

Cambridge Rowing Lake

Milton, Landbeach
and Waterbeach
Cambridgeshire



Geoarchaeological Assessment and Deposit Model



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GEOARCHAEOLOGICAL ASSESSMENT AND DEPOSIT MODEL

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SUMMARY

In September 2004 Oxford Archaeology (OA) was commissioned by the Cambridge Rowing Trust to undertake a geoarchaeological assessment at the proposed site of the Cambridge Rowing Lake. The Research Design for the Archaeological Mitigation of the Cambridge Rowing Lake, Revision 7 (OA 2003), identified the creation of a sub-surface deposit model for the site as an important step in the development of a mitigation strategy. This report presents the results of the deposit modelling and is based upon data gathered during the various phases of evaluation at the site.

The model demonstrated that variable thicknesses of undisturbed alluvial and peat deposits exist, predominantly on the low-lying areas of the floodplain, sealed beneath a thin layer of ploughsoil. These deposits thin and disappear against the rise of the terrace in the north western sector of the development where topsoil and a thin subsoil seal features dated to the late Iron Age and Roman period.

The greatest depths of fine-grained alluvium appear to date to the late Pleistocene to early Holocene period and consist of sands, sandy clays and silts, which directly overlie the Pleistocene gravels. Along the line of the proposed Cut these deposits infill undulations in the surface of the gravels, which may represent relict Pleistocene or early Holocene channels. In areas at the edges or between the channels, sand bars, eyots or elevated gravel ridges may have existed which persisted as 'islands' of drier ground during later periods before they were buried by later alluvial deposits. As such they may have acted as a foci for activity and provided a platform from which the abundant resources of wetland environment could be exploited. Bronze Age features were identified in Trench OA18 (OA 2004) associated with a gravel high.

In the evaluation trenches to the south of Fen Road, at the southern extent of the development, a possible weathered horizon or remnant buried soil was identified at the upper surface of the sands and silts. A number of prehistoric worked flints have been recovered during the various evaluation phases from this horizon. However, the presence of Romano-British features cut into the top of this deposit suggests it represents a surface that may have been extant over a considerable timespan. On the floodplain, to the north of Fen Road, a localised sequence of peat/organic mud was identified in two trenches overlying the basal gravels. This was in turn overlain by a more extensive complex of intercalated minerogenic sediments and grey, carbonate rich deposits. Initial impressions indicate that a permanent shallow water body, perhaps a poorly drained backswamp, probably existed in this location. A broad prehistoric date can be inferred for this sequence of deposits although sedimentation may not have occurred contemporaneously across this area. Sedimentation however appears to have ceased by the early Roman period as evidenced by features of this date cut into the surface of this unit.

Both the weathered horizon and calcareous deposits are overlain by an extensive layer of peat/organic silt clay, which sealed and infilled features dated to the early Roman period and indicates a subsequent expansion of fen environments. This layer was, in turn, overlain by an intermittent minerogenic silt-clay indicative of subsequent seasonal overbank flooding and alluviation from adjacent river channels.

Detailed examination of the sediment sequences revealed significant local variations representative of a range of depositional environments existing at any one time. In some areas these variations are clearly associated with topographic features that were subsequently buried by later alluviation and are no longer visible. The range of the depositional environments represented at the site has varying potential for the preservation of archaeological and palaeoenvironmental remains. Previous investigations in floodplain environments have shown that evidence of human activity has been found in association with the margins of channels and at the wetland/dryland interface. As such these locations are considered to represent significant areas of archaeological potential.

