NAU Archaeology

Report 2564a

An Archaeological Excavation at King's Lynn B Power Station, Norfolk

Assessment Report and Updated Project Design

ENF125441
NHER 28348

Prepared for
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Location:	King’s Lynn B Power Station,
District:	King’s Lynn and West Norfolk
Grid Ref.:	TF 6087 1720
HER No.:	NHER 28348, ENF125441
OASIS Ref:	92305
Client:	Centrica Energy
Dates of Fieldwork:	16-30 November 2010

Summary

Following evaluation of the site by interpretation of the results of window sample cores, an archaeological excavation was conducted for Centrica Energy during the late autumn of 2010 ahead of the proposed expansion of the power station. The planned building works impact on a north-south aligned sea bank earthwork (NHER 28348) which is situated immediately to the east of the power station. As part of the mitigation works, three wide, stepped trenches were excavated through the sea bank using a combination of machine and hand excavation in order to examine the development of the bank and to ascertain its date.

The profile through the sea bank revealed two episodes of bank construction and a final re-structuring phase. Between the first and second banks there appears to have been a period of natural deposition of windblown sand and possible erosion. A single fragment of baked clay which was likely to have been of Roman date was found within one of the earliest layers of the first bank. However the baked clay fragment is probably residual and the date of the first bank is more likely to have been constructed in the Late Saxon of early medieval period.

This report summarises the results of the excavation, quantifies the records and provides an Assessment of that information. This is followed by an Updated Project Design which identifies the further work considered appropriate to complete the Analysis stage of the project including how the project’s results may be disseminated.

1.0 Introduction

This report begins by summarising the background to the project, the site’s location and the project’s initial aims. This introductory section is followed by a discussion of the site’s archaeological and historical background (Section 2.0) and the methodologies employed during the work (Section 3.0).

The fourth part (4.0) presents a summary of the results and the fifth is an assessment of the stratigraphic, artefactual and environmental evidence recovered (Section 5.0). Each data set has been assessed to determine its potential to yield further information and to identify aspects that are of wider significance. The results of these individual assessments are then brought together in a general discussion of the site’s significance. The relevant results of the excavation are also brought into this assessment.

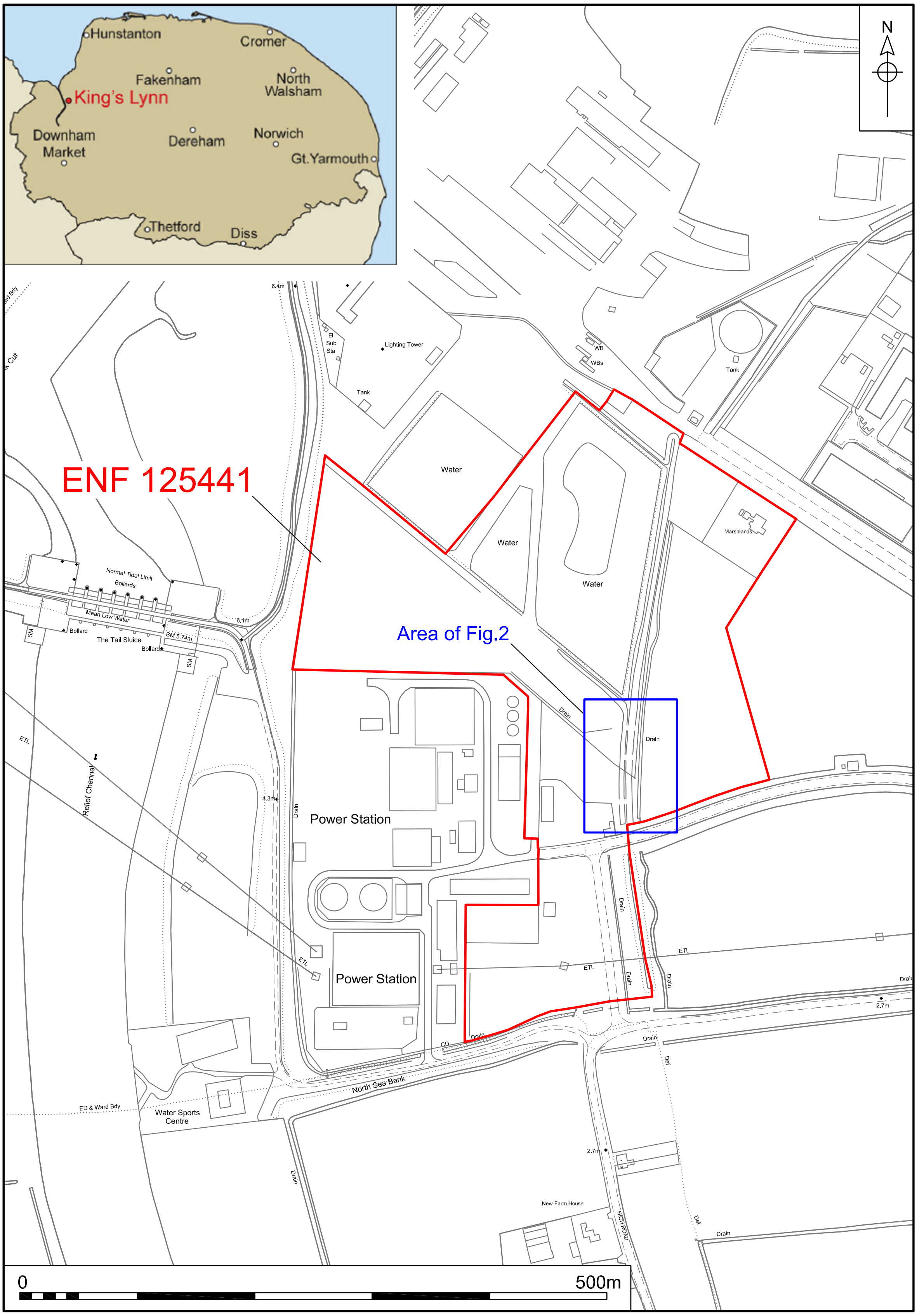

Figure 1. Site location. Scale 1:5000

The sixth part of the report comprises an Updated Project Design (Section 6.0). This describes the research objectives that will underpin subsequent work and details the nature of the additional tasks to be undertaken. The appendices contain tabulated information including specialist data.

1.1 Project Background

King's Lynn B Power Station is situated 1km to the south of King's Lynn adjacent to the River Great Ouse (Fig. 1). The power station lies next to the mouth of a canalised tributary of the River Great Ouse known as the Ouse Relief Channel. Major changes to the King's Lynn B Power Station are likely to affect the historic sea bank located on the east side of the power station complex. An excavation, targeted on the bank was designed to record and elicit information to allow further understanding of this important historic earthwork.

The work was undertaken following a brief issued by Norfolk Historic Environment Service (Ref. CNF 42422). This work has been undertaken at the pre-determination stage of the planning process; the local authority is the Borough Council of King's Lynn and West Norfolk. The excavation was conducted in accordance with a Project Design and Method Statement prepared by NAU Archaeology (Ref. NAU/BAU2564/NP). This work was commissioned and funded by Centrica Energy.

A previous phase of window sampling was undertaken across the site, particularly concentrated on the sea bank earthwork (Green 2010). Window samples from the sea bank itself suggested that there were identifiable sea bank cores which would require further investigation.

This programme of work was generally designed to assist in defining the character and extent of any archaeological remains within the proposed redevelopment area, following the guidelines set out in *Planning Policy Statement 5: Planning For The Historic Environment* (2010). The work was also undertaken in line with The Borough Council of King's Lynn and West Norfolk's Local Plan Adopted Version (November 1998), policies 4/ 9-11.

The results of the excavation will enable decisions to be made by the Local Planning Authority about the treatment of any archaeological remains found. The three trenches were targeted on the former sea bank (NHER 28348) as it is proposed that this feature would be heavily reduced in size by the new power station expansion.

The site archive is currently held by NAU Archaeology and on completion of the project will be deposited with the Norfolk Museums and Archaeology Service (NMAS), following the relevant policies on archiving standards.

1.2 Geology and Topography

The power station is located within the Eastern Fen Edge, part of the East Anglian Fens. The area is characterised as a flat, low lying area that surrounds the Wash and survives as the largest area of former coastal wetland in Britain. This environmental region stretches across parts of Lincolnshire, Cambridgeshire, Norfolk and Suffolk, and covers approximately 4,000km^2. Fenland is a large basin which has until present times been accumulating sediments for most of the last 10,000 years. Environmental conditions have changed at certain periods in the past and this has affected the nature of the sediments. In broad terms the areas of freshwater influence (towards the inner edge of the basin) saw an accumulation of peat whereas marine clays, silts and sands were deposited towards the Wash (Waller 1994).

