

KWNL11/003



KEADBY WIND FARM, NORTH LINCOLNSHIRE

Archaeological Evaluation of Compound 3

for SSE Renewables

GBDC/003/0025C/1 & PA/2011/0583

February 2012

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HA Job no.: KWNL11/003

NGR: SE 818 133

Parish: Keadby with Althorpe

Council: North Lincolnshire

OASIS ref.: headland1-118833

Archive will be deposited with North Lincolnshire
Museums Service (ref: KDAA)

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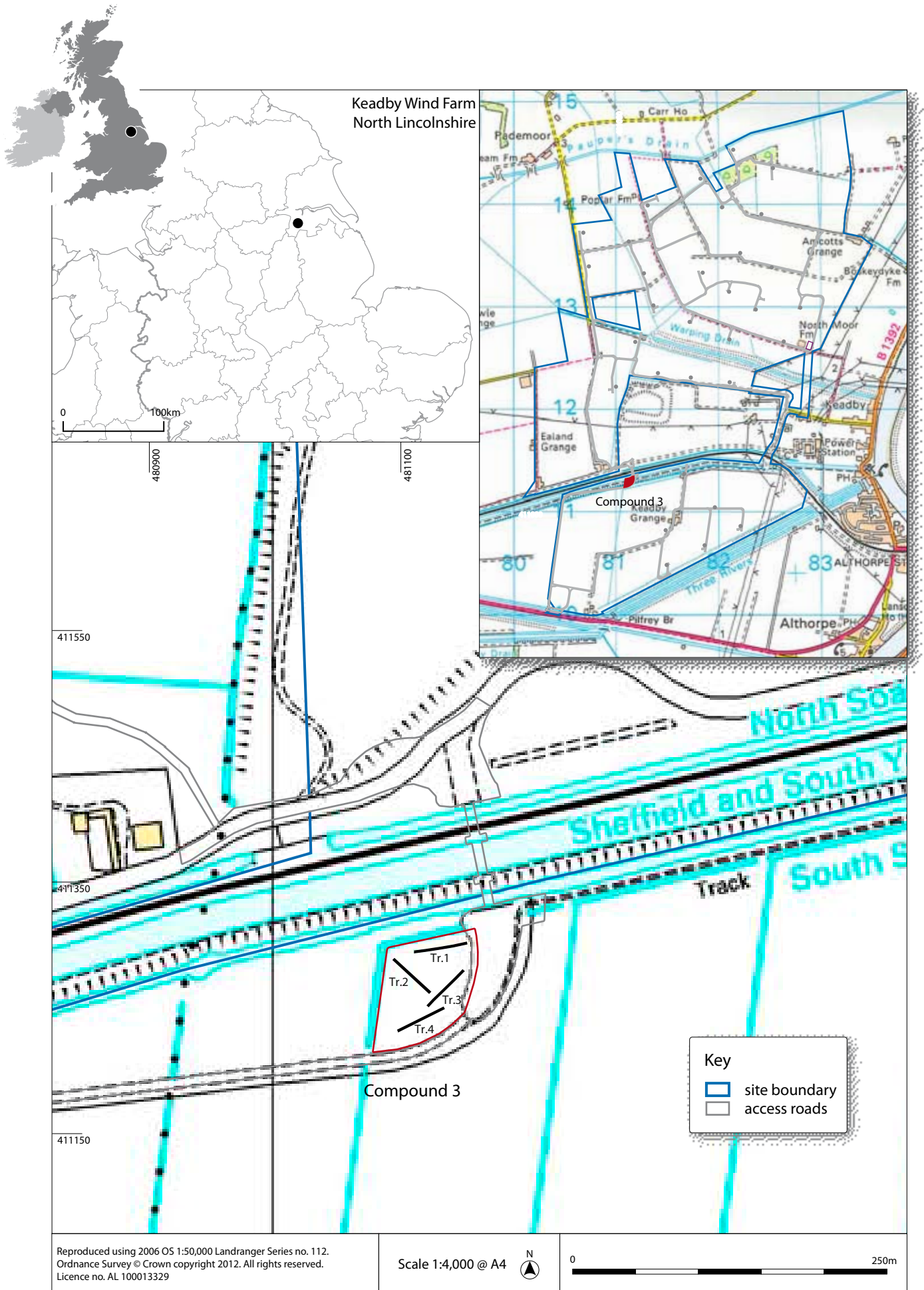
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CONTENTS

