REPORT

Boston Alternative Energy Facility

Geoarchaeological Borehole Survey

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1 Introduction

1.1.1 Following receipt of relevant representations from Lincolnshire County Council (LCC) (RR-014) and Historic England (RR-027), a programme of targeted geoarchaeological investigation was planned in order to further inform the understanding of sub-surface deposits and the potential for buried archaeological and paleoenvironmental remains. The work was undertaken by Wessex Archaeology in October 2021 and comprised three boreholes at locations agreed in advance with heritage stakeholders (Historic England and the historic environment advisors to LCC and Boston Borough Council) via a work package specific Written Scheme of Investigation (WSI). The Outline WSI (document reference 7.3, REP1-011) was also updated and submitted at Deadline 1 of the examination to capture the advice from heritage stakeholders.

1.1.2 The results of the borehole survey and subsequent deposit modelling are set out in the Geoarchaeological Borehole Survey attached as **Appendix A**.

1.1.3 A key objective of the work was to further inform any requirements for trial trenching as part of the wider strategy of archaeological evaluation. Due to the presence of significance depths of alluvium across the site, the placement of trial trenches needs to be carefully planned in order to target features based on all available information to provide the best chance of providing information on potential buried archaeology, rather than just revealing the alluvium.

1.1.4 The results of the borehole survey and subsequent deposit modelling have resulted in an improved understanding of the distribution and geoarchaeological potential of the superficial deposits across the Principal Application Site. These have revealed a sequence of Pleistocene river terrace deposits of the River Witham, overlain by Holocene alluvial deposits which, in places incorporate a peat unit, a lower alluvium with detrital organic inclusions, and a clay-rich upper alluvium, overlain by the modern soil profile or ploughsoil. The alluvium was shown to extend down to 5.77m, 4.50m and 6.38m below ground level in the three boreholes.

1.1.5 No archaeological remains or evidence for archaeological features were revealed although Wessex Archaeology conclude that the alluvium directly overlying the peat may have the potential to contain preserved archaeology. Similarly, there may be potential for deposits of Palaeolithic/prehistoric archaeological potential on the surface of the gravels, however, these deposits are deeply buried and archaeological evaluation by trial trenching or test pitting is unlikely to be practical. Furthermore, whilst peat deposits are archaeologically significant with the potential to preserve a wide range of waterlogged prehistoric archaeological remains, the peat at the present Site is relatively thin and localised, and on that basis its archaeological potential is considered to be low.

1.1.6 The scope of any further archaeological evaluation and mitigation works will need to be considered when the below-ground impact of proposed development are known, as this may have a direct impact on the requirement for and extent of any further archaeological evaluation and mitigation works, as outlined above. The results of this work will guide the approach to, and programme for, wider geoarchaeological monitoring and assessment in conjunction with planned geotechnical site investigations, intrusive evaluation, and the development of the subsequent mitigation strategy, to be agreed with heritage stakeholders and progressed post-consent, as set out in the Outline WSI (document reference 7.3, REP1-011).

1.1.7 A meeting with heritage stakeholders to discuss the results and the scope and programme for further archaeological evaluation and mitigation works is planned for 6 January 2022. Following this meeting, the Outline WSI (document reference 7.3, REP1-011) will be further updated to incorporate further information as required.

Appendix A

Geoarhcaeological Borehole Survey Report

Royal HaskoningDHV

Boston Alternative Energy Facility Boston

Geoarchaeological Borehole Survey

Ref: 255180.03
December 2021

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Document Information

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Fieldwork directed by	Liz Chambers
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Summary

A geoarchaeological borehole survey was undertaken at the site of the proposed Boston Alternative Energy Facility in order to examine the evidence for archaeological or topographic features identified during a previous geophysical survey, to assess the geoarchaeological potential of the superficial geological deposits underlying the wider area of the Site, and to inform on the requirements for and scope of further archaeological and geoarchaeological investigations. Three of a proposed four geoarchaeological boreholes were drilled at the Site, with the resultant core samples described and recorded by the monitoring geoarchaeologist. A basic geoarchaeological deposit model was prepared, integrating the results of the new boreholes with the stratigraphic log from a nearby BGS archive borehole.

The results of the borehole survey and subsequent deposit modelling have resulted in an improved understanding of the distribution and geoarchaeological potential of the superficial deposits across the Site; these have revealed a sequence of Pleistocene river terrace deposits of the River Witham, overlain by Holocene alluvial deposits in places incorporating a peat unit, a lower alluvium with detrital organic inclusions, and a clay-rich upper alluvium, overlain by the modern soil profile or ploughsoil. No archaeological remains or deposits (including relict soil profiles) associated with the archaeological features identified during the geophysical survey in the area of BH01 and BH02 were identified within the boreholes.

The surface of the gravel at the Site is considered to be medium geoarchaeological potential (including the potential for both prehistoric archaeology and buried soils), but the coarse-grained (gravel-rich) deposits of the gravel body are considered to be low geoarchaeological potential. The gravel surface at the Site is deeply buried, and archaeological evaluation of this former land surface via test pitting or trial trenching is unlikely to be practical.

In borehole BH01 the gravel is overlain by a relatively thin peat unit, recorded at between -2.70 to -2.81m OD but absent in BH02 and BH04. The peat is of high geoarchaeological potential, and has the potential to provide a record of past vegetation change and the dynamic relationship between estuarine and semi-terrestrial habitats, and may preserve palaeoenvironmental and/or archaeological evidence for human exploitation of both the wetland and adjoining dry ground environments. On the basis of radiocarbon dating of the basal peat elsewhere in the valley of the River Witham, it may be of Late Neolithic to Bronze Age date or earlier.

Peat deposits are also archaeologically significant with the potential to preserve a wide range of waterlogged prehistoric archaeological remains. However, the peat at the present Site is relatively thin and localised, and on that basis its archaeological potential is considered to be low.

The scope of any further archaeological evaluation and mitigation works will need to be considered when the below-ground impact of the proposed development are known, as this may have a impact on the requirement for and extent of any further archaeological evaluation and mitigation works, as outlined above.

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Wessex Archaeology would like to thank Royal HaskoningDHV for commissioning the geoarchaeological watching brief, in particular Vic Cooper and Paul Salmon. The fieldwork was undertaken by Liz Chambers. This report was written by Dr Daniel Young and Richard Payne and edited by Dr Alex Brown. Graphics were prepared by Nancy Dixon. The project was managed by Dr Alex Brown on behalf of Wessex Archaeology.