The site of the proposed development occupies an area below 5m OD and lies approximately 500m south-east of the Eau Brink cut of the River Great Ouse, some 250m to the east of the Great Ouse Relief Channel. The fenced inner core of the power station is located 60m to the west of this. The southern edge of the development lies immediately north of the east-west North Sea Bank and west of its north-south alignment. The excavated area lies some 15m further north, well within the development area (Fig. 1).

The underlying geology consists of Ampthill and Kimmeridge Clay including Upware limestone (Sheet 52N 00 Solid Geology, British Geological Survey) overlain by silty clayey marine and brackish deposits and brown calcareous alluvial soils (Soil Survey of England and Wales: Soils of Norfolk 1:100,000, Ordnance Survey).

2.0 Archaeological and Historical Background

A search of the Norfolk Historic Environment Record (NHER) has been undertaken and the most relevant entries reproduced below in chronological order supplemented by information from Penn 1995.

Prehistoric to Roman

It is thought that this part of the Fens in which the power station is located was, until perhaps the Roman period, situated on the edge of the Wash basin. The area was closer to the sea than other parts of the Fens and it was subjected to marine deposition from a northerly direction and advancing fenland peat from the south. In the earlier prehistoric period the marsh would have been a mixture of saltwater and freshwater and as the prehistoric period continued peat began to accumulate from the south. Into the Roman period the eastern fens were brackish and referred to as 'uninhabitable bog' and unlike the western fens it was not densely exploited. From AD100 there was a tidal advance which left spreads of marine silts over the area. Old watercourses (roddons) have been mapped and can be seen to cut through these silts from the later Roman period onwards.

Saxon to Medieval

The main element of the development of the area in this later period was the reclamation of the large pool or 'lenn' which gave its name to the settlement of Lynn, known as Bishop's Lynn in its earlier incarnation. The sea bank recorded during the current excavation lay virtually at the centre of this large landscape feature, a large expanse of mud flats which for much of this earlier period would have been subjected to periods of marine inundation. Over several centuries this area was reclaimed through the construction of banks and ditches. The North Sea Bank to the south of the site was one of the first medieval banks to enclose the area and by the time the Scales Howe Bank was constructed towards the centre of the reclaimed area the Lenn occupied a smaller area. Salterns to the south and east of the development site were situated on the edge of the Lenn in a period prior to the reclamation, when there was easy access to salt water. It is worth noting that there is an irregular pattern of fields within the area of the Lenn compared with the long thin fields to the south, which might suggest that in some areas the land was never fully reclaimed, or else considered to be of better use as pasture.

The North Sea Bank (NHER 21807) runs approximately east-to-west from the River Nar to the former east bank of the Old Great Ouse Channel, with a further section lying between the Eau Brink Cut (NHER 13532 - an artificial waterway made in 1821 to remove the bend in the Great Ouse) and the Great Ouse Relief Channel. The fact that land levels appear to be higher on the north side of this bank than on the south suggests that over time sediments have accumulated against the north side. The north-south aligned sea bank (NHER 28348) examined during this project is thought to be a spur of the North Sea Bank.

The three trenches excavated as part of this project were dug through sea bank NHER 28348, an earthwork which is orientated north-south and may once have continued as far as the Scales Howe Bank (NHER 21808), a possible 13th-century earthwork to the north. The North Sea Bank (NHER 21807) itself forms a junction with NHER 28348 to its south and is considered to be of 11th-century date. The Historic Environment Record notes that the suggestion that bank NHER 28348 is of 12th-century date is refuted by R. Silvester who undertook a significant amount of work in the 1980s across the Norfolk Fens as part of the Fenland Survey project. It also records that a cut through the bank made for the main entrance to the power station compound revealed that the bank is made purely of soil at this point and that only find - one horse bone - was recovered. The bank is visible on 1947 RAF aerial photographs and it is depicted on the 2nd edition 25" Ordnance Survey map (1902-7) which shows the line of the earthwork as one continuous bank from grid reference TF 60965 16971 to TF 60836 17867. The northern end of the bank appears to have been truncated by the 19th-century Eau Brink Cut. A further section of sea bank (NHER 21808) continuing round to the west and situated on the opposing side of the River Ouse may have formed part of the original defence scheme and may be of 13th century date (NHER).

Green Dyke (NHER 21806), a north-to-south aligned earthwork of possible Late Saxon or medieval date, is situated 2km to the east of the current site. The NHER states that at certain places along its length it forms parish boundaries and that it is mentioned in a documentary reference of 1379. This ditch is another feature in this landscape thought to have been associated with early reclamation of land around King’s Lynn. A pattern of sea-banks, connected with the reclamation of land within this part of the Fenland basin is suggested in Silvester’s report on Marshland and the Nar Valley (1988).

Several more earthworks and cropmarks (NHERs 38231, 38232 and 38235) and possible medieval saltern mounds (NHER 38255) were located to the east of the site. The group of undated features that make up NHER 38255 were observed as cropmarks in vertical aerial photographs taken by the RAF in 1961. They appear as six separate areas of lighter coloured or parched crop and were sub-rounded and irregular in shape ranging in diameter from 11-34m.

Post medieval

The Eau Brink Cut on the River Great Ouse (NHER 13532) mentioned above is relevant to the present work being an artificial waterway completed in 1821 to remove the bend in the river.

A post-medieval stack base (NHER 38302) south of the site was observed on 1946 RAF vertical aerial photographs. Its form is a single circular or ring-like bank, with a narrow ditch to the outside and a depression at the centre with a maximum diameter of 10m. The stack base was found in an area thought to have been protected from the sea in the medieval period although the feature itself is most likely to be of post-medieval date, however such circular features are known from different periods within the Fen area, and it may be earlier. The feature was on the line of the Relief Channel, and is now destroyed.

A sugar factory (NHER 13755) built in 1927 and demolished in 1997 lay just to the north of the site. The site had included a lime kiln which had operated with the aid of a hand-operated narrow gauge railway to remove spoil. Anecdotally, some of the large dumps of material to the west of sea bank and north of the site are believed to be the results of activity at the factory.

Multi-period

Fieldwalking, metal detecting and evaluation between 1984 and 2001 around the general area of the development site recovered a range of medieval and post-medieval objects, including pottery fragments. The concentrated nature of some of the finds was suggestive of a settlement. A medieval pilgrim bottle, a jetton and a complete post-medieval stoneware vessel were also collected. Other finds included a post-medieval button, coin, bells and a toy.

From 1981 to 1988 an extensive programme of archaeological field survey, excavation and environmental studies known as the Fenland Project examined a considerable area of the fens in Lincolnshire, Cambridgeshire, Norfolk and Suffolk. The findings of this survey have been published in several volumes of the East Anglian Archaeology monograph series along with a synthetic volume (Hall and Coles 1994). Excavations resulting from the survey as part of the Fenland Management Project are published in the Lincolnshire Archaeology and Heritage Report Series (Crowson *et al*. 2005, Lane and Morris 2001).