| | | |
|-----|--|---|
| 1. | INTRODUCTION | 1 |
| 2. | TRIAL TRENCHING | 1 |
| 3. | GOUGE AUGER SURVEY | 2 |
| 3.1 | Introduction | 2 |
| 3.2 | Method | 2 |
| | <i>Fieldwork</i> | 2 |
| | <i>Laboratory work</i> | 2 |
| 3.3 | Results | 5 |
| | <i>Auger survey</i> | 5 |
| | <i>Plant macrofossil and wood assessment</i> | 5 |
| 4. | DISCUSSION | 5 |
| 5. | REFERENCES | 6 |
| | APPENDICES | 7 |
| | Appendix 1 – Site registers | 7 |
| | <i>Trench register</i> | 7 |
| | <i>Context register</i> | 7 |
| | <i>Photographic register</i> | 7 |
| | <i>Sample register</i> | 8 |
| | Appendix 2 – Environmental tables | 8 |
| | <i>Auger results for Compound 3</i> | 8 |

LIST OF ILLUSTRATIONS

| | | |
|--|--|------|
| <i>Illus 1</i> | | viii |
| <i>Location plan</i> | | |
| <i>Illus 2</i> | | 2 |
| <i>View of Compound 3 from the north-east</i> | | |
| <i>Illus 3</i> | | 3 |
| <i>Trench layout and location of auger points AP1 – AP8</i> | | |
| <i>Illus 4</i> | | 4 |
| <i>Digital Elevation Model (DEM) showing peat depth and extent in Compound 3</i> | | |



Illus 1
Location plan

KEADBY WIND FARM, NORTH LINCOLNSHIRE

Archaeological Evaluation of Compound 3

The proposed site of Compound 3 at Keadby Wind Farm was evaluated through trial trenching. Four trenches, roughly 40m long by 1.6m wide, were excavated across the site, exposing light grey alluvial sands at 0.4m to 0.6m below ground surface. A series of drains, aligned north to south and east to west, was cut into the sand, but no significant archaeological features were uncovered.

In conjunction with the trial trenching an auger survey was carried out over the area of the compound, to clarify the nature and extent of below-ground deposits. Although not previously identified during test-pitting for site investigations work, nonetheless it is clear that peat deposits are present here. The peat was found to be a wood peat up to 2.4m deep containing fragments of birch and alder together with large oak trees.

1. INTRODUCTION

Keadby Wind Farm is located on the western side of the River Trent and is between the villages Keadby and Crowle. The scheme comprises 34 turbines located within an area of around 9.5km² centered on NGR SE 818 133. The site comprises large arable fields bounded by ditches and tracks. The southern half of the site is bisected by the Doncaster to Scunthorpe railway and the Stainforth and Keadby Canal; to the north, the site is crossed by the Pauper's and Warping Drains, which drain into the River Trent (Illus 1). The site is generally very flat and low-lying, roughly 0–2m OD and is a product of historic land reclamation.

Planning permission was granted for the construction of the Keadby Wind Farm subject to a number of archaeological conditions. In order to meet the terms of the archaeological conditions to the satisfaction of the planning authority, an Archaeological Mitigation Plan (Headland Archaeology 2012) was drawn up, to mitigate the impacts of the wind farm development on the cultural heritage resource of the development area. The archaeological evaluation of the site for the proposed Compound 3 reported here is part of this mitigation strategy.

The aim of the evaluation was to locate and characterize any archaeological features that would be affected by the construction of the site compound. At the same time an auger survey was carried out over the compound area, to clarify the nature and extent of below-ground deposits.