Boston Alternative Energy Facility, Boston, Lincolnshire

Geoarchaeological borehole survey

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Royal HaskoningDHV to undertake a purposive geoarchaeological borehole survey in advance of development associated with the proposed Boston Alternative Energy Facility. The proposals relating to the site include the construction of an energy from waste ('EfW') power station with a gross electrical output of up to 104 megawatts electric ('MWe') (delivering 80 MWe of renewable energy to the National Grid).

1.1.2 The Facility includes a lightweight aggregate manufacturing plant, a new wharf and a stock checking, processing and storage facility, two carbon dioxide recovery plants, and electrical export infrastructure to support the operational phase of the development on land at the Riverside Industrial Estate, located on the bank of The Haven in Boston, Lincolnshire. A separate Habitat Mitigation Area is also included as part of the Facility, located approximately 170 m south east of the Principal Application Site.

1.2 Site location and geology

1.2.1 The proposed development at Boston, Lincolnshire (hereafter referred to as the 'Site') is located c. 2.5km southeast of the centre of Boston (**Figure 1**). The Site is divided in to four Areas; Area 1 lies west of Nursery Road; Area 2 lies south of Nursery Road and west of Bittern Way, whilst Areas 3 and 4 lie west of Nursery Road.

1.2.2 The site lies at an elevation of between c. 1.5 and 2.5m OD, with a slight slope down to the east. The majority of the Site is currently occupied by arable fields and covers an area of c. 3.7 hectares.

1.2.3 The Site is located close to the western bank of The Haven, which forms the tidal lower reach of the River Witham, where it drains this river and several of the major land drains of the northern Fens in to The Wash.

1.2.4 The geology of the Site is mapped by the British Geological Survey (BGS) as mudstones of the Ampthill Clay Formation, overlain by Holocene Tidal Flat Deposits (TFD), described here by the BGS as 'clay and silt'.

1.3 Scope of document

1.3.1 This report provides a detailed description of the results of the borehole survey, interpreted within a wider geoarchaeological context, and assesses whether the aims of the survey have been met. The results reported on here will provide information on the sediments underlying the Site, informing on the geoarchaeological resource and the requirement for, and methods of, any further geoarchaeological or archaeological works.

1.3.2 To help frame geoarchaeological investigations of this nature, Wessex Archaeology has developed a five-stage approach, encompassing different levels of investigation appropriate to the results obtained, accompanied by formal reporting of the results at the level achieved. The stages are summarised below (**Table 1**). This report represents Stage 2 of this process.

Table 1 Staged approach to geoarchaeological investigations

Stage 1: WSI / Geoarchaeological Desk-based Assessment	Review of sub-surface data (e.g. mapping, existing GI, BGS logs), and summary of local or regional context. Establish likely presence/ absence/ distribution of archaeologically relevant deposits. May include modelling of existing data, and for larger schemes a fuller landscape characterisation. Present recommendations for fieldwork including type, number, distribution and depth of sampling methods.
Stage 2: Fieldwork, interpretation and reporting (e.g. Borehole survey)	Fieldwork to investigate deposits and obtain samples, followed by reporting. Reporting will present results (usually including deposit modelling), interpretations and recommendations for further work. Should suitable deposits be present, detailed recommendations for palaeoenvironmental assessment and dating will be made (Stage 3).
Stage 3: Palaeoenvironmental assessment	Assessment of subsamples agreed in Stage 2 (for e.g. pollen, diatoms, plant macrofossils, molluscs, ostracods and foraminifera), together with radiocarbon dating. Reporting will summarise results in the archaeological and palaeoenvironmental context of the local or wider area. Should deposits have the potential for analysis, recommendations will be for Stage 4 work.
Stage 4: Analysis	Full analysis of samples specified in Stage 3, together with a detailed synthesis of the results, in their local, regional or wider archaeological and palaeoenvironmental context as appropriate. Publication would usually follow from a Stage 4 report.
Publication	The scope and location of a publication report will be agreed in consultation with the client and LPA advisor. The publication report may comprise a note in a local journal or a larger publication article or monograph, dependant on the significance of the archaeological work.

2 GEOARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 The following section provides a summary of the known geoarchaeological context for the Site and the surrounding landscape.

2.1.2 Where age estimates are available for deposits these are expressed in millions of years (Mya), thousands of years (kya) and within the Holocene epoch as either years Before Present (BP), Before Christ (BC) and Anno Domini (AD). Where radiocarbon dates are included, they are quoted as calibrated (cal) BC or AD. These dates are supplemented where relevant with the comparable Marine Isotope Stage (MIS) where odd numbers indicate an interglacial period and even numbers a glacial period.

2.2 Solid geology

2.2.1 The geology of the Site is mapped by the British Geological Survey (BGS) as mudstones of the Ampthill Clay Formation, formed in a shallow-marine environment 157- 164 Mya, during the Jurassic period.

2.3 Superficial geology

2.3.1 The superficial geology across the Site is mapped by the BGS as Tidal Flat Deposits of Holocene (11.7kya-present) date (**Figure 1**), described here as clay and silt. These sediments are deposited in sand or mudflats within the intertidal zone, and may locally contain layers of sand, gravel and peat.

2.3.2 The Site lies within the lower valley of the River Witham, the modern channel of this River lying immediately east of the Site and draining in to The Wash. Prior to Devensian deglaciation, the valley of the modern Witham was occupied by the Pleistocene River Trent, forming the trunk river of the late Middle Pleistocene Wash system (Bridgland et al. 2015; Gibbard et al. 2021). During periods of low sea level this river would have extended north-eastwards across what is now the floor of the North Sea, possibly via the Inner Silver Pit (Boreham et al. 2010).

2.3.3 Upstream of Boston, Pleistocene river terrace deposits (sands and gravels) are mapped flanking the sides of the valley of the Witham. The oldest recorded terrace deposit of the Trent-Witham system is the Eagle Moor-Martin terrace, which is here considered to date from MIS 8 (300-243 Kya; Bridgland et al. 2010; Boreham et al. 2010). However, downstream of Tattershall and towards the modern Wash estuary these Pleistocene sediments are buried beneath significant thicknesses of fluvial and estuarine alluvium (Boreham et al. 2010).