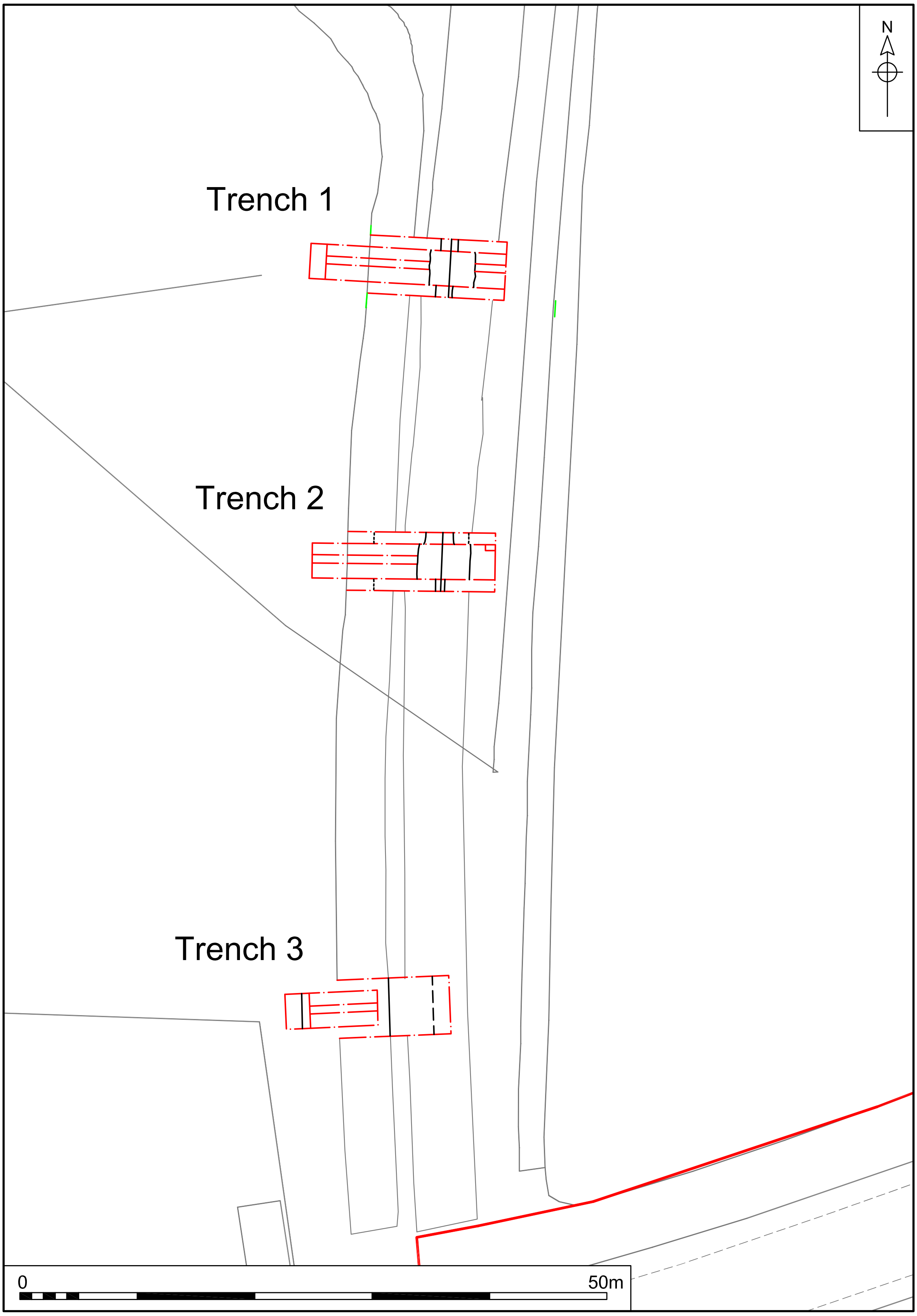

Figure 2. Site location. Scale 1:500

3.0 Methodology

(Fig. 2 and Plates 1 and 2)

The aim of the excavation was to record and profile the nature of former sea bank (NHER 28348) and to ascertain its sequence of development and date.

Plate 1. The former sea bank as an earthwork (pre-excavation), looking south

The Brief required that three trenches, measuring 12m by 4m, be targeted on the area of sea bank likely to be damaged by the forthcoming power station development. They were also positioned close to parts of the sea bank thought to contain more of the historic core suggested by the evaluation work undertaken previously (Green 2010).

It was envisaged that the trenches would be evenly spaced along the length of the sea bank and one of the trenches would be excavated through the bank adjacent to the artificial lake located at the northern end of the development. After early examination of the proposed locations, trenching adjacent to the lake was considered to be a safety risk. It was proposed by Centrica Energy that the trenches should be located at least 40m south of the lake area to avoid weakening of the bank and a possible breach which was agreed with Norfolk Historic Environment Service (Fig. 2).

In order to achieve a full profile through the bank and to allow safe working at depths the trenches were locally stepped. To realise this, the trenches measured 5m wide at the surface rather than the 4m originally specified. All three trenches were excavated into underlying natural deposits, although only a photographic record could be made for the lowest part of Trench 1 due to quickly rising water levels; drawn sections were achieved for the lowest parts in Trenches 2 and 3.

Machine excavation was carried out with a 14 tonne tracked hydraulic 360˚ excavator equipped with a toothless ditching bucket and operated under constant archaeological supervision. Layers were removed in spits with occasionally hand-excavation in order to search for finds, check relationships, and to better understand the composition of the deposit.

Plate 2. Machining Trench 3, looking south-west

A north to south orientated live electricity cable was present in each of the three trenches along the length of the bank. As the cable appeared to be of 1960-1970s date or earlier there was a possibility that the cable wrapping contained asbestos. Work ceased until a large soil bund had been placed over and around the cable and continued once it was reburied. Trench 3 appeared to contain a further two cables and as such, with the agreement of NHES just half of the bank was exposed. It was however still possible to achieve a full-depth profile through the bank at this point.

Spoil and exposed surfaces were scanned with a metal-detector although there were no finds through this process.

Seven environmental samples were taken from deposits [66], [70], [81], [26], [21], [5] and [38] (Samples <1> to <7> respectively). Analysis of *in-situ* deposits as they appeared on the sections was undertaken in the field by Dr Green and the data obtained at this time provides the basis for the interpretational sections presented in this report (Figs 3-5, below). On the final fieldwork day a series of sub samples through the sequence of bank deposits was taken by the author so that diatom analysis could be undertaken.

All archaeological features and deposits were recorded using NAU Archaeology pro forma. Trench locations, plans and sections were recorded at appropriate scales. Monochrome and digital photographs were taken of all relevant features and deposits where appropriate.

The temporary benchmark used during the course of this work was transferred from an Ordnance Survey benchmark with a value of 2.81m OD, located on the north-west side of a house directly to the south of the power station and created on the edge of the excavation area.

Site conditions were good, with the work mostly taking place in fine weather (apart from Dr Green's fieldwork which was undertaken in heavy snow after an icy spell). Access to the site was good.

4.0 Summary of Results

4.1 Summary of Excavation Results

Plate 3. Trench 1 section, looking north

Three stepped trenches were excavated through the sea bank earthwork and full profiles drawn. The results at this stage are best presented as a whole (rather than as separate results for each trench) due to the integrated nature of the work. Eighty-one individual context numbers were allocated during the fieldwork and all but three of these (representing a relatively recent ditch in Trench 1) were given to deposits appearing to form part of the sea bank or deposits below it (i.e. the deepest parts of Trenches 2 and 3). It was not possible to ascertain the character of all of the deposits from field observation alone and environmental work was undertaken in the post-excavation phase of the work.