2. TRIAL TRENCHING

Magnar Dalland

The proposed site of Compound 3 is located on the south side of the Stainforth and Keadby Canal. The compound covers some 5,800m² and measures 90m north to south by 70m transversely. It is bounded to the north and west by an L-shaped open drain and to the south and east by a road and the embankment for an unfinished bridge across the canal (Illus 2).

Four trenches, roughly 40m long by 1.6m wide, were opened up across the site (Illus 3) covering a total area of over 264m² equivalent to 4.5% of the total area of the compound. The trenches were excavated down to light grey fine alluvial sand at 0.4m to 0.6m below the ground surface. On top of the sand was a layer of grey clayey silt, 0.2m to 0.4m deep. The turf and dark grey silty topsoil was generally 0.2m deep. A 0.4m deep deposit of made ground comprising yellowish crushed sandstone and mortar with bricks and pockets of mid-grey soil extended 3.5m into Trench 1 at its east end. This was made ground associated with the unfinished bridge-head to the east. Made-ground deposits were also recorded in the test pit data (TP03) from this area (Geotechnical Engineering Ltd 2009).

Cut into the alluvial sand and exposed in the bottom of the trenches was a series of drains. The drains were generally aligned east to west and north to south and are



2

Illus 2

View of Compound 3 from the north-east

likely to represent several different phases of drainage. The width of the drain-cuts varied from 0.15m to 0.45m. No significant archaeological features were exposed in the trenches. The Trench, Context, Photographic and Samples registers are listed in Appendix 1.

3. GOUGE AUGER SURVEY

Scott Timpany

3.1 Introduction

Trial trenching in the area of Compound 3 provided an opportunity for gouge auger survey to build on the sedimentary information provided by borehole, window sampling and test-pit data for this part of the development area. Previous test pits had revealed no peat in this area but did record potential organic bands within silts. The records for this area only extended to a maximum depth of 3.5m and so the gouge augering also gave an opportunity to build on these records and investigate deeper sediments. The aim was then to be able to tie these records in with the deeper borehole sequences near to this area.