2.3.4 The Site is located towards the northwest of the low-lying Fenland, which during the Holocene has been progressively infilled with unconsolidated sediments as a response to sea-level change and local geomorphological processes (Wheeler & Waller 1995). Marine clastic sediments dominate at seaward localities close to the Wash, intercalating with freshwater deposits over the central part of the basin and where they meet the valleys of Rivers draining in to the Wash. Around the landward edge of the basin freshwater deposits dominate, namely organic, fluviatile and lacustrine clastic deposits (Wheeler & Waller 1995).

2.3.5 Peat deposits of Holocene age, referred to as Nordelph Peat but in places including up to three distinct peat units, have been widely recorded across the low-lying Fenland (Wheeler & Waller 1995). Where these peat deposits are present they are of high archaeological and palaeoenvironmental potential, and may include material of Mesolithic date onwards.

3 ARCHAEOLOGICAL BACKGROUND

3.1.1 An archaeological background to the Site was provided as part of a Cultural Heritage Desk-Based Assessment produced by Moan (2019), a summary of which is presented here supplemented by background material provided in Archaeological Project Services (2010).

3.2 Prehistoric and Roman

3.2.1 As highlighted in the East Midlands Historic Environment Research Framework (Knight et al. 2012) the Witham Valley more widely is well known as a focus of activity during the Mesolithic and Neolithic periods, and has yielded a range of evidence for the exploitation of

this wetland zone during the Late Bronze Age and Iron Age periods (e.g. Catney & Start 2003).

3.2.2 However, there is no prehistoric activity recorded within a 1km radius of the Site. Roman activity has been identified in the wider environs in the form of sherds of grey-ware pottery dated to the 4th century AD, found c. 700m east of the Site. A Roman pit containing burnt clay and animal bone was identified c. 900m east of the Site.

3.2.3 A possible former land surface potentially of Roman date was identified during trial trenching in the industrial area directly to the east of Area 2 (Archaeological Project Services 2010), however no anthropogenic evidence was found.

3.3 Saxon and medieval

3.3.1 Excavations undertaken at White House Lane, Fishtoft, revealed extensive Late Saxon occupation principally of late 9th – 10th century date. Pottery retrieved from the excavations suggested a strong link to Lincoln (Palmer-Brown and Johnson 1997).

3.3.2 Medieval activity within the survey area is represented by a section of the extant / known earthwork named 'Roman Bank' on historical mapping, which runs northwest to southeast along and just within the eastern boundary of Areas 3 and 4. The earthwork measures 4km in length and was used as a flood defence. The origins of this section of the bank are unclear however a section of the bank located c.30km to the south of the survey area was dated to the late Saxon period.

3.3.3 Within the wider environs of the survey area medieval activity has been recorded in the form of pottery finds and kilns, a coin, and settlement features such as postholes, pits and drainage channels. Many of these were located close to St. Nicholas' Church (c.660m north of the survey area), which has standing remains that potentially date from the 13th century.

3.3.4 The site lies within Skirbeck Quarter. Skirbeck is first mentioned in the Domesday Survey of c. AD 1086. Referred to as Scirebec, the name is derived from the Old Norse and means 'the clear stream' (Cameron 1998, 111). At the time of Domesday, Skirbeck was held by Count Alan and Eudo son of Spirewic and contained two churches with two attendant priests, 2 fisheries and 40 acres of meadow (Foster and Longley 1976). Recent work has defined the holding of Eudo as that relating to Skirbeck Quarter, which was held as sokeland of his manor of Tattershall and was largely agricultural land with its tithes going to Skirbeck church (Roffe 2000).

3.3.5 Artefacts of medieval date are known from the general vicinity, though few are suggestive of settlement. These include the findspot of a 12th century pit containing pottery, animal bone and shell which may be suggestive of settlement or some seasonal activity like fishing (Cope-Faulkner and Young 1999, 3). The site is bordered by a sea-bank on its northern and eastern sides. Though termed 'Roman Bank', this is believed to be a Late Saxon or early medieval construction.

3.4 Post-medieval

3.4.1 Post-medieval activity is widespread within 1km of the Site and consists mainly of farmsteads, drains and sluices. Within the wider environs, but with no exact location, several maritime losses are recorded. Pottery findspots have also been recorded within the wider environs.

3.4.2 Within the Site field boundaries and ditches are shown on historic mapping some of which have been removed to create larger fields. A pond is seen on the historic mapping within Area 2 as well as an outbuilding associated with Battery Farm in the north of Area 1 and a footpath along the Roman Bank that runs along the eastern boundary of Areas 3 and 4.

3.5 Previous archaeological investigations

Archaeological evaluation (Archaeological Project Services 2010)

3.5.1 An archaeological evaluation was undertaken adjacent to the Site in 2010 by Archaeological Project Services, comprising a total of seven trenches associated with the development site of Biomass No. 3. The evaluation identified a sequence of natural clays and silts interpreted as being deposited in an estuarine environment, prior to and after the Roman period.

3.5.2 Clay with traces of organic material was the earliest recorded deposit in Trenches 1 to 4, where their surface was recorded at levels of between -0.22m to 0.22m OD. These deposits were recorded beneath an extensive clay layer with an upper surface of c. 2m OD. This clay layer has an undulating surface, and it was considered possible that this unit equates with the older marine alluvium representing the Roman land surface (Archaeological Project Services 2010).

3.5.3 A palaeochannel recorded in Trenches 2 and 3 was interpreted as being part of a small creek system and typical of that forming in an estuarine environment. No archaeological features or artefacts were encountered during the evaluation.

Geophysical Survey (Magnitude Surveys 2020)

3.5.4 A magnetometer and electromagnetic survey was undertaken at the Site by Magnitude Surveys in August 2020. During this survey anomalies of anthropogenic origin were identified, including a possible enclosure ditch and two locations of possible burning or production activity of unknown date.

3.5.5 A probable palaeochannel and a potential spur or unmapped extension of a known medieval earthwork were also identified. Overall, the results of the investigation did not indicate the presence of significant or extensive archaeological features, but that localised areas of potential archaeological and geoarchaeological interest are present at the Site.