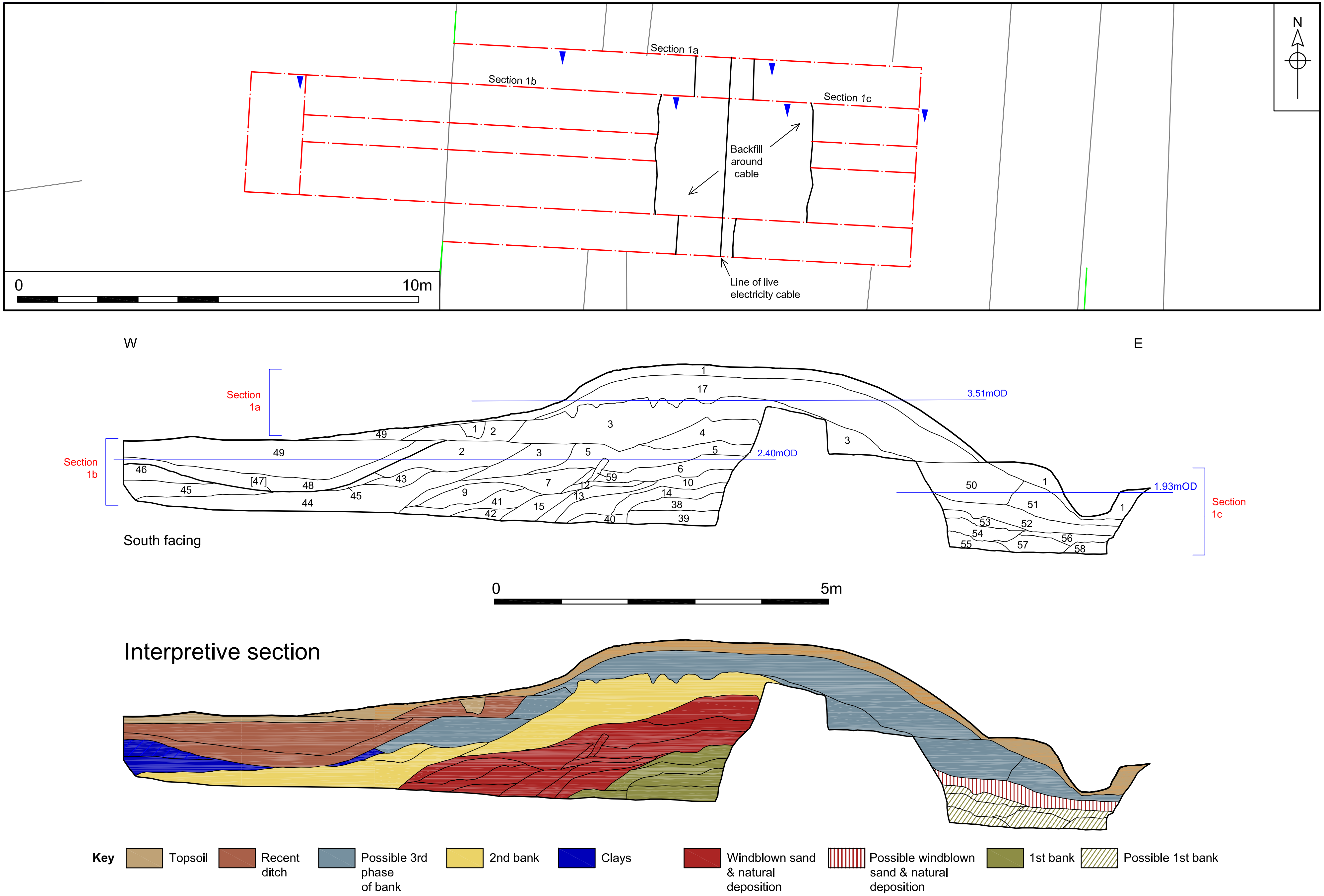

Figure 3. Trench 1, plan (1:125) and sections (1:75)

Plate 4. Trench 2 section, looking north

Plate 5. Trench 3 section, looking north

During the fieldwork it was thought by the archaeologists that there were at least two banks represented in the sequence. After further environmental data was collected an initial examination of the findings confirmed that there were two phases of bank with deposits of windblown sands in between. Most of the bank layers consisted of separate deposits of silty sand although some clay was also present.

The stratigraphy of the bank observed in Trenches 1, 2 and 3 followed a similar but not identical sequence and their sections are shown in Figures 3, 4 and 5 and Plates 3, 4 and 5 respectively. An environmental assessment of the plant macrofossils and the microscopic observation of sediments of a representative sample of the units identified have been carried out (Sections 5.3 and 5.4, below).

The height of the top of the upper bank is remarkably similar across the three trenches, ranging between 3.80 and 3.92m OD (See Table 1 below).

	Trench 1	Trench 2	Trench 3	Mean height
Modern surface at top of last bank (m OD)	3.82	3.92	3.80	3.83
Top of earliest bank (m OD)	2.35	2.35	2.4	2.36
Top of naturally deposited sediments below first bank(m OD)	1.4	1.28-1.72 (1.5)	1.5-1.8 (1.65)	1.52

Table 1. Height of sea bank (m OD) and related deposits in Trenches 1, 2 and 3.

The sedimentary sequence suggests that there is at least one hiatus in the creation of the bank we see today as an upstanding feature in the modern landscape. The bank appears to have initially been constructed as either a relatively low feature or one which has been eroded and damaged by flooding at some point in its early history. Following its construction and the subsequent possible weathering or flood damage the bank is then sealed by natural deposits including windblown sands. There then follows a period when up to three successive bank rebuilding events can be recognised, although all three of these later building phases were not recognised in all sections through the bank.

4.1.1 Natural deposits below the earliest bank

The undisturbed sediments at the base of the bank were slightly laminated firm clays and in places sands and silts. The botanic indications from these clay deposits suggest that they were likely to have formed in a freshwater marsh where there was at least some still and open water.

4.1.2 The earliest bank

Although the sediments in the bank were not uniform and homogeneous they were characterised by being structureless and without any sedimentary features; firm brown sandy clay was a common deposit. They were primarily derived from estuary deposits brought downstream by the River Ouse and a small amount of marine sand.. The only artefact recovered in this investigation was a tiny fragment of possible briquetage from local salt making (this fragment could be of Roman, Late Saxon or medieval date). There are records of several salterns (for local salt production) next to the River Nar (1km to the east) at east one of these dates to the 12th century and indicates the River Nar was tidal at this time (Silvester 1988, 26). However, such a small fragment of probable briquetage could well be residual in the sediments on the mud flat.

4.1.3 Sediments above earliest bank - probably naturally deposited

This sequence of sediments show in places clear lamination and sedimentary structure which is the reason it is described as a naturally deposited sediment.

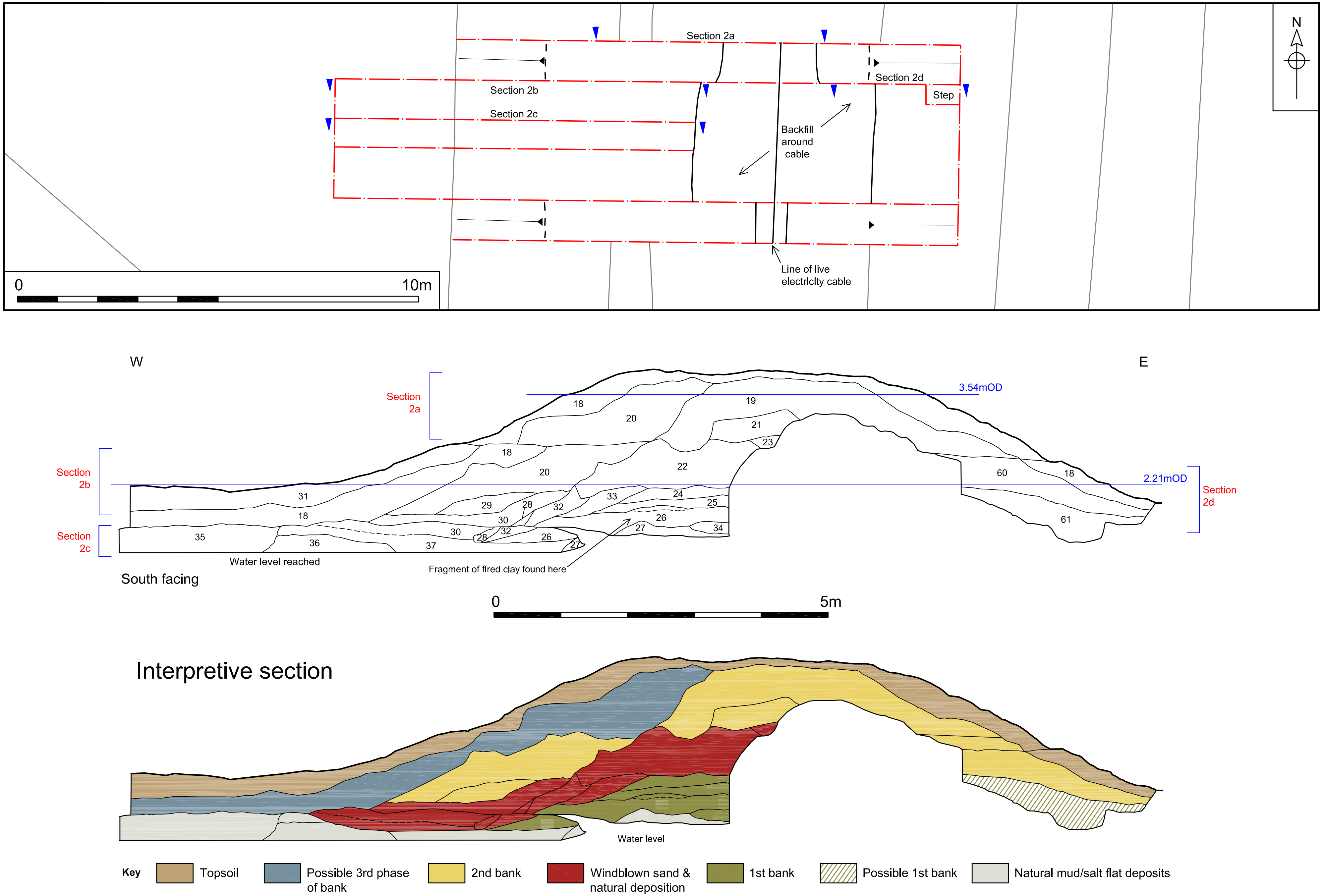

Figure 4. Trench 2, plan (1:125) and sections (1:75)

Although there is considerable variation in this deposit both within each trench but in particular between the trenches there is an overall fine sandy nature to this sediment even without structure. Microscopic analysis confirmed the well-sorted nature of this fine sand and sub-rounded to sub-angular grains which strongly suggest that this was a windblown sand. It is envisaged that during stormy or windy periods, probably in medieval times, some sort of dune development occurred banking up against the side of the existing bank. It is notable that the earliest bank is only a maximum of 1m high at this time and it is possible it had been eroded by flood waters.