3.2 Method

Fieldwork

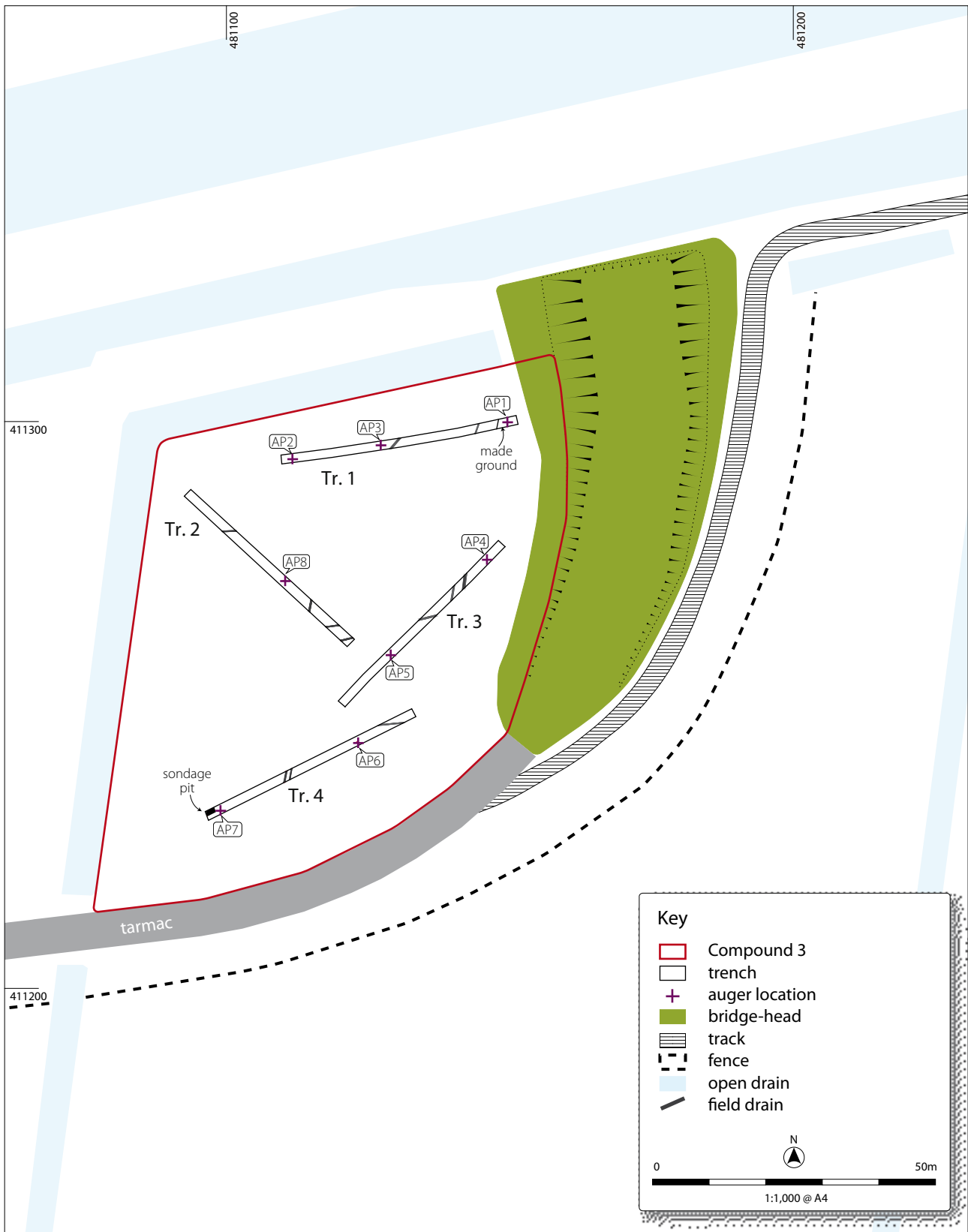
A total of eight auger points (AP1 – AP8: Illus 3) were undertaken and the sedimentary sequence was recorded at each location. All of the auger points were then levelled through survey in the field, with a differential GPS to record their position and the OD heights of the current ground surface.

Bulk samples were taken from the basal and upper peat layers encountered through the digging of a sondage, 1.8 x 0.9m and some 3m deep, at the west end of Trench 4. This provided the opportunity to assess the plant macrofossils in order to gain a better understanding of the nature of the peat.

Laboratory work

Wood identification

Samples were thin sliced along radial, tangential and transverse sections using a razor blade and then bleached before being mounted on a slide in glycerol and examined

