty Gravel |
| **BH62** | 2.15 | 3.57 | Bedrock |
| **BH62** | 3.57 | 4.85 | Weathered Bedrock |
| **BH62** | 4.85 | 6.5 | Bedrock |
| **BH64** | 0 | 0.4 | Clayey Sand |
| **BH64** | 0.4 | 0.9 | Gravelly Sand |
| **BH64** | 0.9 | 1.2 | Sandy Gravel |
| **BH64** | 1.2 | 1.8 | Void |
| **BH64** | 1.8 | 2.1 | Gravel |
| **BH64** | 2.1 | 2.56 | Bedrock |
| **BH64** | 2.56 | 4.15 | Bedrock |
| **BH64** | 4.15 | 4.38 | Silty Clay |
| **BH64** | 4.38 | 4.63 | Bedrock |
| **BH64** | 4.63 | 6.2 | Bedrock |
| **BH66** | 0 | 0.5 | Clayey Sand |
| **BH66** | 0.5 | 1.2 | Gravelly Sand |
| **BH66** | 1.2 | 2.05 | Void |
| **BH66** | 2.05 | 2.7 | Gravel |
| **BH66** | 2.7 | 3.4 | Bedrock |
| **BH66** | 3.4 | 3.7 | Bedrock |
| **BH66** | 3.7 | 6 | Bedrock |
| **BH69** | 0 | 0.5 | Sandy Clay |
| **BH69** | 0.5 | 1.2 | Gravelly Sand |
| **BH69** | 1.2 | 1.7 | Silty Clay |
| **BH69** | 1.7 | 2.13 | Void |
| **BH69** | 2.13 | 2.3 | Silty Clay |
| **BH69** | 2.3 | 4.2 | Bedrock |
| **BH69** | 4.2 | 4.35 | Gravel |

| Borehole | Depth1 | Depth2 | Keyword |
|---|---|---|---|
| **BH69** | 4.35 | 4.5 | Bedrock |
| **BH69** | 4.5 | 5.07 | Void |
| **BH69** | 5.07 | 6 | Bedrock |
| **BH71** | 0 | 0.2 | Gravelly Sand |
| **BH71** | 0.2 | 0.4 | Sandy Gravel |
| **BH71** | 0.4 | 1.24 | Void |
| **BH71** | 1.24 | 1.4 | Gravel |
| **BH71** | 1.4 | 1.6 | Void |
| **BH71** | 1.6 | 1.8 | Gravel |
| **BH71** | 1.8 | 6 | Bedrock |
| **BH72** | 0 | 0.3 | Made Ground |
| **BH72** | 0.3 | 1.2 | Made Ground |
| **BH72** | 1.2 | 2.2 | Made Ground - Archaeological Potential |
| **BH72** | 2.2 | 2.94 | Gravel |
| **BH72** | 2.94 | 6 | Bedrock |
| **BH80** | 0 | 0.5 | Clayey Sand |
| **BH80** | 0.5 | 0.8 | Sandy Gravel |
| **BH80** | 0.8 | 1.6 | Void |
| **BH80** | 1.6 | 1.9 | Weathered Bedrock |
| **BH80** | 1.9 | 2.3 | Bedrock |
| **BH80** | 2.3 | 3.3 | Bedrock |
| **BH80** | 3.3 | 3.7 | Bedrock |
| **BH80** | 3.7 | 6.8 | Bedrock |
| **BH82** | 0 | 0.4 | Sandy Clay |
| **BH82** | 0.4 | 0.6 | Sandy Gravel |
| **BH82** | 0.6 | 1.1 | Gravel |
| **BH82** | 1.1 | 1.7 | Void |
| **BH82** | 1.7 | 6.2 | Bedrock |
| **BH84** | 0 | 0.5 | Clayey Sand |
| **BH84** | 0.5 | 0.8 | Gravelly Sand |
| **BH84** | 0.8 | 1.3 | Sandy Gravel |
| **BH84** | 1.3 | 1.6 | Void |
| **BH84** | 1.6 | 1.8 | Gravel |
| **BH84** | 1.8 | 2 | Bedrock |
| **BH84** | 2 | 2.36 | Void |
| **BH84** | 2.36 | 3.56 | Bedrock |
| **BH84** | 3.56 | 3.91 | Bedrock |
| **BH84** | 3.91 | 6 | Bedrock |
| **BH85** | 0 | 0.5 | Clayey Sand |

| Borehole | Depth1 | Depth2 | Keyword |
|---|---|---|---|
| **BH85** | 0.5 | 1 | Sand |
| **BH85** | 1 | 1.2 | Gravelly Sand |
| **BH85** | 1.2 | 1.7 | Sandy Gravel |
| **BH85** | 1.7 | 6 | Bedrock |
| **TP045** | 0 | 0.3 | Sandy Clay |
| **TP045** | 0.3 | 1 | Sandy Clay |
| **TP046** | 0 | 0.5 | Sandy Clay |
| **TP046** | 0.5 | 1.4 | Gravelly Clay |
| **TP046** | 1.4 | 1.8 | Gravelly Clay |
| **TP046** | 1.8 | 2 | Gravelly Clay |
| **TP046** | 2 | 2.4 | Gravelly Clay |
| **TP046** | 2.4 | 3 | Clayey Gravel |
| **TP047** | 0 | 0.4 | Sandy Clay |
| **TP047** | 0.4 | 0.6 | Gravelly Clay |
| **TP047** | 0.6 | 0.95 | Clayey Gravel |
| **TP056** | 0 | 0.5 | Clayey Sand |
| **TP056** | 0.5 | 1.7 | Gravelly Sand |
| **TP056** | 1.7 | 1.8 | Sandy Gravel |
| **TP063** | 0 | 0.4 | Gravelly Sand |
| **TP063** | 0.4 | 1.6 | Gravelly Sand |
| **TP067** | 0 | 0.1 | Clay |
| **TP067** | 0.1 | 0.8 | Sandy Clay |
| **TP067** | 0.8 | 2.6 | Sandy Clay |
| **TP067** | 2.6 | 3 | Sandy Clay |
| **TP070** | 0 | 0.4 | Sandy Clay |
| **TP070** | 0.4 | 1.7 | Gravelly Sand |
| **TP081** | 0 | 0.3 | Sandy Clay |
| **TP081** | 0.3 | 1.4 | Silty Clay |
| **TP083** | 0 | 0.3 | Sandy Clay |
| **TP083** | 0.3 | 1.5 | Gravelly Sand |
| **TP086** | 0 | 0.4 | Clayey Sand |
| **TP086** | 0.4 | 0.7 | Gravelly Sand |
| **TP086** | 0.7 | 1.5 | Sandy Gravel |
| **TP086** | 1.5 | 1.6 | Gravel |