4.1.4 Later phases of bank construction

In Trench 3 a single later phase of bank construction is recorded (Fig. 5), whereas in Trench 2 (Fig. 4) there are probably two later phases of bank construction and in Trench 1 there are three (Fig. 3).

These later phases of bank construction resulted in structureless and in some places massive firm alluvial clay deposits with some areas of softer siltier and sandier deposits. The upper bank sediments were similar to the sediments of the first bank but contained less organic material and stronger indications (although very slight) of a marine signal. Again the sediments would have been obtained from deposits adjacent to the site, presumably from the unenclosed eastern side of sea bank where tidal influences were perhaps even stronger than they had been when the first bank was constructed. It is also possible that the influence of greater volumes of alluvium being carried downstream in the River Ouse as the river became more canalised may have provided a slightly different sediment to build the bank.

It is proposed that these provisional phases of bank development should be more fully examined and presented in an archive report and publication summary. More importance could be attached to the phasing if they can be dated.

4.2 Archive Quantification

Table 2 summarises the archive components that were generated during the excavation.

Archive	
Context records	81
Drawn sections	10
Drawn plans	3
Black and white negative and print films	2
Finds	1 bag
Environmental samples	7

Table 2. Archive quantification

Following completion of the excavation, all written and drawn records were checked and cross-referenced. Typed versions of context, drawing and sample registers were created. Context information and finds data were combined within a single spreadsheet. All photographic films were processed and a photographic archive assembled, accompanied by a list. The fragment of fired clay was washed, marked and bagged. The records produced during the environmental assessment have been assimilated into the project archive

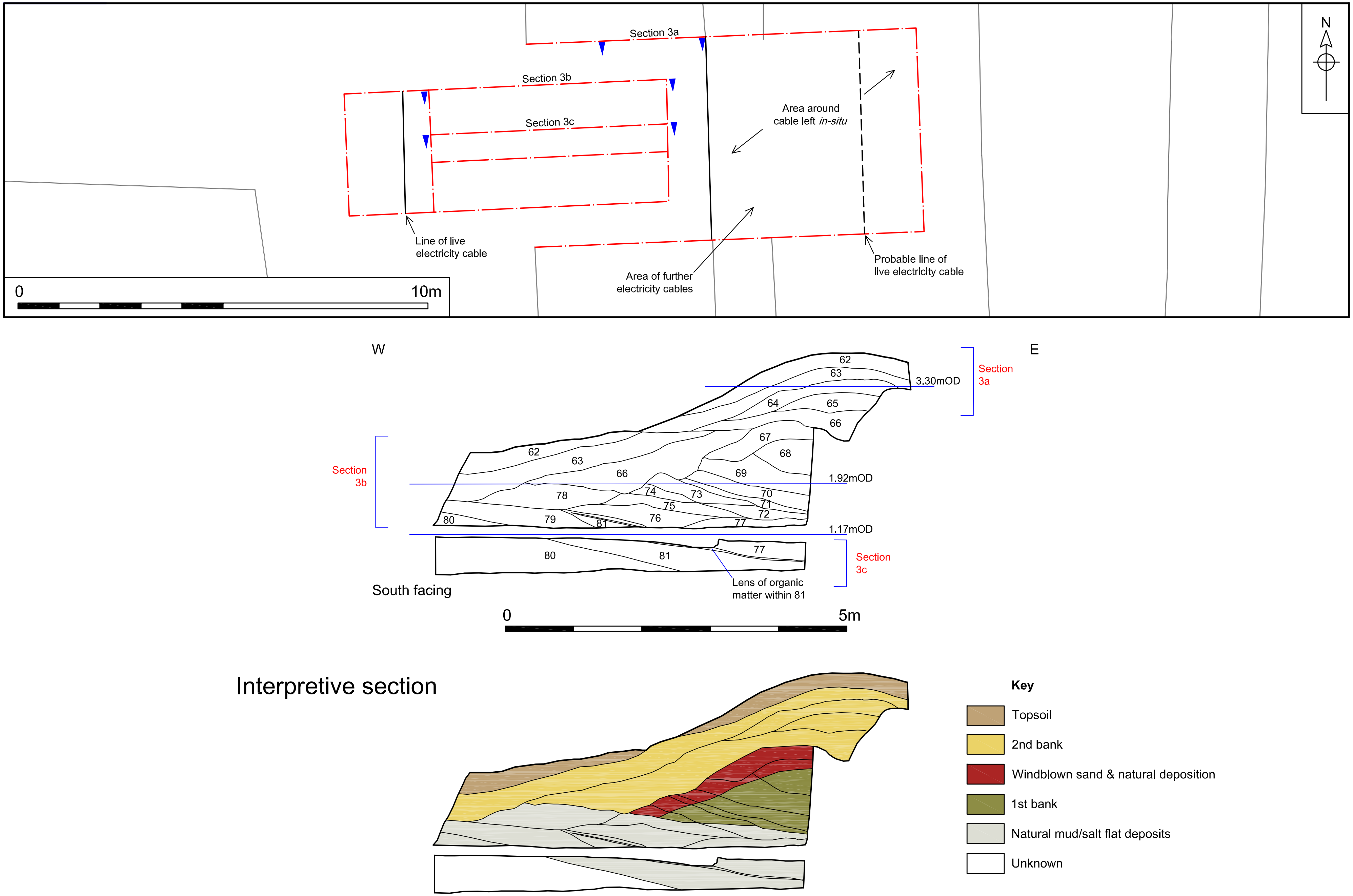

Figure 5. Trench 3, plan (1:125) and sections (1:75)

5.0 Assessment

The following section presents an assessment of the stratigraphic, artefactual and environmental data recovered during this work. This assessment considers the significance of each data set in relation to its potential to address the project's objectives and research aims. It also seeks to identify aspects of the project that are of a wider significance or that can potentially address new research questions.

A variety of sources have been consulted as part of this assessment including *Research and Archaeology: A Framework for the Eastern Counties* (Glazebrook 1997; Brown and Glazebrook 2000) which summarises the archaeological resources of East Anglia and presents detailed research agendas for each period.

5.1 Assessment of the Stratigraphic Data and Site Potential

5.1.1 The Stratigraphy

The three trenches excavated through the sea bank earthwork presented the opportunity to draw and record three extensive sections. Layers encountered on the site were recorded and the stratigraphic relationships are quite clear. The interface between the lower deliberate deposits in the first bank and the natural mud/salt flat deposits was observed at the base of each trench's sequence, though quickly rising water within Trench 1 did not allow the lowest part of that section to be drawn. A photographic record of the deposits was also made. The presence of a live electric cable necessitated a small bund to be constructed around it which obscured some of the deposits on the eastern side of the bank, however many of the earliest deposits remained visible and a full sequence could be recorded. There was no obvious truncation or disturbance of the bank in the three trenches apart from service runs and a ditch of relatively recent date (in Trench 1).

The area adjacent to the lake on the north side of the development site appeared to be higher and more sharply defined (possibly reflecting more recent re-modelling) and this coincided with a large amount of dumping of material that had occurred prior to the creation of the lake just to the north-west. The sections through the bank south of this area more accurately reflect the historic shape of the bank at least in its post-medieval form. The initial phasing of the banks presented in this report has been based on the stratigraphy clearly visible in the sections.

5.1.2 Site Potential

5.1.2.1 Comparative sites

It appears that there has been relatively little fieldwork undertaken on the sea banks on the edge of the fens, and as such this new information is valuable. It is of particular note that there are few published sections through sea banks However, a description by Fowler (1950, 12) of a cut through the Cambridgeshire sea bank at Leverington is remarkably similar to this example being investigated at Kings Lynn B Power Station. The core of the sea bank at Leverington was only 3ft (approximately 1m) high and was followed by three subsequent additions (Silvester 1988,160).

A very detailed analysis of the 'Sea Bank' at Clenchwarton to the north of the present site on the seaward side of the River Ouse was carried out by Crowson (*et al* 2005) and provides an excellent model of how to proceed with the investigations at the present site. Interestingly and unexpectedly it is dated to the eleventh century by sherds of Late Saxon pottery found within the body of the bank (Crowson *et al* 2005, 204). Even without firm dating evidence for this project, is hoped that phasing the banks will enable comparisons to be made with other known sites such as that at Clenchwarton (Crowson *et al* 2005, 204) and Leverington (Silvester 1988, 160) and that the site can add to what is known of the reclamation of the Lenn, to the south of King's Lynn. The excavation results may also contribute to fenland studies more generally.