4 AIMS AND OBJECTIVES

4.1 Introduction

4.1.1 As outlined within the Written Scheme of Investigation (WSI) for the Site (Wessex Archaeology 2021) a total of four purposive geoarchaeological boreholes were recommended, each of which was located in order to investigate selected anomalies identified during the previous geophysical survey (Magnitude Surveys 2020), including:

- A localised area of burning, potentially related to salt production activity;
- A possible earthwork or bank related to the medieval ‘Sea Bank’ marked on OS maps of the area; and
- A possible palaeochannel running roughly east to west through Area 2, towards the estuary of the River Witham.

4.2 Overarching aims and objectives

4.2.1 The specific aims and objectives of the geoarchaeological borehole survey were as follows:

- Gain information about the heritage assets and superficial deposits within the proposed development area;
- Provide detailed information regarding the date, character, extent, integrity and degree of preservation of the identified heritage assets and superficial geological deposits;
- Mitigate against impacts on archaeology and superficial deposits with geoarchaeological potential;
- Inform requirements for and scope of further archaeological and geoarchaeological investigations;
- Place the results of the borehole survey within its local, regional, and national, archaeological and geoarchaeological context, and

4.2.2 The aims were addressed by achieving the following:

- Undertaking a geoarchaeological borehole survey, comprising a three of a proposed four window sample boreholes;
- Investigating the nature of geophysical features identified during a previous survey of the Site by Magnitude Surveys (2020), including a possible palaeochannel, a possible earthwork or bank related to the medieval 'Sea Bank', and a localised area of burning, potentially related to salt production activity;
- Identifying the presence of sequences of superficial deposits with archaeological and/or geoarchaeological potential;
- Recording sequences and obtaining representative environmental samples from suitable deposits;
- Establishing the potential of the superficial deposits to preserve archaeological and/or palaeoenvironmental remains, and;
- Reporting on the results, with recommendations and proposals for appropriate further work where appropriate.

4.3 Overarching research themes

4.3.1 On the basis of the likely superficial deposits that may be encountered at the Site, the geoarchaeological investigations have the potential to contribute to the Strategic Objectives identified in the East Midlands Historic Environment Research Framework (Knight et al. 2012). Particularly relevant Strategic Objectives include:

Pleistocene/Palaeolithic

- 1D: Further investigate Upper Palaeolithic open-air sites

- 1F: Investigate the annual patterns of movement of Late Upper Palaeolithic hunter-gatherers

Mesolithic

- 2A: Enhance understanding of the environmental background to Mesolithic activity
- 2G: Investigate the topographic locations of activity foci

Neolithic and Early to Middle Bronze Age

- 3E: Target sites with Late Mesolithic and Early Neolithic organic remains
- 3I: Investigate the development and intensification of agriculture

Late Bronze Age and Iron Age

- 4J: Investigate the settlement and environmental resource of the Witham Valley

Romano-British

- 5H: Investigate the landscape context of rural settlements
- 5I: Support research and publication of landscape syntheses

High Medieval

- 7I: Investigate the development of the open-field system and medieval woodland management

4.3.2 The potential for the geoarchaeological investigations to address each of these Strategic Objectives will be assessed as the work progresses, with recommendations made for further works associated with these Objectives where appropriate.

5 FIELDWORK METHODS

5.1 Borehole survey

5.1.1 Three of the proposed four geoarchaeological boreholes were drilled at the Site, as follows (**Figure 2**):

- BH01, targeting a possible earthwork or bank related to the medieval 'Sea Bank' marked on OS maps of the area;
- BH02, targeting a localised area of burning, potentially related to salt production activity; and
- BH04, located within the footprint of a possible palaeochannel running roughly east to west through Area 2, towards the estuary of the River Witham.

5.1.2 Boggy and uneven ground conditions in the area of the boreholes meant that it was not possible to drill a fourth borehole during the time on site (proposed borehole BH03, a second borehole located within the possible palaeochannel, was not undertaken).

5.1.3 However, given the consistent sequence of sediments recorded across the Site, including those within the possible palaeochannel, three boreholes were considered sufficient to assess the geoarchaeological potential of the deposits present at the Site.

5.1.4 A Terrier window sampling rig was used to extract sleeved cores 1.0m in length to the top of the sands and gravels, to a maximum depth of 7m bgl or refusal.

5.1.5 The cores were split and described (including photographs) on-site by the attending geoarchaeologist as work proceeded. Where sequences were recorded that warranted further investigation, they were sealed and returned to the Wessex Archaeology laboratory for further detailed geoarchaeological investigation. The selected sequences were chosen on the following basis:

- Potential to address the aims and objectives and wider research agenda;
- Representative of common deposit types of geoarchaeological potential within the Site, with a particular focus on the retrieval of sequences preserving peat, organic-rich sediment or buried land surfaces.

5.1.6 Before drilling commenced, service plans were consulted, and all locations were scanned using a Cable Detection Tool.

5.1.7 On retrieval the cores were split and recorded on Site. and described by a suitably experienced geoarchaeologist following Hodgson (1997), to include information such as:

- Depth
- Texture
- Composition
- Colour
- Inclusions
- Structure (bedding, ped characteristics etc.)
- Contacts between deposits

5.1.8 Interpretations were made regarding the probable depositional environments and formation processes of the sampled deposits. This data was then tabulated by borehole and depth (**Appendix 1**).

5.1.9 Borehole locations were backfilled with arisings. Where selected boreholes were retained (BH01; BH04) the exploratory holes were backfilled with bentonite pellets.

5.2 Deposit modelling

5.2.1 Deposit modelling was undertaken following Historic England guidelines (2020) and consisted of one north-south aligned stratigraphic profile (transect) illustrating the key deposits across the Site (**Figure 3**).

5.2.2 The resultant stratigraphic records from the borehole survey (BH01, BH02 and BH04) were used together with one archive borehole record from the BGS online database (https://mapapps2.bgs.ac.uk/geoindex/home.html; TF34SW360) to produce the transect.

5.2.3 The transect is a two-dimensional vertical illustration of the deposit records along a line drawn across the Site linking locations of boreholes, allowing comparisons to be made between the records and indicating the possible make-up of the deposits between those records.

5.2.4 The key aims of the modelling were to interpret the data, identifying the probable environments represented, and determine areas of higher and/or lower geoarchaeological potential where further work may be required (e.g. deposits with potential for the recovery of significant archaeological and palaeoenvironmental remains).