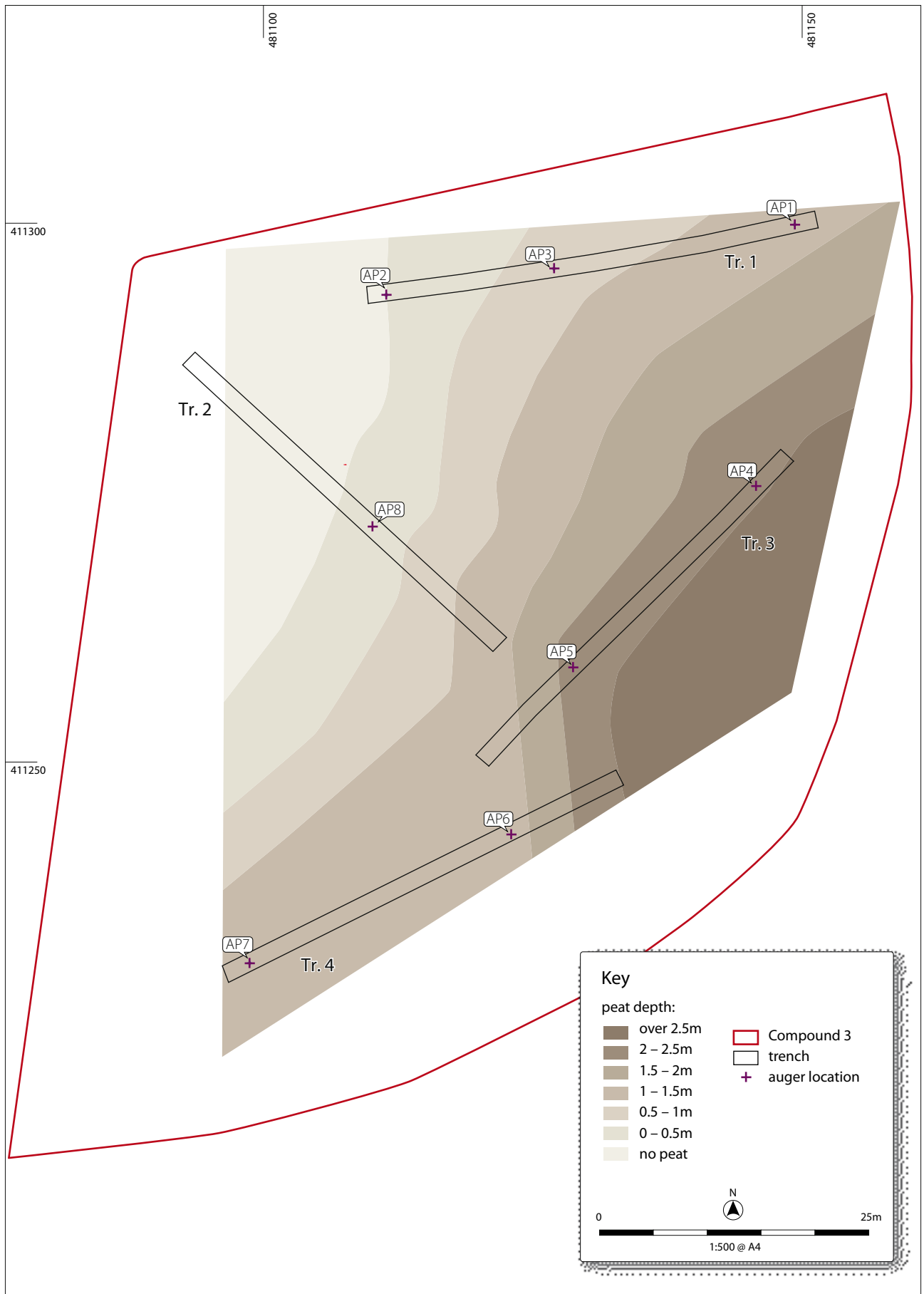


Illus 3

Trench layout and location of auger points AP1 – AP8



4



Illus 4

Digital Elevation Model (DEM) showing peat depth and extent in Compound 3

under a microscope at x100 and x400 magnification as required. Wood sections were identified using features described by Schweingruber (1978; 1990) and IAWA (1989).

Plant macrofossil assessment

The bulk samples were sub-sampled (250ml) and assessed. Samples were washed through a small stack of sieves with 1mm and 250µm meshes. The remains were sorted and identified using a binocular microscope at magnification of x10 and x40 where greater magnification was needed for identification. Identifications were confirmed using modern reference material and seed atlases including Cappers *et al.* (2006).

Digital Elevation Model (DEM) construction

The auger and survey data have been combined using Geographic Information System (GIS) to produce a DEM of the peat thickness and depth of the deposit (Illus 4).

3.3 Results

Auger survey

The auger survey revealed the presence of a wood peat layer within the Compound 3 area that was not previously recorded in the test pit (TP03) data. The recorded depth of peat ranged from 0.22m to 2.43m and was seen to be thickest in the east of the site, thinning out to the north and west (Illus 4). This represents a significantly deeper peat than is known to be present elsewhere in the wider area, deeper for example than the peat identified at Tween Bridge Wind Farm, near Thorne (Environmental Archaeology Consultancy 2011). The results of the auger survey are summarised in Appendix 2.