# Annex 3: Stratigraphy deposit model

# Geoarchaeological Deposit Modelling Report

# Annex 3: Stratigraphy deposit model

| Borehole | Depth1 | Depth2 | Formation |
|---|---|---|---|
| **BH01** | 0 | 0.5 | Topsoil |
| **BH01** | 0.5 | 1.8 | Tidal Flat Deposit |
| **BH01** | 1.8 | 3.3 | Blisworth Limestone Formation: (Jn) |
| **BH01** | 3.3 | 6.3 | Rutland Formation: (Jb-Jn) |
| **BH08** | 0 | 0.3 | Topsoil |
| **BH08** | 0.3 | 2 | Tidal Flat Deposit |
| **BH08** | 2 | 3.1 | Glaciolacustrine Deposit |
| **BH08** | 3.1 | 6 | Rutland Formation: (Jb-Jn) |
| **BH15** | 0 | 0.4 | Topsoil |
| **BH15** | 0.4 | 1.2 | Tidal Flat Deposit |
| **BH15** | 1.2 | 4 | Till |
| **BH15** | 4 | 6 | Glaciolacustrine Deposit |
| **BH16A** | 0 | 0.3 | Topsoil |
| **BH16A** | 0.3 | 0.3 | Tidal Flat Deposit |
| **BH16A** | 0.3 | 1.2 | Till |
| **BH16A** | 1.2 | 2.49 | Blisworth Clay Formation: (Jn) |
| **BH16A** | 2.49 | 3.5 | Blisworth Limestone Formation: (Jn) |
| **BH16A** | 3.5 | 6 | Rutland Formation: (Jb-Jn) |
| **BH17** | 0 | 0.2 | Topsoil |
| **BH17** | 0.2 | 1.2 | Tidal Flat Deposit |
| **BH17** | 1.2 | 2.19 | Blisworth Limestone Formation: (Jn) |
| **BH17** | 2.19 | 6.1 | Rutland Formation: (Jb-Jn) |
| **BH18** | 0 | 0.3 | Topsoil |
| **BH18** | 0.3 | 0.3 | Tidal Flat Deposit |
| **BH18** | 0.3 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH18** | 1.2 | 4.83 | Kellaways Clay Member: (Jc) |
| **BH18** | 4.83 | 6.9 | Cornbrash Formation: (Jn-Jc) |
| **BH19** | 0 | 0.3 | Topsoil |
| **BH19** | 0.3 | 1.7 | Tidal Flat Deposit |
| **BH19** | 1.7 | 2 | Sand And Gravel Superficial Deposit |
| **BH19** | 2 | 4.2 | Kellaways Clay Member: (Jc) |
| **BH19** | 4.2 | 6 | Cornbrash Formation: (Jn-Jc) |
| **BH26** | 0 | 0.3 | Topsoil |
| **BH26** | 0.3 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH26** | 1.2 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH34** | 0 | 0.4 | Topsoil |
| **BH34** | 0.4 | 0.5 | Sand And Gravel Superficial Deposit |

| Borehole | Depth1 | Depth2 | Formation |
|---|---|---|---|
| **BH34** | 0.5 | 2.62 | Blisworth Limestone Formation: (Jn) |
| **BH34** | 2.62 | 6 | Rutland Formation: (Jb-Jn) |
| **BH39** | 0 | 0.5 | Topsoil |
| **BH39** | 0.5 | 0.9 | Sand And Gravel Superficial Deposit |
| **BH39** | 1.2 | 2.2 | Blisworth Limestone Formation: (Jn) |
| **BH39** | 2.2 | 5.68 | Rutland Formation: (Jb-Jn) |
| **BH39** | 5.68 | 6.1 | Stamford Member: (Jb-Jn) |
| **BH39** | 6.1 | 6.1 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH42** | 0 | 0.3 | Topsoil |
| **BH42** | 0.3 | 2.65 | Sand And Gravel Superficial Deposit |
| **BH42** | 2.65 | 2.8 | Blisworth Limestone Formation: (Jn) |
| **BH42** | 2.8 | 6 | Rutland Formation: (Jb-Jn) |
| **BH44** | 0 | 0.3 | Topsoil |
| **BH44** | 0.3 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH44** | 1.2 | 1.9 | Stamford Member: (Jb-Jn) |
| **BH44** | 1.9 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH49** | 0 | 0.3 | Topsoil |
| **BH49** | 0.3 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH49** | 1.2 | 2 | Stamford Member: (Jb-Jn) |
| **BH49** | 2 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH52** | 0 | 0.3 | Topsoil |
| **BH52** | 0.3 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH52** | 1.2 | 1.9 | Stamford Member: (Jb-Jn) |
| **BH52** | 1.9 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH57** | 0 | 0.3 | Topsoil |
| **BH57** | 0.3 | 0.5 | Sand And Gravel Superficial Deposit |
| **BH57** | 0.5 | 1 | Stamford Member: (Jb-Jn) |
| **BH57** | 1 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH61** | 0 | 0.4 | Topsoil |
| **BH61** | 0.4 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH61** | 1.2 | 3.63 | Stamford Member: (Jb-Jn) |
| **BH61** | 3.63 | 6.5 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH62** | 0 | 0.4 | Topsoil |
| **BH62** | 0.4 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH62** | 1.2 | 1.4 | Stamford Member: (Jb-Jn) |
| **BH62** | 1.4 | 6.5 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH64** | 0 | 0.4 | Topsoil |
| **BH64** | 0.4 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH64** | 1.2 | 2.56 | Stamford Member: (Jb-Jn) |