It would seem that the lack of cultural material from the deposits forming such banks often makes it very difficult to date them and the current site is no exception. However the large amount of *in-situ* sandy deposits situated at key stages through the profile, which if they can be dated via Optically Stimulated Luminescence (OSL) dating techniques, could provide valuable dating evidence. If additional invasive work is undertaken on the sea bank then there could be an opportunity for taking samples for OSL dating and if successful and the sequence of the banks can be dated through scientific techniques then the results would be of regional and perhaps national significance.

5.2 Assessment of the Artefactual Material

A single fragment of fired clay was examined by a specialist who has assessed the significance of the material, both in relation to the site itself and in terms of its wider importance. The results of the assessment are summarised below and information is also tabulated in Appendices 2a and b.

5.2.1 Baked Clay

by Sarah Percival

A small scrap of undated baked clay was recovered from layer [26] in Trench 2. The fragment is made of dense silty clay and has a pink/orange core and white surfaces reminiscent of briquetage however the small size of the scrap precludes precise identification.

Salt extraction was an important industry around King's Lynn in the Late Saxon to medieval period and the large mounds of washed silt left by the process are commonly found in the environs of the town (Silvester 1988, 27). Briquetage, the baked clay debris of brine evaporation hearths, is also widely occurring in the Fens and is most often of Roman date (Lane and Morris 2001).

5.3 Assessment of the Environmental Material

by Val Fryer

5.3.1 Introduction and method statement

Although dating evidence was absent, samples for the evaluation of the content and preservation of the plant macrofossil assemblages were taken, and seven were submitted for assessment (Samples <1> to <7> from deposits [66], [70], [81], [26], [21], [5] and [38] respectively).

The samples (or sub-samples thereof) were processed by manual water flotation/washover and the flots were collected in a 300 micron mesh sieve. The dried flots were scanned under a binocular microscope at magnifications up to x16 and the plant macrofossils and other remains noted are listed in Appendix 3. Nomenclature within the table follows Stace (1997). Both charred and de-watered plant remains were recorded, with the latter being denoted within the table by a lower case 'w' suffix. Because of the de-watered nature of the assemblages, it proved difficult to identify possible modern contaminants. However, some roots, seeds, leaves, chaff elements and arthropod remains were almost certainly intrusive.

The non-floating residues were collected in a 1mm mesh sieve and sorted when dry; artefacts/ecofacts were not recorded.

5.3.2 Results

Although scarce, charred plant macrofossils, including a barley (*Hordeum* sp.) grain, a spelt wheat (*T. spelta*) glume base and a bread wheat (*T. aestivum*/*compactum*) type rachis node, were noted within four of the samples studied. However, as all were recorded as single specimens within an assemblage, their contemporaneity with the contexts from which the samples were taken cannot be easily proven. De-watered seeds were recorded at a low to moderate density within four assemblages, but again, it was difficult to ascertain the antiquity of the remains. Rough grassland and wetland taxa were recorded, including specimens of musk thistle (*Carduus* sp.), thistle (*Cirsium* sp.), silver weed (*Potentilla anserina*), buttercup (*Ranunculus* sp.), sea club rush (*Bolboschoenus*/*Schoenoplectus* sp.), sedge (*Carex* sp.), spike rush (*Eleocharis* sp.), pondweed (*Potamogeton* sp.) and water crowfoot (*Ranunculus* subg. *Batrachium*). Small charcoal/charred wood fragments were present within all but one assemblage along with pieces of charred and de-watered root/stem.

Shells of both terrestrial and fresh/brackish water molluscs were recorded within four assemblages. Most were moderately well-preserved, possibly indicating that these, too, were reasonably modern in origin. Remains other than mineralised soil concretions were scarce, but did include occasional fragments of black porous and tarry material, pieces of bone, fish bone and marine mollusc shell and de-watered arthropod remains including caddis larval cases. The assemblage from Sample <3> was almost entirely composed of densely compacted concretions of dark brown to black mud, including some very finely comminuted fragments of organic material including plant remains. The significance (if any) of this material is currently unknown.

5.3.3 Conclusions and recommendations for further work

In summary, the assemblages are extremely small and sparse and it would appear to be very difficult to distinguish which of the remains may be contemporary and which may be intrusive. Therefore, close interpretation of the deposits is difficult, if not impossible. Charred remains are present, but as single specimens, which may easily have travelled through the soil column through the action of small mammals, arthropods or molluscs. Therefore, even the presence of a spelt glume base (in Trench 1), a macrofossil rarely seen in post-Roman contexts, is open to interpretation. Although the charred remains have been separated out from the main sample, it is considered highly unlikely that any are suitable for AMS/C14 dating, and this form of dating is not recommended.

5.4 Assessment of the Diatoms and Sedimentology

by Frances Green

5.4.1 Introduction

Four sediment samples <10P> [19], <12P> [22], <13P> [30], <20> [26] were prepared for diatom analysis from small bagged samples of bank and related sediments from Trench 2 at Kings Lynn Power Station B.

5.4.2 Methods

Diatom samples were prepared by heating 1-2cm^3 of sediment in water. Since none of the samples had a high organic content the Hydrogen peroxide stage of the preparation was omitted.

The sample was then mounted in Naphrax and heated on a hotplate to remove the solvent from the Naphrax.

The resultant slides were investigated under x1000 magnification with the use of immersion oil.

5.4.3 Results

No diatoms were identified in any of the samples. However the microscopic analysis of the sediments allowed a more detailed description of the sediments to be made and included identification of pollen in two of the samples.

The results are described for each sample below under the headings of the major sedimentological units identified.

5.4.3.1 Naturally deposited sediment below the earliest bank <13P> [30]

Before processing the sediment was a dark grey clay mottled with brown.

The slide was full of clay, a little silt and small amount of fine sand. There was a background of unidentifiable organic debris much of it appearing as small humified and amorphous blobs.

Incidentally pollen grains were found at very low frequencies (4 grains). The pollen was from grass and Chenopodiaceae. Although little can be said about such a low frequency of pollen, it is notable that both these pollen types are found in the freshwater end of the upper saltmarsh. Chenopodiacae pollen can be derived from a wide range of plants which are tolerant of relatively hostile environments and frequently typify middle and upper saltmarsh (Chenopodiaceae are also often weedy species of disturbed and open fully terrestrial ground).

No diatoms were identified.

5.4.3.2 Earliest bank <20P>[26]

This deposit prior to processing was a mid brown sandy clay. The slide contained poorly sorted fine sand with both angular and sub-angular grains. There was a relatively high percentage of organic material, some of it coating the sand grains the rest as unidentifiable amorphous fragments. There were occasional opaque fragments which were probably finely divided charcoal. Rarely encountered were grains of glauconitic sand.

Pollen cf. Carophyllacae were very rare (two grains).

No diatoms were identified.

5.4.3.3 Sediments above earliest bank- probably naturally deposited <12P> [22]

Before processing the deposit was a mid ginger brown fine sand. Under the microscope the sand grains were observed to be all relatively small, well-sorted and were sub-rounded to sub-angular but never angular.

The sand grains were coated with what appeared to be clay and organic material. There was also a small percentage of glauconitic sand grains and rare opaques - possibly small fragments of charcoal.

5.4.3.4 Final bank <10P> [19]

Before processing the sample was a mid ginger brown clay with silt and fine sand. When viewed under the microscope the preparation was full of clay silt and fine sand and contained a moderate quantity of amorphous and unidentifiable organics. The sand grains were generally sub-angular in character. There were rare opaques which were likely to be charcoal.

Rare glauconitic sand grains of marine origin were observed together with a single fragment of a marine foraminifera, both indicating at a marine origin for at least some of the sediments in this bank deposit.

No diatoms were identified.

5.4.4 **Discussion**

5.4.4.1 Natural deposits below the earliest bank

Botanic indications from the clay deposits below the lower bank suggest it was likely to have formed in a freshwater marsh where there was at least some still and open water.

The plant macrofossil results from similar deposits below the earliest bank contain several indicators of freshwater conditions and further indicate at least localised shallow aquatic conditions. The presence of seeds of *Potomogeton* (pondweed) and Caddis larval cases suggest still open water and *Eleocharis* (spike rush) often indicate damp or wet ground.

5.4.4.2 The Earliest bank

The earliest bank is composed of sandy clay. These sediments were derived from the estuary with the clays probably from predominantly terrestrial sources having been brought downstream by the River Ouse and dumped on its mud flats. The small proportion of marine sand was also likely to have been from the tidal influence on the river. The few pollen grains may be derived from river sediment or from part of the mudflat. The tiny percentage of charcoal and the virtual absence of other cultural material suggest the site is some distance from any settlement. The bank material is likely to be derived from very close to the site of the bank. Research on the 'Sea Bank' at Clenchwarton to the north and seawards of the present site by Crowson *et al* (2005) illustrates a model of sea bank construction which suggests that short lengths of sea bank were constructed very rapidly - during one cycle of the tide and the sediments were taken from deposits adjacent to the sea bank itself on the mudflat.