6 RESULTS

6.1 Borehole survey

6.1.1 A total of three boreholes (BH01, BH02 and BH04; **Figure 2**) were drilled at the Site to a maximum depth of 7m below ground level (bgl). Inspection pits to 1.2m in depth were hand dug at each borehole location. These boreholes were located as follows:

- BH01, targeting a possible earthwork or bank related to the medieval 'Sea Bank' marked on OS maps of the area;
- BH02, targeting a localised area of burning, potentially related to salt production activity; and
- BH04, located within the footprint of a possible palaeochannel running roughly east to west through Area 2, towards the estuary of the River Witham.

6.1.2 No archaeological remains, including any remains or deposits associated with the earthwork in the area of BH01 and the possible burning in the area of BH02, were encountered in any of the hand dug inspection pits or boreholes.

6.1.3 The full results from the borehole survey are tabulated in **Appendix 1,** summarised below and supported by the results of the deposit modelling of the Site (**Figure 3**).

BH01

6.1.4 The modern soil profile was recorded in BH01 overlying a fine-grained sand, silt and clay alluvium to a depth of 5.62m bgl (-2.55m OD), commonly laminated and oxidised towards the top of the unit and increasing in sand content with depth. No evidence for sediments related to the construction of an earthwork, or buried soils that might underlie that earthwork, were identified within BH01.

6.1.5 This unit overlay silt with woody inclusions to 5.77m bgl (-2.70m OD), in turn overlying a very silty peat with woody material and leaves to a depth of 5.88m bgl (-2.81m OD).

6.1.6 The peat directly overlay sands and gravels, the upper surface of which was recorded at 5.88m bgl (-2.81m OD).

BH02

6.1.7 In BH02 the modern soil profile was recorded forming in to a fine grained sand, silt and clay alluvium to a depth of 4.50m bgl (-1.89m OD), commonly laminated and oxidised towards the top of the unit. No evidence for burning was identified in the upper part of the sequence in BH02.

6.1.8 This unit overlay a silt with occasional organics (wood fragments and root/leaves) to depth of 5.96m bgl (-3.35m OD), in turn overlying a firm sand to a depth of 6.62m bgl (-4.01m OD).

6.1.9 The basal unit in BH02 was the sands and gravels, the upper surface of which was recorded at 6.62m bgl (-4.01m OD). No peat unit was identified within BH02.

BH04

6.1.10 The modern ploughsoil was recorded in BH04 forming in to a fine-grained, oxidised silt and clay alluvium to a depth of 1.83m bgl (0.66m OD). This unit overlay silt and clay alluvium, including frequent woody material, to a depth of 6.38m bgl (-3.89m OD).

6.1.11 Sands and gravels were recorded as the basal unit within BH04, the upper surface of which was recorded at 6.38m bgl (-3.89m OD). Recovery was poor within this unit.

7 DISCUSSION

7.1 Introduction

7.1.1 A geoarchaeological borehole survey was undertaken at the site of the proposed Boston Alternative Energy Facility in order to examine the evidence for archaeological or topographic features identified during a previous geophysical survey (Magnitude Surveys 2020), to assess the geoarchaeological potential of the superficial geological deposits underlying the Site, and to inform on the requirements for and scope of further archaeological and geoarchaeological investigations.

7.1.2 A total of three of a proposed four geoarchaeological boreholes were drilled at the Site (BH01, BH02 and BH04; **Figure 2**), with the resultant core samples described and recorded by the monitoring geoarchaeologist. A basic geoarchaeological deposit model was then prepared, integrating the results of the new boreholes with the stratigraphic log from a nearby BGS archive borehole (**Figure 3**).

7.1.3 The borehole survey and subsequent deposit modelling have resulted in an improved understanding of the distribution and geoarchaeological potential of the superficial deposits across the Site; these have revealed a sequence of Pleistocene river terrace deposits of the River Witham, overlain by Holocene alluvial deposits in places incorporating a peat unit, a lower alluvium with detrital organic material, and a clay-rich upper alluvium, overlain by the modern soil profile or ploughsoil.

7.1.4 No archaeological remains or deposits (including relict soil profiles) associated with the archaeological features identified during the geophysical survey in the area of BH01 and BH02 were identified within the boreholes.

7.1.5 Specifically, no evidence for sediments related to the construction of an earthwork, or buried soils that might underlie that earthwork, were identified within BH01, and no evidence for burning was identified in the upper part of the sequence in BH02.

7.2 Sedimentary sequence and depositional environment

7.2.1 The basal unit identified in the new geoarchaeological boreholes, and which overlies the Ampthill Clay Formation bedrock in the area of the Site, are Pleistocene river terrace deposits of the River Witham, most likely equivalent to the Late Devensian (MIS 2; 23-

11.7kya) buried 'Floodplain' gravel of the Witham and the Holme Pierrepont terrace of the River Trent (see Gibbard et al. 2021).

7.2.2 This unit comprises sands and gravels of a high-energy braided river system which, while it was active, would have been characterised by longitudinal gravel bars and intervening low-water channels in which finer-grained sediments might have been deposited. The sands directly overlying the gravel in BH02 may represent such deposits, or the upper fluvially-reworked part of the Floodplain gravel.

7.2.3 The surface of the Floodplain gravel is recorded at levels between -2.81m OD (BH01) and -4.01m OD (BH02) (**Figure 3**), the variation in the height of the gravel typical of that in a braided river in which longitudinal gravel bars and intervening low-water channels have formed.

7.2.4 In borehole BH01 the Floodplain gravel is overlain by a relatively thin peat unit, recorded at between -2.70 to -2.81m OD and absent in boreholes BH02 and BH04. A slightly thicker (0.3m) peat unit was recorded at a slightly lower elevation of between -3.2 to -3.5m OD in TF34SW360 to the north of the Site (**Figure 3**).

7.2.5 The peat recorded in BH01 represents a phase of reduced and/or relatively stable sea-levels when semi-terrestrial plant communities became dominant in a wetland fen. During the period of peat formation, vegetation communities such as reed swamp, sedge fen or carr woodland would have dominated these locations, representing environments that would have been attractive to a range of fauna (wild fowl, grazers and browsers) and which humans may have hunted as part of their subsistence strategies.