| Borehole | Depth1 | Depth2 | Formation |
|---|---|---|---|
| **BH64** | 2.56 | 6.2 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH66** | 0 | 0.5 | Topsoil |
| **BH66** | 0.5 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH66** | 1.2 | 2.05 | Stamford Member: (Jb-Jn) |
| **BH66** | 2.05 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH69** | 0 | 0.5 | Topsoil |
| **BH69** | 0.5 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH69** | 1.2 | 1.7 | Till |
| **BH69** | 1.7 | 6 | Stamford Member: (Jb-Jn) |
| **BH71** | 0 | 0.2 | Topsoil |
| **BH71** | 0.2 | 0.4 | Sand And Gravel Superficial Deposit |
| **BH71** | 0.4 | 1.24 | Stamford Member: (Jb-Jn) |
| **BH71** | 1.24 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH72** | 0 | 1.2 | Made Ground |
| **BH72** | 1.2 | 2.2 | Made Ground - Archaeological Potential |
| **BH72** | 2.2 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH80** | 0 | 0.5 | Topsoil |
| **BH80** | 0.5 | 0.8 | Sand And Gravel Superficial Deposit |
| **BH80** | 0.8 | 6.8 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH80** | 6.8 | 6.8 | Lower Lincolnshire Limestone Member: (Jb) |
| **BH82** | 0 | 0.4 | Topsoil |
| **BH82** | 0.4 | 0.6 | Head |
| **BH82** | 0.6 | 6.2 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH84** | 0 | 0.5 | Topsoil |
| **BH84** | 0.5 | 1.3 | Sand And Gravel Superficial Deposit |
| **BH84** | 1.3 | 6 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH84** | 6 | 6 | Lower Lincolnshire Limestone Member: (Jb) |
| **BH85** | 0 | 0.5 | Topsoil |
| **BH85** | 0.5 | 1 | Blown Sand |
| **BH85** | 1 | 1.2 | Sand And Gravel Superficial Deposit |
| **BH85** | 1.2 | 1.7 | Upper Lincolnshire Limestone Member: (Jb) |
| **BH85** | 1.7 | 6 | Lower Lincolnshire Limestone Member: (Jb) |
| **TP045** | 0 | 0.3 | Topsoil |
| **TP045** | 0.3 | 1 | Glaciofluvial Deposit |
| **TP046** | 0 | 0.5 | Topsoil |
| **TP046** | 0.5 | 3 | Blisworth Clay Formation: (Jn) |
| **TP047** | 0 | 0.4 | Topsoil |
| **TP047** | 0.4 | 0.95 | Glaciofluvial Deposit |
| **TP056** | 0 | 0.5 | Topsoil |

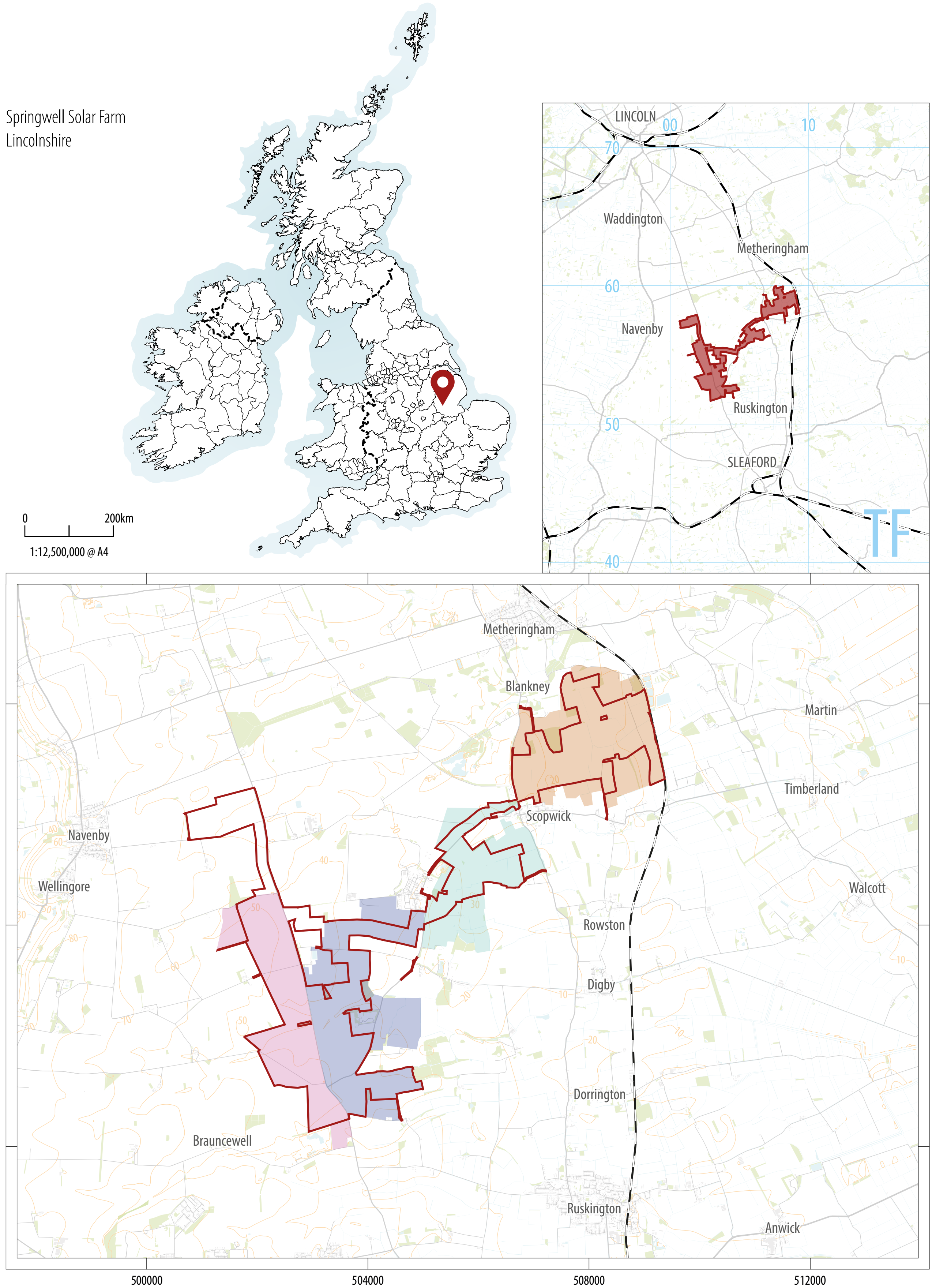
| Borehole | Depth1 | Depth2 | Formation |
|---|---|---|---|
| **TP056** | 0.5 | 1.8 | Sand And Gravel Superficial Deposit |
| **TP056** | 1.8 | 1.8 | Stamford Member: (Jb-Jn) |
| **TP056** | 1.8 | 1.8 | Upper Lincolnshire Limestone Member: (Jb) |
| **TP063** | 0 | 0.4 | Topsoil |
| **TP063** | 0.4 | 1.6 | Sand And Gravel Superficial Deposit |
| **TP067** | 0 | 0.1 | Topsoil |
| **TP067** | 0.1 | 0.1 | Sand And Gravel Superficial Deposit |
| **TP067** | 0.1 | 3 | Till |
| **TP070** | 0 | 0.4 | Topsoil |
| **TP070** | 0.4 | 1.7 | Sand And Gravel Superficial Deposit |
| **TP070** | 1.7 | 1.7 | Stamford Member: (Jb-Jn) |
| **TP081** | 0 | 0.3 | Topsoil |
| **TP081** | 0.3 | 1.4 | Sand And Gravel Superficial Deposit |
| **TP083** | 0 | 0.3 | Topsoil |
| **TP083** | 0.3 | 1.5 | Sand And Gravel Superficial Deposit |
| **TP083** | 1.5 | 1.5 | Upper Lincolnshire Limestone Member: (Jb) |