Excavation of the sondage in Trench 4 revealed large tree remains in the peat. These included a stump with the root base still visible from the middle of the peat layer, which was later identified as oak (*Quercus* sp.), together with smaller root and probable branch remains (Plant macrofossil and wood assessment, below). Augering revealed that the peat thinned out quite dramatically, especially within Trench 1 where at the eastern edge 1.3m of peat was recorded (AP1), declining to 0.75m in the middle (AP3) before disappearing altogether at the western end (AP2). The deepest peat (2.43m) was recorded at AP 4 in Trench 3.

At the western edge of the site and particularly within AP2 grey brown sandy silt with organic bands (approximately 0.01m thick) were observed at the same depth as the peat. These bands, together with the silt, may represent episodes of peat spread from the edge of the peatland or periods of relative stability.

The peat layer was found to overlies a grey silty coarse sand layer. This was also observed in the base of TP03

(Geotechnical Engineering Ltd 2009) and was also present in the nearest borehole (T11: Geotechnical Engineering Ltd 2009). This sand layer is seen to continue all the way down to the Mercian Mudstone Group at 12.9m in Borehole T11, indicating there are no further organic deposits below the peat encountered at Compound 3. Overlying the peat were layers of silty clay suggesting minerogenic inwash events, likely to represent the flooding of this and above these a fine sand with laminations of clay suggested to represent episodic flooding and sand deposition events.

Plant macrofossil and wood assessment

Assessment of the sub-samples from the base and top of the peat in Trench 4 and near to AP7 showed the presence of waterlogged plant remains (WPR) and wood fragments. The preservation of the material was seen to be excellent with most of the wood fragments present still retaining their bark and WPR showing little signs of damage or degradation.

Wood fragments identified from within the basal peat were found to be alder (*Alnus glutinosa*), while the presence of birch (*Betula* sp.) is also indicated in the form of bud scales, catkins and seeds, indicating a wet woodland canopy of alder and birch. Bramble (*Rubus fruticosus*) fruits were also present in the WPR assemblage for this layer with bramble known to have grown in the field layer of prehistoric wet woodland (Timpany 2005).

WPR remains were found to be sparse within the upper part of the peat layer with only buttercup (*Ranunculus* sp.) and fungal sclerotia observed. Wood identifications showed the continued presence of alder and birch suggesting the continued presence of these trees amongst the woodland canopy. The presence of an oak stump in the middle of the peat layer would suggest the peatland was becoming more terrestrialized, allowing for the spread of oak into the wetland. The presence of oak trees gradually colonising such wetland areas has been seen from prehistoric woodland investigations in the UK (eg Timpany 2005).

4. DISCUSSION

The augering at Compound 3 was able to determine the presence of peat that was hitherto not recorded in this area. The peat was found to be a wood peat containing fragments of birch and alder together with large oak tree remains (stump) seen within the sondage at the end of Trench 4. The presence of wood peat in the area around Compound 3 has been recorded at borehole T11 to the east where 0.3m of peat was recorded and at test pit TP02 to the west where 0.1m of peat was recorded. No peats have thus far been recorded immediately to the north of Compound 3, as indicated for example by test pits TPPA and TPPB or window sample WS01 (Geotechnical



Engineering Ltd 2009; Bam Ritchies 2011; data summarised in the Archaeological Mitigation Plan, Figure 1B). This would suggest the peat deposit at Compound 3 is one of the deepest in this part of the development area. Further augering and trial-trench evaluation work across the development area will help build up the picture of peat spread, enabling a more accurate palaeotopographic model to be constructed.

The palaeoenvironmental potential of the peats and organic deposits has previously been commented upon in the Archaeological Mitigation Plan (Headland Archaeology 2012). The current assessment has shown that WPR and wood fragments show excellent levels of preservation indicating there is also good potential for the presence of micro-fossils (eg pollen) and insect remains. The occurrence of large oak remains at the site also indicates good potential for dendrochronological studies that can be used for dating as well as to provide information on palaeoclimate.