7.2.6 The peat has significant geoarchaeological potential, preserving a range of palaeoenvironmental indicators important for reconstructing past vegetation change and reconstructing the dynamic relationship between estuarine and semi-terrestrial habitats, and may preserve palaeoenvironmental evidence for human exploitation of both the wetland and adjoining dry ground environments (e.g. in the form of episodes of environmental manipulation – including woodland clearance, use of fire and agriculture).

7.2.7 Peat deposits are also archaeologically significant with the potential to preserve a wide range of waterlogged prehistoric archaeological remains. The peat at the present Site is relatively thin and localised, and on that basis its archaeological potential is considered to be low.

7.2.8 The peat recorded in BH01 is equivalent to the 'discontinuous' basal peat recorded overlying pre-Holocene deposits elsewhere in the north-western Fens and the Witham valley (see Waller 1994 for a review). Further upstream of the Witham at Woodhall Spa, radiocarbon dates from the basal peat acquired by Valentine and Dalrymple (1975) were of Late Neolithic to Bronze Age date, ranging from 4205 ± 110 BP (HAR-192) to 3620 ± 130 BP (HAR-149), with altitudes for these dates estimated by Waller (1994) at between c. -1.7 and 0m OD. Dates obtained from a basal peat overlain by 'alluvial silt and clay' at Tattershall Castle pit (Shotton et al. 1974) were also Late Neolithic (4570 ± 150 BP).

7.2.9 Closer to the present Site, radiocarbon dating was undertaken on organic deposits up to about eight metres below the current ground level recorded during geotechnical investigation close to the River Witham in Boston, c. 1km to the northwest (Archaeological Project Services 2012). The results showed that the peat deposits here were of Neolithic date, dating from c. 5250 to 4850 BC.

7.2.10 Overlying the peat in BH01, and the Floodplain gravel or sand in BH02 and BH04, is a silt or silty clay with detrital organic material including woody and in places herbaceous remains formed on the estuarine floodplain of the River Witham, at a distance from any active channels, most likely during the Early to Middle Holocene (c. 11.7-4.2kya).

7.2.11 These deposits are in turn overlain by an inorganic sandy or silty clay, again formed on the floodplain of the River Witham, but most likely incorporating eroded sediments derived from the surrounding landscape following the intensification of land use from the Neolithic period onwards. These deposits are likely to be of Middle to Late Holocene date (c. 8.2kya to present).

7.2.12 Mineral-rich (e.g. sandy, silty or clayey) alluvium in general has a low geoarchaeological potential except where it is located in close association with datable peat horizons or organic-rich units. Here, the alluvial deposits directly overlying the peat have potential for microfossil assessment/analysis, investigating the marine and or freshwater influence at the Site and providing information on relative sea level rise (RSL) and its relationship to peat formation in the lower valley of the River Witham.

8 CONCLUSION AND RECOMMENDATIONS

Summary

8.1.1 The key results of the geoarchaeological borehole survey, and the geoarchaeological and archaeological potential of the deposits at the Site, are summarised as follows:

- **Pleistocene river terrace deposits** equivalent to the buried Floodplain gravel of the River Witham and the Holme Pierrepont terrace of the Trent, were encountered widely across the Site. The river terrace deposits provide the undulating topographic template upon which Holocene alluvial sediments have been deposited.

- Prior to widespread alluviation during the Holocene, the surface of the gravel would have included areas of higher, drier ground adjacent to the floodplain, and as such there is potential for the preservation of prehistoric archaeology on the surface of the Pleistocene gravels. However, these deposits are deeply buried, recorded at between 5.88 and 6.62m bgl.

- The surface of the gravel is considered to be medium geoarchaeological potential (including the potential for both prehistoric archaeology and buried soils), but the coarse-grained (gravel-rich) deposits of the gravel body are considered to be low geoarchaeological potential.

- **Alluvium** was recorded across the Site overlying the Pleistocene river terrace deposits. The alluvium at the site is comprised of three units: a basal peat (recorded only in BH01), the silt-rich lower alluvium with frequent detrital organic material, and the clay-rich upper alluvium.

- The deposits of the lower and upper alluvium are in most cases of low geoarchaeological potential, except where they are present in close association with the peat unit in BH01 (i.e. where radiocarbon dating of the peat can provide a reliable chronological context).

- The inorganic alluvial sediments have the potential to preserve microfossil remains (ostracods, foraminifera, diatoms) that are useful in establishing the marine or freshwater origin of deposits, but these may be of uncertain source area.

- The archaeological potential of the alluvium is low, except where it is associated with the peat deposits and may therefore have the potential to contain preserved archaeology, including waterlogged archaeology.

- **Peat** was recorded only in BH01, 0.11m thick and recorded at between -2.70 to -2.81m OD (5.77 to 5.88m bgl). Peat deposits are generally assigned a high geoarchaeological potential; however, the potential of the thin, localised peat identified at the present Site is more limited, particularly in the context of the more widespread, thicker peat units identified elsewhere in the valley of the Witham and the north-western Fens.

- On the basis of radiocarbon dating of the basal peat elsewhere in the valley of the River Witham, it may be of Neolithic to Bronze Age date or earlier. Establishing the chronology of this deposit in the first instance would help to assess the potential of the deposit for contributing to the valley-wide palaeoenvironmental research design that has been published by the Witham Valley Archaeology Research Committee (French & Rackham 2003; Stocker & Everson 2003) and other regional research agendas.

Recommendations

8.1.2 Depending on the construction design, the Site may impact upon:

- Deposits of Palaeolithic/prehistoric archaeological potential on the surface of the gravels. These deposits are deeply buried, recorded at between 5.88 and 6.62m bgl, and archaeological evaluation by trial trenching or test pitting is unlikely to be practical.

- Peat deposits of geoarchaeological potential recorded at between -2.70 to -2.81m OD (5.77 to 5.88m bgl) in the northern part of the Site in the area of BH01.

- The alluvium directly overlying the peat may have the potential to contain preserved archaeology, including waterlogged archaeology, where it is associated with the underlying peat deposits; again, these deposits are deeply buried and archaeological evaluation by trial trenching or test pitting is unlikely to be practical.

8.1.3 The scope of any further archaeological evaluation and mitigation works will need to be considered when the below-ground impact of proposed development are known, as this may have a direct impact on the requirement for and extent of any further archaeological evaluation and mitigation works, as outlined above.