# Annex 4: Illustrations

# Geoarchaeological Deposit Modelling Report

# Annex 4: Illustrations

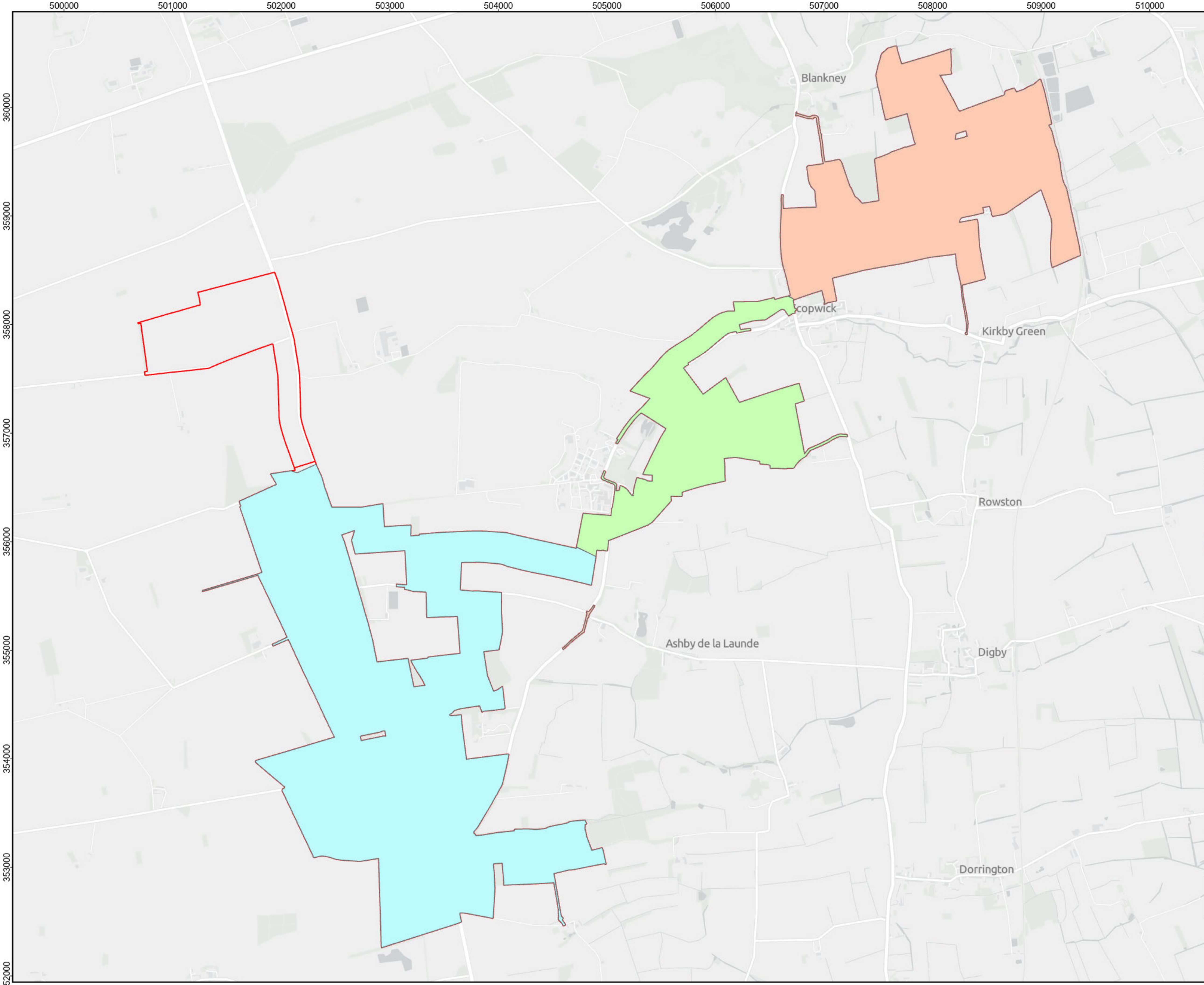
Springwell Solar Farm
Lincolnshire






Headland Archaeology Yorkshire & North
Units 23–25 & 15 | Acorn Business Centre | Balme Road | Cleckheaton BD19[redacted]
[redacted]

**ILLUS 1** Site location




LEGEND:

- Springwell Central
- Springwell East
- Springwell West
- Order Limits

NOTES:

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter


| Rev | Date | Description | Drn | Chk | App |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| 01 | 25/10/2024 | DCO Submission | RSK | RSK | EDF |

**Springwell Solar Farm**

Springwell Solar Farm

DOCUMENT: ENVIRONMENTAL STATEMENT VOLUME 3: APPENDIX 9.2
Regulation 5(2)(a)

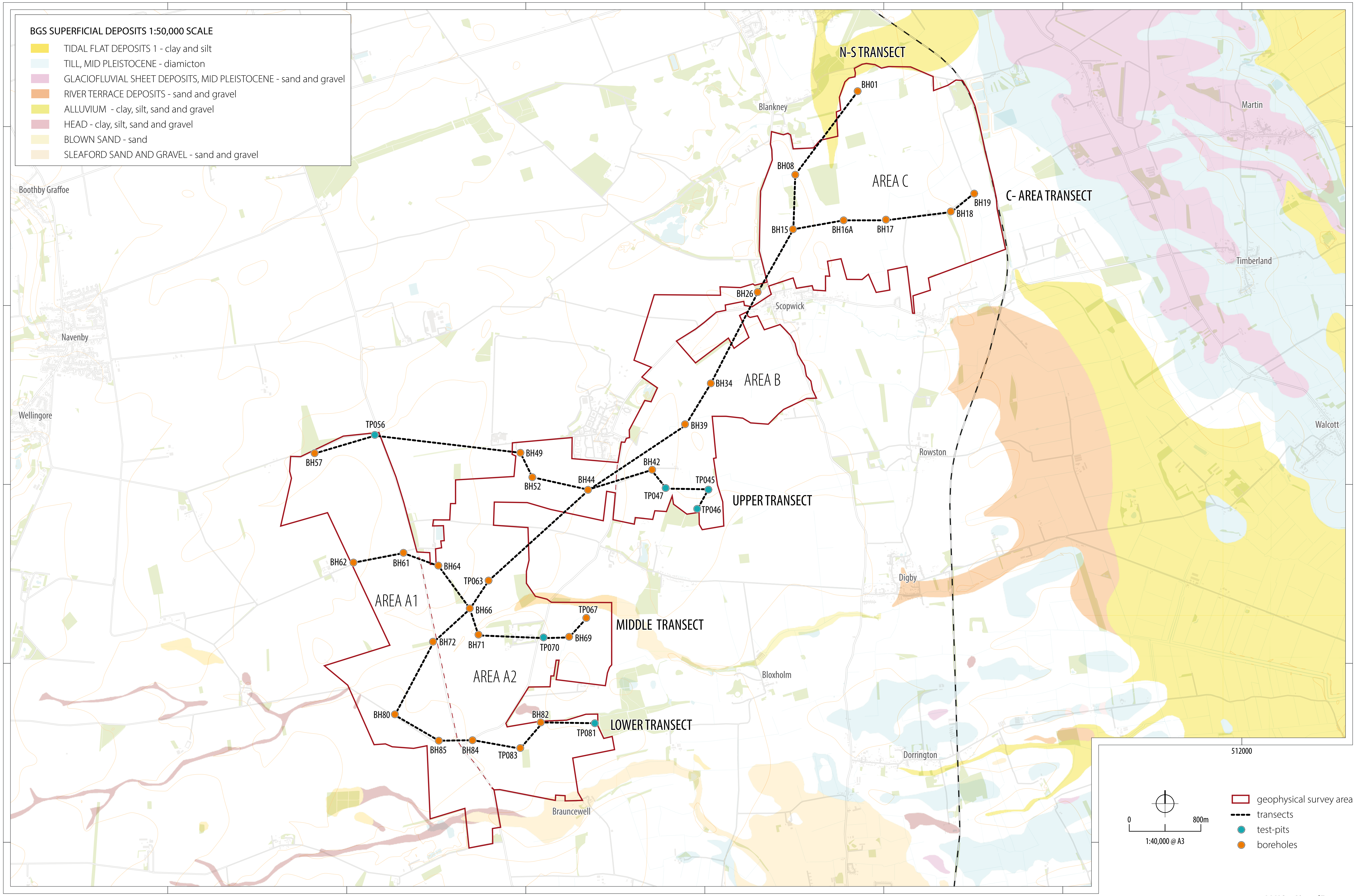
TITLE:
Illustration 2: Area Plan

PINS REFERENCE NUMBER:
EN010149/APP/6.3

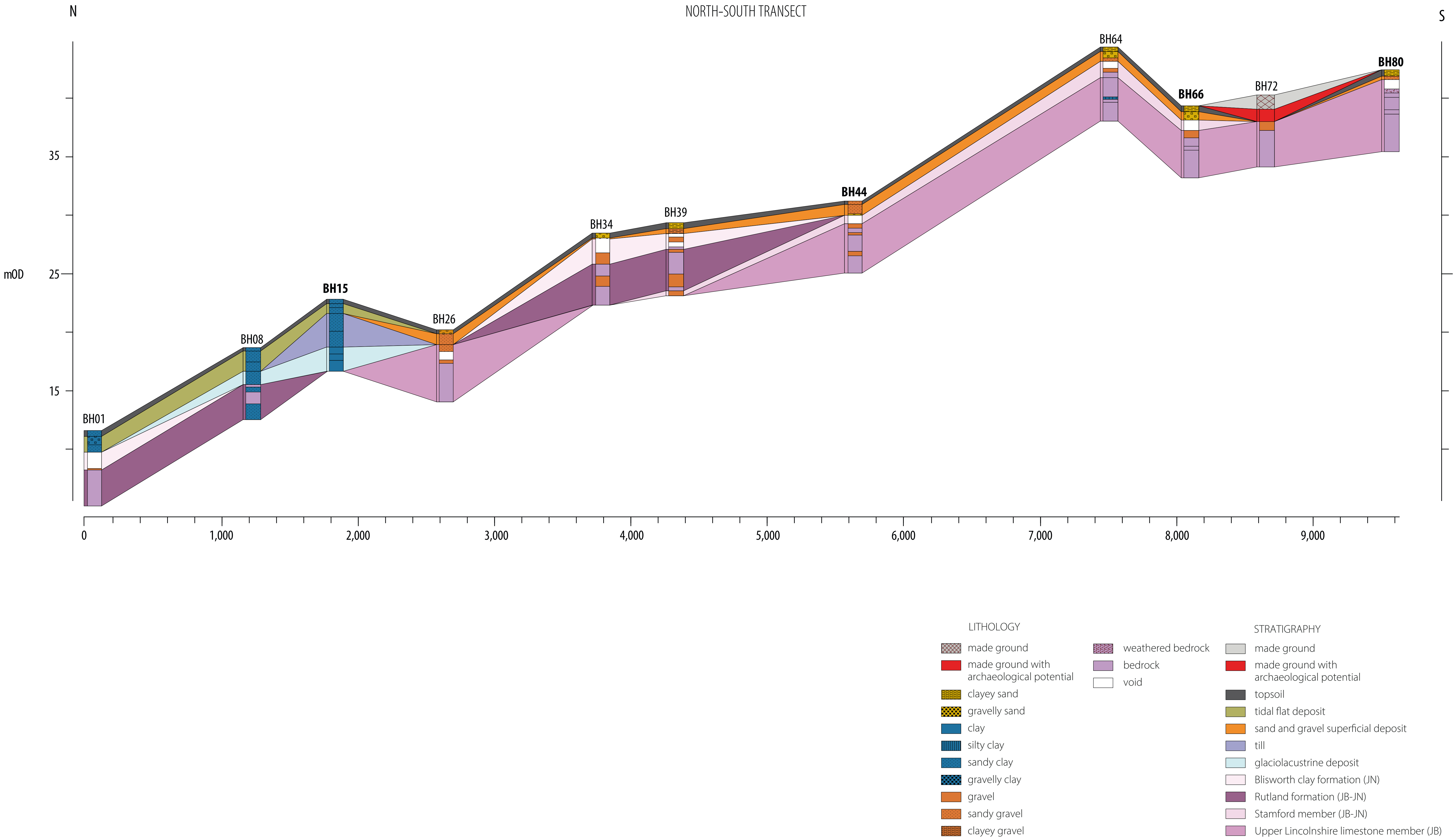
0 0.5 1
Kilometers
Scale: 1:32,500 @ A3

REV 01

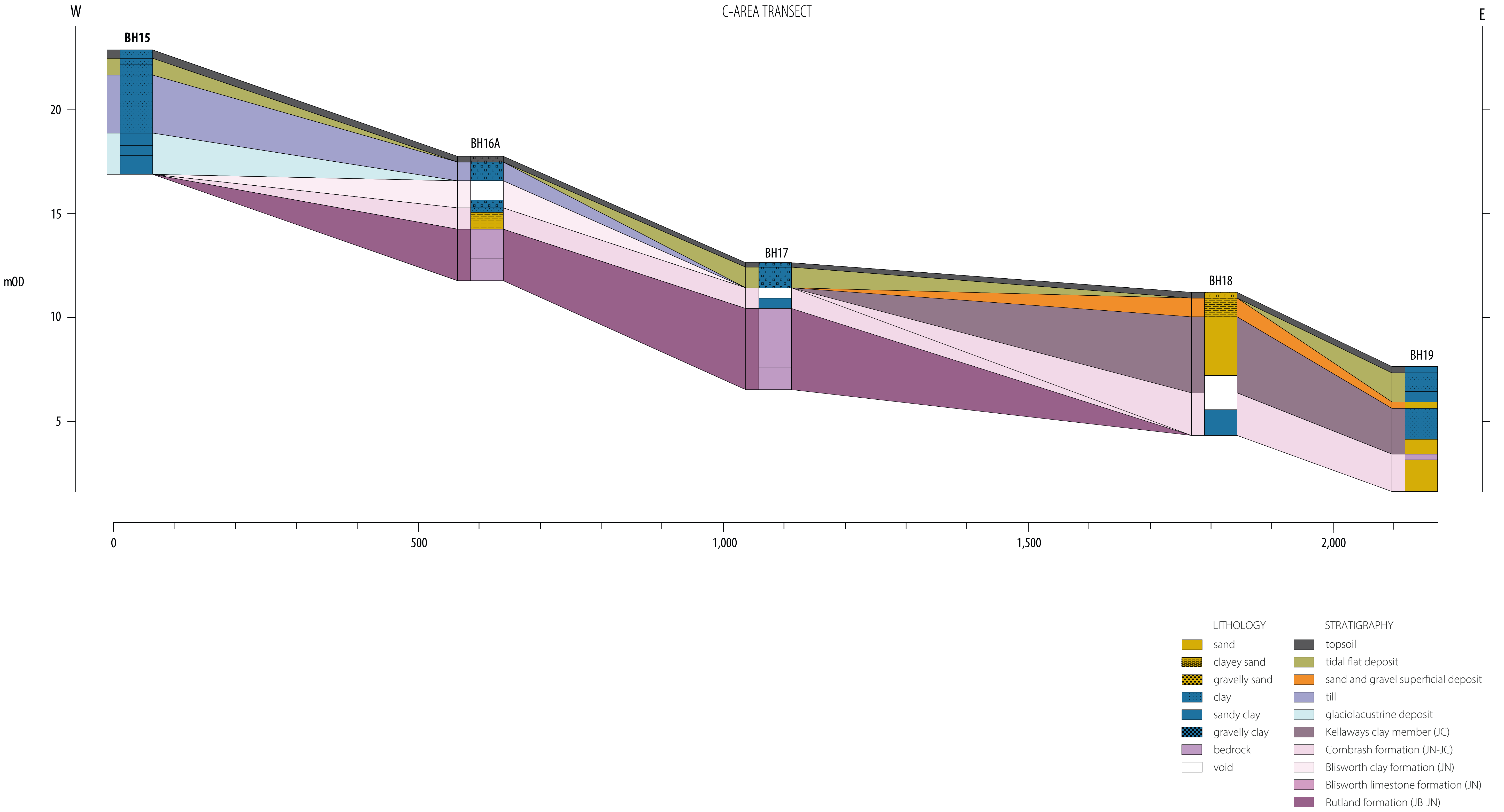
Path: A:\Consultancy\P22-216 Springwell Solar; formerly Acre Lane\10 GIS\04 GIS Project\DCO Submission Template.aprx\DBA Plate 2