5.4.4.3 Sediments above earliest bank- probably naturally deposited

Although a slightly mixed deposit, overall the sands that sandwiched between the earliest bank and the last bank had characteristics in common with windblown sands, being well sorted, fine grained and distinctly not angular. This confirms the probable wind blown origin of these sands. There is a period of significant mobilisation of windblown sands in the medieval period (from the beginning of the 14th century) on the coversands of north Lincolnshire which accounts for the burial of Saxon and medieval settlements such as Flixborough (Loveluck and Atkinson, 2007). The source of these sands is likely to have nothing to do with the timing of these periods of wind blow and sand deposition in Lincolnshire but simply is an interesting parallel to consider in the further work on this site.

5.4.4.4 Final bank

The upper bank sediments were firm clays and sands derived from the alluvium on the mudflats of the River Ouse estuary. The presence of rare marine sands (glauconitic sands) and a marine foraminifera show how at least a small proportion of this sediments was derived from a marine source in the tidal River Ouse.

5.4.5 **Conclusions**

No diatoms were found in the sediments analysed and this is either because the diatoms have been dissolved and lost in post-deposition processes or the sediments did not contain any diatoms initially. The location of the sediments in the estuary of a very heavily sediment laden river, mostly derived from terrestrial deposits means that any diatoms which grew on these sediments were quite diluted but the total lack of any diatoms even in the upper marsh/freshwater sediments which lay beneath the earliest bank suggest the diatoms have been more likely lost post-deposition. Despite the lack of diatoms there are some preliminary suggestions that can be that can be drawn.

The earliest bank appears to have been built on at least periodically wet and predominantly freshwater upper marsh alluvial mudflat sediments on which vegetation was in part established. It was constructed using the same sediments as underlie the bank and these sediments are likely to have come from close to the sea bank itself.

A sequence of probably naturally deposited, in part wind blown sands, lies above the first bank. There is no clear indication of an erosive phase between these two events but it is quite possible.

Finally there was second phase of sea bank construction (as evidenced in Trench 2 at least). These upper bank sediments were similar to the sediments of the first bank but contained less organic material and stronger indications (although very slight) of a marine signal. Again the sediments would have been obtained from adjacent to the site, presumably from the unenclosed eastern side of sea bank where tidal influences were perhaps even stronger than they had been when the first bank was constructed.

6.0 Updated Project Design

6.1 Introduction

The Updated Project Design is based on the results of the assessment and details the general aims of the post-excavation programme and its revised research objectives. It also presents a publication proposal that suggests how and where the project's results should be published. This is followed by a breakdown of the individual tasks that need to be undertaken to bring this project to completion.

6.2 General Aims

The aims of the post-excavation programme can be summarised as follows:

- To undertake further analysis of specific data sets where required to meet the initial aims of the project and the revised research objectives that have arisen as a result of the assessment.
- To create an ordered and indexed research archive for deposition with an appropriate curatorial institution.

6.3 Revised Research Objectives

Following the assessment of the evidence recovered during this project it is possible to set out refined research objectives. These are as follows:

- To refine, where possible, the developmental sequence of the sea bank
- To place the overall site into a wider regional context, exploring its potential in particular to contribute to knowledge of how the fenland was reclaimed and protected. The results of the present work will be examined in light of the extensive works associated with the Fenland Project (e.g. Silvester 1988 and Waller 1994).
- To disseminate the results of the project via an archive report and summary article.

6.4 Stratigraphic Analysis

The initial phasing of the site presented within this report will be further examined in light of the wider context of the site.

6.5 Artefactual Analysis

A catalogue entry for the single piece of baked clay will be included within the project archive. There is no further analysis to be undertaken on the finds assemblage.

6.6 Environmental Analysis

A catalogue of the results of the environmental sample assessment will be included within the archive and reference made in the publication to the results. No further analysis is required.

If further interventions are planned within this area, it is suggested that sample columns are placed through the bank deposits and through the surrounding soil horizon as this may facilitate the identification of intrusive materials. However, if such work is not viable, further sampling is not recommended unless specific questions need to be addressed.

6.7 Diatom Assessment and Sedimentology

The purpose of this diatom assessment was to determine if the deposits were from a brackish, marine or freshwater source. Since no diatoms were identified this has not been possible. However, the sediments do show potential for pollen analysis, which may throw further light on the environmental conditions and the source of the sediments.

6.8 Paleogeographical Considerations

If further work were undertaken on the sea bank in the future, then sample deposits could be taken in an attempt to answer questions of absolute dating, sequence and derivation of bank material and environmental conditions in the past. Possible approaches are outlined below

- Analysis of foraminifera which if present would provide an environmental framework for the sea bank in this area and also provide additional information as to the source of the sediments
- Pollen analysis has potential to provide information on palaeoenvironmental conditions since pollen is present in at least some of the sediments. If the opportunity arose a series of monoliths through all deposits may be useful however, in this situation the foraminifera study may give more useful results.

Dating the sea bank/s is of prime importance as there are very few dated sections through similar earthworks and this site provides an invaluable opportunity to do so. The sedimentology of the sea bank suggests several phases of construction with some separated by periods of natural deposition and possible erosion. The understanding of this potentially complex sequence would benefit from more than one date from the bank, ideally one from the lower bank intermediate deposits and others from the upper banks. A range of further techniques could be deployed however it is possible that OSL dating would provide the best method for dating the banks, as material suitable for AMS or C14 dating appears to be absent.

- There is potential for additional scientific dating techniques to be deployed on the bank deposits. Radiocarbon (C14) dating could be undertaken if there were sufficiently large fragments of suitable material found if further fieldwork were undertaken. However, as outlined in section 5.3.3 the examples found during the present project were not suitable and it is unlikely that the results would be different from other interventions in the same area.
- OSL dating on the naturally deposited wind blown sand deposits would be a useful technique to deploy when the sea bank is exposed. Note that these sandy deposits are in places mixed with silt and clay deposits and the cleanest deposits were recorded in Trench 3. A strategy to facilitate OSL sampling of the sands in the bank could be developed if access to suitable deposits can be arranged and HES and English Heritage determine the scope of the work.

6.9 Publication Proposal

It is anticipated that an archive report will be produced which will be submitted to Norfolk Historic Environment Service and a short article or summary containing the results of the excavation be presented in the relevant local journal.

6.10 Storage, Curation and Conservation

The intended recipient for the artefactual material is the Norfolk Museums and Archaeology Service (NMAS), subject to the agreement of the landowner. The artefacts and ecofacts will be packaged according to NMAS specifications, following the guidelines laid out the Institute for Archaeologists' Standards and Guidelines for the creation, compilation, transfer and deposition of archaeological archives 2008.

6.11 Resources and Programming

The post-excavation programme will be undertaken by a project team led by a Project Officer responsible for implementation of the Updated Project Design. Elements of the programme will be delegated to nominated staff. The work of each team member will be scheduled and co-ordinated by the Project Officer. To ensure completion of the project to agreed performance targets, monitoring of the project will be carried out by a member of the NAU senior management, who will also provide advice and support to the Project Officer.

6.11.1 Staff

The project team will consist of NAU Archaeology staff and External Specialists where applicable.

Staff	Initials.	Role
Jayne Bown	JB	Archaeology Manager
Peter Crawley	PC	Project Officer
David Dobson	DD	Senior Illustrator
Frances Green	FG	Geo-archaeologist
Nigel Page	NP	Project Manager
Sarah Percival	SP	Finds Specialist
Lucy Talbot	LT	Finds Co-ordinator

6.11.2 Analysis Tasks

Task	Task Description	Duration (days)	Staff
Stratigraphic Analysis			
1	Grouping of site data; preparation of stratigraphic descriptions	1.0	PC
Artefact Analysis			
2	Scan flots for artefacts and ecofacts	0.5	SP
3	Note for publication and Finds Catalogue from results of Task 2	0.5	SP
Sedimentological Analysis			
4	Palaeogeographic consideration of the site within wider region	1.0	FG
Archive Report			
5	Descriptive text and discussion	3.0	PC

Task	Task Description	Duration (days)	Staff
6	Graphics additional figure(s) and amendments	2.0	DD
7	Internal Edit	1.0	JB
8	Cross-checking and final preparation of archive	1.5	PC/LT
9	Sign Off	0.5	NP
Published Summary			
9	Summary illustrations	1.0	DD
10	Preparation of Summary text for publication	2.0	PC/JB

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This report was edited by Jayne Bown and produced by David Dobson. The project was overseen by Nigel Page.