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9 APPENDIX

9.1 Borehole logs

Site Code: 255180	Site Name: Boston Alternative Energy Facility	Borehole ID: BH01
Coordinates (NGR) X: 533747.971	Coordinates (NGR) Y: 342377.147	Level (top): 3.07m OD
Length:	Width:	Depth: 6.50 m

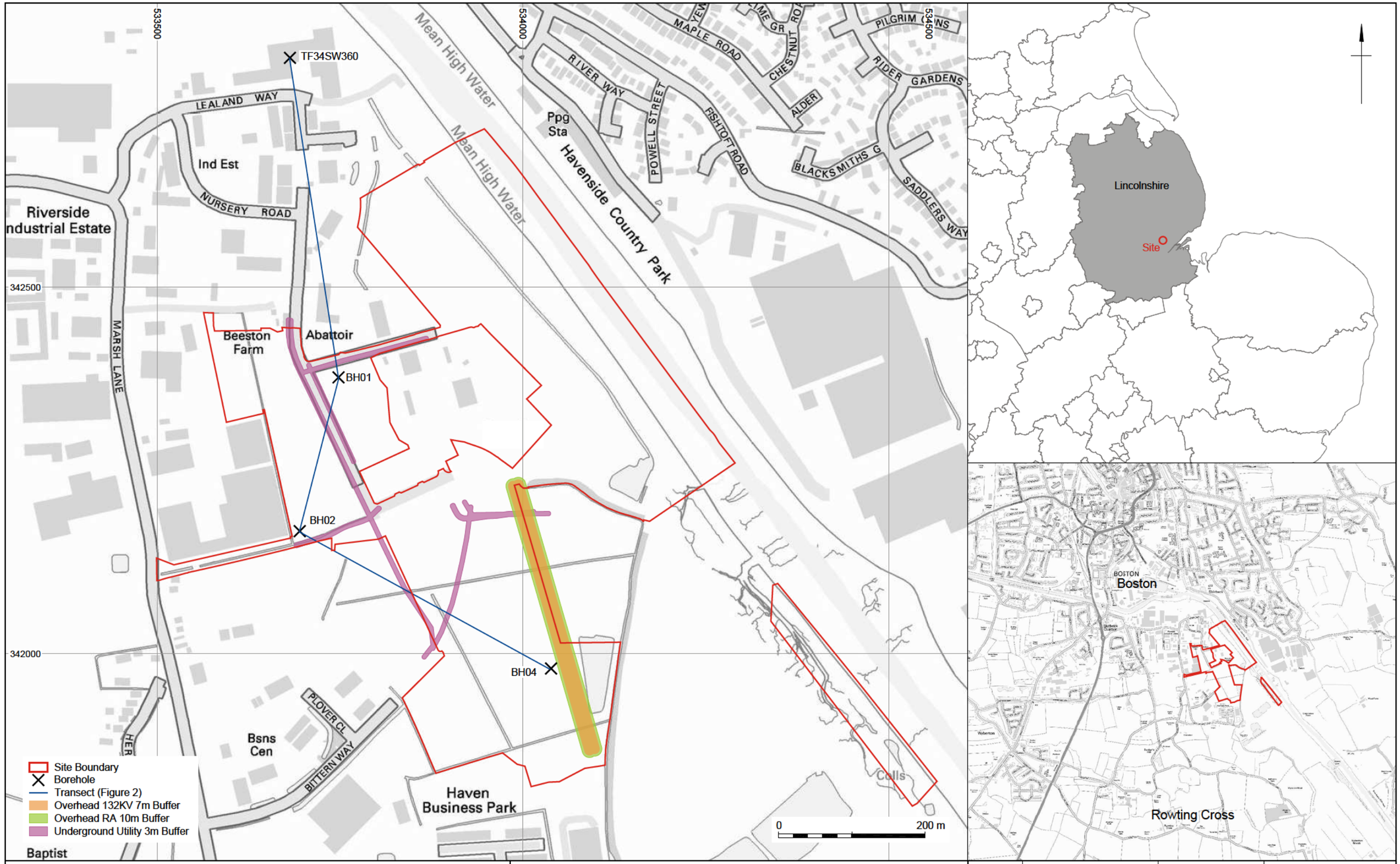
Context Number	Description	Interpretation	Depth m bgl	Depth m OD
11	Firm 7.5YR 4/4 clay silt (silt content increasing with depth) moderate iron staining throughout. Lower part possibly laminated.	Modern soil profile/ploughsoil over alluvium	0.00 to 1.00	3.07 to 2.07
12	Firm but soft 10YR 4/4 sandy silt/silty sand (sand is very fine) with moderate iron staining throughout Possibly laminated Grades into unit below with diffuse lower boundary	Alluvium	1.00 to 2.68	2.07 to 0.39
13	Firm but soft 2.5Y 3/2 sandy silt/silty sand (sand is very fine) with moderate darker lenses of 2.5Y 2.5/1 silt throughout profile, increasing in sand content with depth Strongly laminated Lower boundary not visible due to collapsing borehole mixing of sediments	Alluvium	2.68 to 5.62	0.39 to -2.55
14	Soft 10YR 4/1 silt with moderate organic inclusions (woody) Strongly laminated Sharp lower boundary	Alluvium	5.62 to 5.77	-2.55 to -2.70
15	Friable black very silty peat with frequent organic material (woody and rooty/leaves) Possibly laminated Abrupt lower boundary	Peat	5.77 to 5.88	-2.70 to -2.81
16	Moist loose but firm mid greyish brown fine sand with occasional small-large sub-rounded pebbles, very occasional small angular pebbles Collapsing borehole and refusal at 6.50. 6-6.50 shows wet dark grey very fine sand with no inclusions	Sands and gravels	5.88+	-2.81

Site Code: 255180	Site Name: Boston Alternative Energy Facility	Borehole ID: BH02
Coordinates (NGR) X: 533694.976	Coordinates (NGR) Y: 342167.26	Level (top): 2.61m OD
Length:	Width:	Depth: 7 m