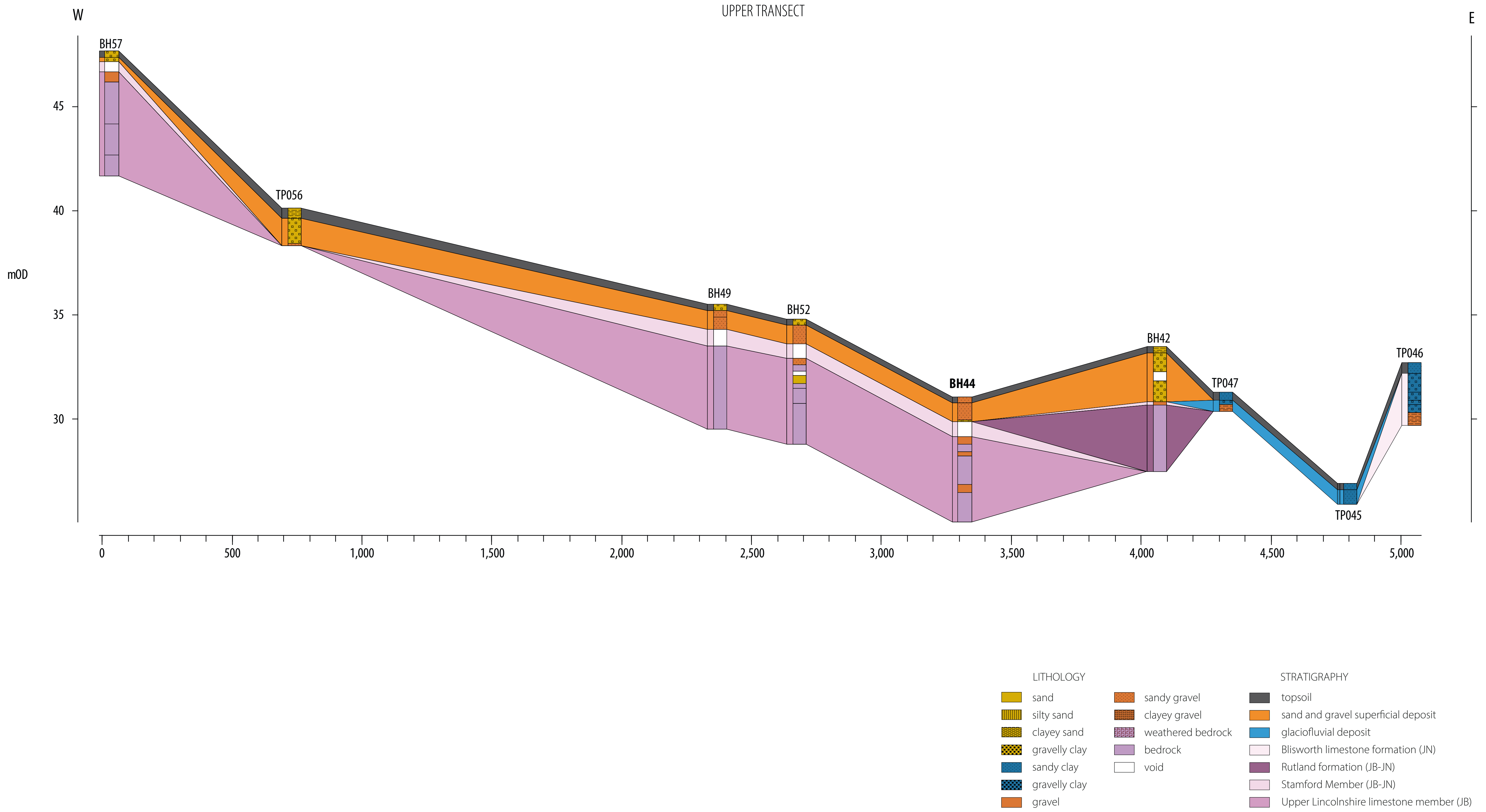

**ILLUS 3** Plan of Transects




**ILLUS 4** Deposit Model Transect 1

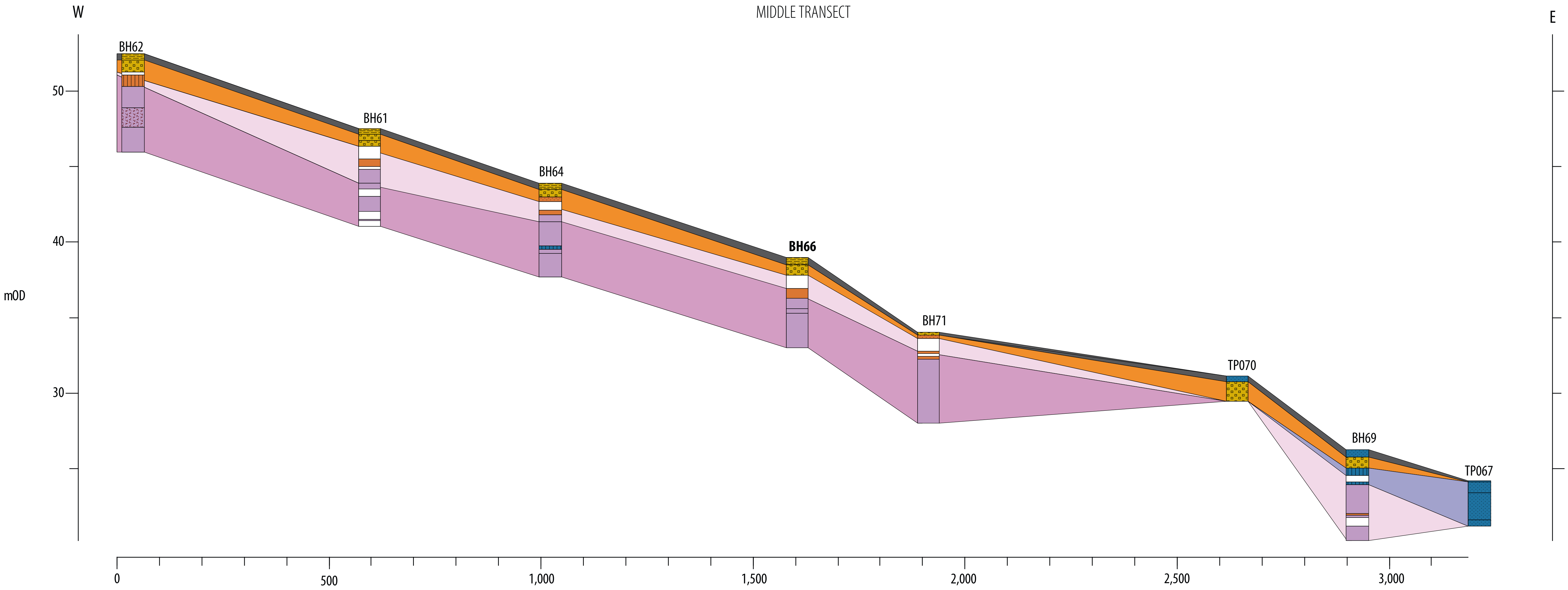


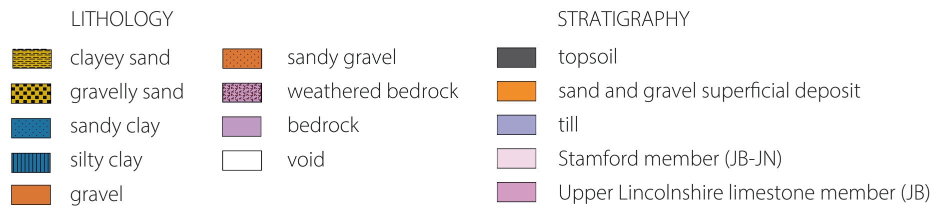

**ILLUS 5** Deposit Model Transect 2



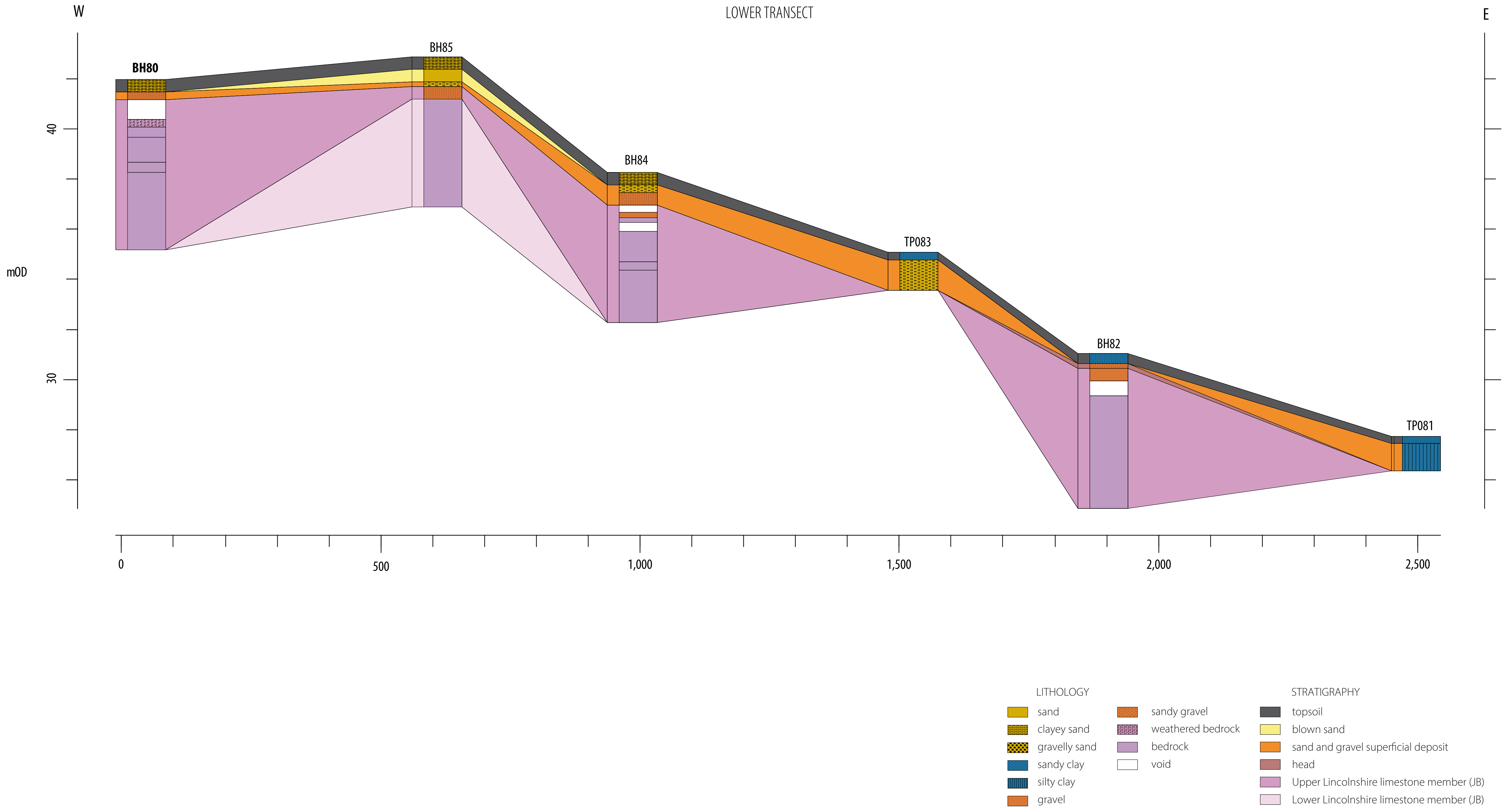



**ILLUS 6** Deposit Model Transect 3




**ILLUS 7** Deposit Model Transect 4




**ILLUS 8** Deposit Model Transect 5

Springwell
Solar Farm

springwellsolarfarm.co.uk

Application Document Ref: EN010149/APP/6.3
Planning Inspectorate Scheme Ref: EN010149