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APPENDICES

Appendix 1 – Site registers

Trench register

| Trench no. | Alignment | Dimensions | Stratigraphy | Stratigraphy | Natural | Details |
|------------|-----------|------------|--------------------------|------------------------|----------------------|---|
| 1 | E-W | 1.6m x 42m | Turf and topsoil: 0–0.2m | Subsoil: 0.2–0.5m | Light grey fine sand | The cuts of two drains were exposed at the base of the trench. A 0.4m deep deposit of made ground (003) extended 3.5m into the trench at the east end. |
| 2 | NW-SE | 1.6m x 39m | Turf and topsoil: 0–0.2m | Subsoil: 0.2–0.5–0.6m | Light grey fine sand | The cuts of four drains were exposed at the base of the trench. |
| 3 | NE-SW | 1.6m x 40m | Turf and topsoil: 0–0.2m | Subsoil: 0.2–0.4–0.45m | Light grey fine sand | The cuts of three drains were exposed at the base of the trench. |
| 4 | NE-SW | 1.6m x 41m | Turf and topsoil: 0–0.2m | Subsoil: 0.2–0.3–0.4m | Light grey fine sand | The cuts of three drains were exposed at the base of the trench. A sondage pit some 2.7m deep was dug into the west end of the trench to expose the full depth of buried peat deposits. |

Context register

| Context no. | Trench no. | Description | Dimensions (m) |
|-------------|------------|---|-------------------|
| 001 | 1–4 | Turf and dark grey brown sandy silt loam. | 0.2m deep |
| 002 | 1–4 | Grey clayey silt. Subsoil/B horizon. | 0.2m to 0.4m deep |
| 003 | 1 | Yellowish crushed sandstone and mortar containing bricks and pockets of mid grey soil. Made ground. | 0.4m deep |
| 004 | 1–4 | Light grey fine alluvial sand. | – |

Photographic register

| Photo no. | Digital file | Facing | Description |
|-----------|------------------|--------|--|
| 01 | KWNL11-003-Pic01 | W | View across north part of site from bridge-head |
| 02 | KWNL11-003-Pic02 | SW | View across site from bridge-head |
| 03 | KWNL11-003-Pic03 | S | View across south-east part of site from bridge-head |
| 04 | KWNL11-003-Pic04 | NW | Made ground (C004) at east end of Trench 1 |
| 05 | KWNL11-003-Pic05 | W | Trench 1 seen from the east |
| 06 | KWNL11-003-Pic06 | E | Trench 1 seen from the west |
| 07 | KWNL11-003-Pic07 | SE | Trench 2 seen from the north-west |
| 08 | KWNL11-003-Pic08 | NW | Trench 2 seen from the south-east |
| 09 | KWNL11-003-Pic09 | SW | Trench 3 seen from the north-east |

| Photo no. | Digital file | Facing | Description |
|-----------|------------------|--------|---|
| 10 | KWNL11-003-Pic10 | NE | Trench 3 seen from the south-west |
| 11 | KWNL11-003-Pic11 | SW | Trench 4 seen from the north-east |
| 12 | KWNL11-003-Pic12 | NE | Trench 4 seen from the south-west |
| 13 | KWNL11-003-Pic13 | SW | Sondage pit at west end of Trench 4 |
| 14 | KWNL11-003-Pic14 | SW | Sondage pit at west end of Trench 4 |
| 15 | KWNL11-003-Pic15 | SW | Sondage pit at west end of Trench 4 |
| 16 | KWNL11-003-Pic16 | SE | Sondage pit at west end of Trench 4 |
| 17 | KWNL11-003-Pic17 | NW | Wood recovered from peat retrieved from sondage pit |



| Photo no. | Digital file | Facing | Description |
|-----------|------------------|--------|---|
| 18 | KWNL11-003-Pic18 | NW | Wood recovered from peat retrieved from sondage pit |
| 19 | KWNL11-003-Pic19 | SW | View across site showing backfilled trenches |

Sample register

| Sample no. | Description |
|------------|--------------------------|
| 001 | Basal peat from Trench 4 |
| 002 | Upper peat from Trench 4 |