Context Number	Description	Interpretation	Depth m bgl	Depth m OD
21	Fairly friable 10YR 3/4 clay silt with maize roots, very occasional CBM fragments Diffuse lower boundary	Modern soil profile-ploughsoil	0.00 to 0.30	2.61 to 2.31
22	Firm 10YR 4/3 (to 10YR 4/1 at 0.80m) clay silt/silt with occasional small-large sub-rounded/sub-angular pebbles, occasional to moderate iron staining throughout Possibly laminated Diffuse lower boundary	Alluvium	0.30 to 2.60	2.31 to 0.01
23	Soft 10YR 3/1 silt (has very fine granular appearance) with moderate organics smears throughout Strongly laminated Sharp to diffuse lower boundary	Alluvium	2.60 to 4.50	0.01 to -1.89
24	Soft but firm 2.5Y 3/1 silt with occasional to moderate organic material (wood fragments and smears), occasional molluscs (4.57m) Strongly laminated Sharp lower boundary	Alluvium	4.50 to 5.71	-1.89 to -3.10
25	Soft but firm 5Y 3/2 silt with occasional organics (wood fragments and root/leaves) Strongly laminated Sharp lower boundary	Alluvium	5.71 to 5.96	-3.10 to -3.35
26	Fairly firm sand (possibly slightly silty) too loose to Munsell (light grey) Sharp lower boundary	Sand	5.96 to 6.62	-3.35 to -4.01
27	Firm to compact slightly silty sand with moderate to frequent small-large sub-angular, angular and sub-rounded pebbles and stones, occasional small sub-rounded cobble [Refusal at 7m]	Sands and gravels	6.62+	-4.01

Site Code: 255180	Site Name: Boston Alternative Energy Facility	Borehole ID: BH04
Coordinates (NGR) X: 534038.235	Coordinates (NGR) Y: 341979.846	Level (top): 2.49m OD
Length:	Width:	Depth: 6.50 m

Context Number	Description	Interpretation	Depth m bgl	Depth m OD
41	Fairly firm 10YR 4/2 silty clay/clay silt with maize roots at top of profile, occasional to moderate iron staining increasing down profile [Possibly ploughsoil is 0.30m as sediment is much drier from 0.30m but no change in composition or colour] Plug/lens of 10YR 4/1 silt at 1.10-1.30m Sharp lower boundary	Modern soil profile-ploughsoil over alluvium	0.00 to 1.83	2.49 to 0.66
42	Firm 10YR 4/2 silty clay/clay silt with root channels marked in grey silt, rooting and occasional organics (woody fragments) towards base of unit, moderate to frequent iron staining from 2.10 Sharp lower boundary	Alluvium	1.83 to 2.56	0.66 to -0.07
43	Firm 10YR 4/1 silt with occasional to moderate organics (woody fragments and smears) Strongly laminated [No recovery 5-6m]	Alluvium	2.56 to 6.38	-0.07 to -3.89
44	Poor recovery; slightly silty sand with moderate to frequent small-large sub-angular, angular and sub-rounded gravels	Sands and gravels	6.38+	-3.89



Coordinate system: OSGB36 National Grid

Utility routes have been digitised from plans obtained from the asset owners, geophysical survey and data provided by the client.

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Scale:	1 5000 at A3	Initials (studio):	ND
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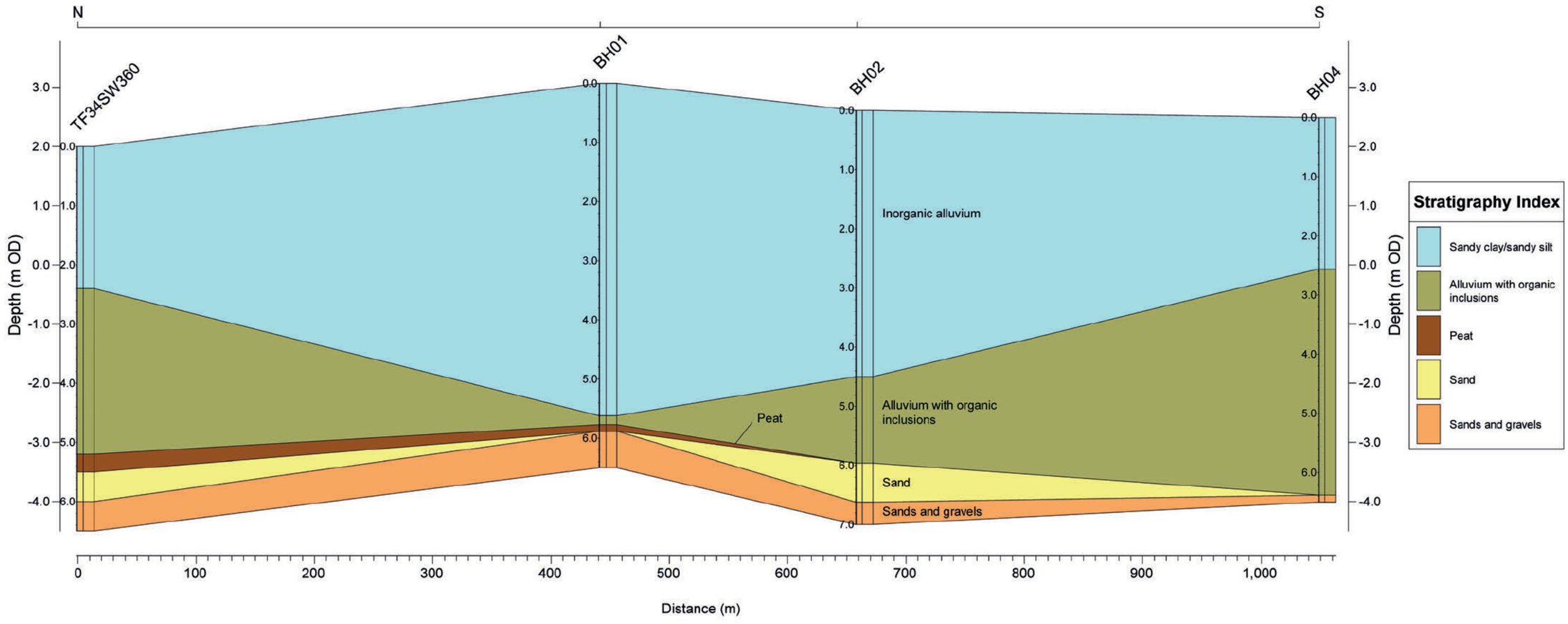
Site location showing boreholes and north-south transect

Figure 1



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North-south transect

Figure 2

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