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Appendix 1a: Excavation context data

Context	Type	Description	Date
1	Deposit	Layer on Section 1, Trench 1	Unknown
2	Deposit	Layer on Section 1, Trench 1	Unknown
3	Deposit	Layer on Section 1, Trench 1	Unknown
4	Deposit	Layer on Section 1, Trench 1	Unknown
5	Deposit	Layer on Section 1, Trench 1	Unknown
6	Deposit	Layer on Section 1, Trench 1	Unknown
7	Deposit	Layer on Section 1, Trench 1	Unknown
8	Deposit	Layer on Section 1, Trench 1	Unknown
9	Deposit	Layer on Section 1, Trench 1	Unknown
10	Deposit	Layer on Section 1, Trench 1	Unknown
11	Deposit	Layer on Section 1, Trench 1	Unknown
12	Deposit	Layer on Section 1, Trench 1	Unknown
13	Deposit	Layer on Section 1, Trench 1	Unknown
14	Deposit	Layer on Section 1, Trench 1	Unknown
15	Deposit	Layer on Section 1, Trench 1	Unknown
16	Deposit	Layer on Section 1, Trench 1	Unknown
17	Deposit	Layer on Section 1, Trench 1	Unknown
18	Deposit	Layer on Section 2, Trench 2	Unknown
19	Deposit	Layer on Section 2, Trench 2	Unknown
20	Deposit	Layer on Section 2, Trench 2	Unknown
21	Deposit	Layer on Section 2, Trench 2	Unknown
22	Deposit	Layer on Section 2, Trench 2	Unknown
23	Deposit	Layer on Section 2, Trench 2	Unknown
24	Deposit	Layer on Section 2, Trench 2	Unknown
25	Deposit	Layer on Section 2, Trench 2	Unknown
26	Deposit	Layer on Section 2, Trench 2	Unknown
27	Deposit	Layer on Section 2, Trench 2	Unknown
28	Deposit	Layer on Section 2, Trench 2	Unknown
29	Deposit	Layer on Section 2, Trench 2	Unknown
30	Deposit	Layer on Section 2, Trench 2	Unknown
31	Deposit	Layer on Section 2, Trench 2	Unknown
32	Deposit	Layer on Section 2, Trench 2	Unknown
33	Deposit	Layer on Section 2, Trench 2	Unknown
34	Deposit	Layer on Section 2, Trench 2	Unknown
35	Deposit	Layer on Section 2, Trench 2	Unknown
36	Deposit	Layer on Section 2, Trench 2	Unknown
37	Deposit	Layer on Section 2, Trench 2	Unknown
38	Deposit	Layer on Section 1, Trench 1	Unknown
39	Deposit	Layer on Section 1, Trench 1	Unknown

Context	Type	Description	Date
40	Deposit	Layer on Section 1, Trench 1	Unknown
41	Deposit	Layer on Section 1, Trench 1	Unknown
42	Deposit	Layer on Section 1, Trench 1	Unknown
43	Deposit	Layer on Section 1, Trench 1	Unknown
44	Deposit	Layer on Section 1, Trench 1	Unknown
45	Deposit	Layer on Section 1, Trench 1	Unknown
46	Deposit	Layer on Section 1, Trench 1	Unknown
47	Cut	Ditch, Section 1, Trench 1	Modern
48	Deposit	Fill of Ditch 47, Section 1, Trench 1	Modern
49	Deposit	Fill of Ditch 47, Section 1, Trench 1	Modern
50	Deposit	Layer on Section 1, Trench 1	Unknown
51	Deposit	Layer on Section 1, Trench 1	Unknown
52	Deposit	Layer on Section 1, Trench 1	Unknown
53	Deposit	Layer on Section 1, Trench 1	Unknown
54	Deposit	Layer on Section 1, Trench 1	Unknown
55	Deposit	Layer on Section 1, Trench 1	Unknown
56	Deposit	Layer on Section 1, Trench 1	Unknown
57	Deposit	Layer on Section 1, Trench 1	Unknown
58	Deposit	Layer on Section 1, Trench 1	Unknown
59	Deposit	Layer on Section 1, Trench 1	Unknown
60	Deposit	Layer on Section 2, Trench 2	Unknown
61	Deposit	Layer on Section 2, Trench 2	Unknown
62	Deposit	Layer on Section 3, Trench 3	Unknown
63	Deposit	Layer on Section 3, Trench 3	Unknown
64	Deposit	Layer on Section 3, Trench 3	Unknown
65	Deposit	Layer on Section 3, Trench 3	Unknown
66	Deposit	Layer on Section 3, Trench 3	Unknown
67	Deposit	Layer on Section 3, Trench 3	Unknown
68	Deposit	Layer on Section 3, Trench 3	Unknown
69	Deposit	Layer on Section 3, Trench 3	Unknown
70	Deposit	Layer on Section 3, Trench 3	Unknown
71	Deposit	Layer on Section 3, Trench 3	Unknown
72	Deposit	Layer on Section 3, Trench 3	Unknown
73	Deposit	Layer on Section 3, Trench 3	Unknown
74	Deposit	Layer on Section 3, Trench 3	Unknown
75	Deposit	Layer on Section 3, Trench 3	Unknown
76	Deposit	Layer on Section 3, Trench 3	Unknown
77	Deposit	Layer on Section 3, Trench 3	Unknown
78	Deposit	Layer on Section 3, Trench 3	Unknown
79	Deposit	Layer on Section 3, Trench 3	Unknown
80	Deposit	Layer on Section 3, Trench 3	Unknown
81	Deposit	Layer on Section 3, Trench 3	Unknown

Appendix 1b: Oasis Feature Summary

Period	Feature	Total
Medieval	Bank	2
Post medieval	Bank	1
Modern	Ditch	1

Appendix 2a: Finds by Context

Context	Material	Qty	Wt	Period	Notes
26	Baked Clay	1	1g	Unknown	

Appendix 2b: OASIS Finds Summary

Period	Material	Total
Unknown	Fired Clay	1

Appendix 3: Environmental Evidence

Sample No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Context No.	**66**	**70**	**81**	**26**	**21**	**5**	**38**
Trench No.	**3**	**3**	**?**	**2**	**2**	**1**	**1**
Cereals							
Hordeum sp. (grain)	x						
Triticum spelta L. (glume base)							x
T. aestivum/compactum type (rachis node)				x			
Cereal indet. (grain frags.)		xcf					xcf
Herbs							
Carduus sp.		xw					xw
Cirsium sp.		xw	xcfw				xw
Fabaceae indet. (?pod frag.)		xcf					
Potentilla anserina L.							xcfw
Ranunculus sp.		xxw					xw
Torilis japonica (DC)Houtt		xcffg					
Wetland plants							
Bolboschoenus/Schoenoplectus sp.		xw					
Carex sp.		xw					xw
Eleocharis sp.			xw				
Phragmites sp. (stem frags./nodes)						xxw	xw
Potamogeton sp.			xw				
Ranunculus subg. *Batrachium* (DC)A.Gray		xw					
Other plant macrofossils							
Charcoal <2mm	x	x	x	x	x		x
Charcoal >2mm		x			x		x
Charred root/stem		x		x			

Sample No.	1	2	3	4	5	6	7
Mineralised root channels		x	x	x		x	x
Waterlogged root/stem		x					
Indet.seeds		xw	xw	x			
Mollusc shells							
Terrestrial species							
Discus rotundatus	x						
Helicidae indet.	x						
Pupilla muscorum						x	
Vallonia sp.	x			x	x		
V. costata	xcf					x	
Fresh/Brackish water species							
Bithynia sp.	xcf						
Hydrobia ulvae	x					x	
H. ventrosa	x					xx	
Other remains							
Black porous 'cokey material		x		x	x	x	x
Black tarry material	x					x	
Bone				x			
Caddis larval cases			xw				
Ferrous fragment				x			
Fish bone				x			x
Marine mollusc shell frags.	x					x	
Mineralised soil concretions	xxx	xxxx		xxxx	xx	xxxx	xx
?Mortar					x		
Small coal frags.		x					
Waterlogged arthropod remains			x				
Vitreous material				x			
Sample volume (litres)	**42**	**14ss**	**16ss**	**16ss**	**16ss**	**16ss**	**16ss**
Volume of flot (litres)	**<0.1**	**<0.1**	**0.6**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
% flot sorted	**100%**	**100%**	**25%**	**100%**	**100%**	**100%**	**100%**

Key: *x = 1–10 specimens   xx = 11–50 specimens   xxx = 51–100 specimens   cf = compare   w = de-watered*