Appendix 2 – Environmental tables

Auger results for Compound 3

8

| Core | Depth (cm) | Sediment | Unit |
|------|------------|--|------|
| AP1 | 0–30 | Topsoil | – |
| AP1 | 30–60 | Made Ground | – |
| AP1 | 60–146 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP1 | 146–165 | Dark grey fine sandy silt | 2 |
| AP1 | 165–206 | Light grey silty clay | 4 |
| AP1 | 206–336 | Dark brown peat with wood fragments | 1 |
| AP1 | 336–356 | Grey silty medium to coarse sand | 3 |
| AP2 | 0–45 | Topsoil | – |
| AP2 | 45–115 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP2 | 115–135 | Grey brown clay with fine sand inclusions | 4 |
| AP2 | 135–143 | Orangey brown fine silty sand with with grey clay laminations | 3 |
| AP2 | 143–205 | Dark grey brown silty medium sand | 3 |
| AP2 | 205–297 | Grey brown fine sandy silt with occasional black organic laminae | 6 |
| AP2 | 297–309 | Grey brown fine sandy silt with occasional sand lenses | 2 |
| AP3 | 0–30 | Topsoil | – |
| AP3 | 30–121 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP3 | 121–152 | Light grey clayey, medium sandy silt | 2 |
| AP3 | 155–230 | Dark brown peat with wood fragments | 1 |
| AP3 | 230–231 | Grey silty medium to coarse sand | 3 |
| AP4 | 0–40 | Topsoil | – |

| Core | Depth (cm) | Sediment | Unit |
|------|------------|--|------|
| AP4 | 40–87 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP4 | 87–105 | Blue grey silty clay | 4 |
| AP4 | 105–254 | Dark brown peat with wood fragments | 1 |
| AP4 | 254–285 | Dark reddish brown peat with wood fragments | 1 |
| AP4 | 285–348 | Dark brown peat with wood fragments | 1 |
| AP4 | 348–400 | Grey silty medium to coarse sand with dark grey silt bands | 2 |
| AP5 | 0–40 | Topsoil | – |
| AP5 | 40–92 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP5 | 92–308 | Dark brown peat with wood fragments | 1 |
| AP5 | 308–314 | Light grey silty medium to coarse sand | 3 |
| AP6 | 0–40 | Topsoil | – |
| AP6 | 40–72 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP6 | 72–294 | Dark brown peat with wood fragments | 1 |
| AP6 | 294–297 | Band of grey brown clay | 4 |
| AP6 | 297–317 | Dark brown peat with wood fragments | 1 |
| AP6 | 317–338 | Grey silty medium to coarse sand | 3 |
| AP7 | 0–30 | Topsoil | – |
| AP7 | 30–96 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP7 | 96–103 | Blue grey silty clay | 4 |

| Core | Depth (cm) | Sediment | Unit |
|------|------------|---|------|
| AP7 | 103–132 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP7 | 132–263 | Dark brown peat with wood fragments | 1 |
| AP7 | 263–273 | Grey silty medium to coarse sand | 3 |
| AP8 | 0–44 | Topsoil | – |
| AP8 | 44–95 | Orangey brown fine silty sand with grey clay laminations | 3 |
| AP8 | 95–142 | Grey brown clay with fine sand inclusions | 4 |
| AP8 | 142–144 | Blue grey silty clay | 4 |
| AP8 | 144–166 | Black to dark brown peat with occasional wood fragments | 1 |
| AP8 | 166–171 | Grey brown silty coarse sand with occasional black organic bands and charcoal fragments | 6 |
| AP8 | 171–190 | Grey silty medium to coarse sand | 3 |

| | | |
|------------------|---------------------------------------|--|
| Unit key: | | |
| 1 | Peat | |
| 2 | Silt, Cohesive Alluvium | |
| 3 | Sand, Granular Alluvium | |
| 4 | Clay, Cohesive Alluvium | |
| 5 | Mudstone | |
| 6 | Sand with organics, Granular Alluvium | |



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