1 INTRODUCTION

- 1.1 The Research Design for the Archaeological Mitigation of the Cambridge Rowing Lake, Revision 7 (OA 2003), identified the creation of a sub-surface deposit model for the proposed site of the Cambridge Rowing Lake as an important step in the development of a mitigation strategy. This report presents the results of the deposit modelling and is based upon data gathered during the various phases of evaluation at the site. This includes the area of Cut and Canal evaluated by OA in 2003 (CARL03) and the Storage Lake evaluated in 2004 (CAST04). It also includes data retrieved during the investigation carried out by the Cambridge County Council Archaeological Field Unit in 1996 (Figs 1 and 2).
- 1.2 The primary objective of the deposit model is to provide base-line data regarding the nature of the sub-surface stratigraphy in order to clarify the context of the archaeological remains discovered and ultimately define areas of potential archaeological significance. Subsurface deposit modelling has the ability to reconstruct past geographies (palaeogeographies) for areas where the surface expression bears little or no relationship to those buried at depth. This type of approach is particularly valuable in floodplain environments where the archaeological potential is difficult to assess by traditional methods. This is often due to thick deposits of alluvium effectively masking earlier deposits that frequently lie at great depth in waterlogged conditions. The results of the model will be used as a framework within which the subsurface topography and human environment of the development area can be understood. This will provide the basis to model development impacts and further mitigation strategies.

2 GEOARCHAEOLOGICAL AND ENVIRONMENTAL BACKGROUND

- 2.1 The proposed development lies on the gravel terrace and floodplain of the River Cam, covering approximately 100 ha of land west of the river beyond the southern limit of the Fenlands (Fig. 1). The solid geology along the route corridor comprises Gault Clay, which outcrops in Waterbeach parish but rarely within the area of the Rowing Lake. (BGS sheet 203). The drift geology of the development area consists of Pleistocene river gravels of the first and second terraces with undulating bars of sand. At the eastern margins of the site the gravels are overlain by Holocene alluvial deposits, which incorporate deposits of peat. Modern ground levels within the development area lie between approximately 3m and 6m OD, with the highest areas located in the north-western sector of the proposed Storage Lake and the lowest elevations on the terrace edge and floodplain along the line of the Cut (Fig. 2).

- 2.2 In order to fully understand the nature of the stratigraphic sequences it is important to consider the changing nature of the sedimentary environment and the context of the site within the valley of the River Cam and British lowland river systems in general.
- 2.3 During the Pleistocene Britain was affected by a sequence of very cold glacial periods, when polar ice-caps expanded, sea levels fell, and much of the North and Midlands was covered in glaciers. Deposits relating to this period presently exist as wedges of sand and gravel sequences on valley sides, eroded by subsequent fluvial incision during periods of lowered sea level to create terraces. The most recent episodes of gravel deposition formed the gravels in the valley bottoms. These gravels were deposited under cold climate conditions in braided stream systems during the Late Pleistocene, between 10-15 ka B.P., when sea level may have been between 25m and 150m lower than present day (Bates 1998: 40). These systems consisted of unstable channels separated by shifting sandbars, probably loaded with silt and eroding wind-blown loess soils (Brown, 1997; Macklin, 1999).
- 2.4 The surface of the valley bottom gravels formed the template onto which alluvial sedimentation later occurred, during the Holocene. Current understanding of the sedimentation that has occurred throughout the Holocene has been summarised in Brown and Keough (1992), Brown (1997), and Robinson (1992). The Holocene regime of lowland river systems seems to have been one of channel stability. The transition from braided river systems, through an anastomosing process where fewer, more stable channels were formed and separated by gravel islands, towards a more stable, channelled flow regime occurred towards the end of the late Devensian.
- 2.5 In East Anglia the environmental development of the Fenland proper has been studied extensively (Waller 1994). The closest sites with palaeoenvironmental studies discussed by Waller however lie some distance to the north-east of the development area at Reach Lode, Swaffham Drain and Wicken Fen (ibid, 112). Discussion of environmental issues in the East Anglian review (Glazebrook 1997) is inevitably presented by Murphy on a period by period basis, with a consequent lack of emphasis on long term development of the environment. Recent consideration of specific environmental issues such as alluviation appear to have been concentrated on the western Fen-edge in the lower reaches of rivers Welland, Nene and Great Ouse (French 1990, French et al 1992; French and Pryor 1992). In the Peterborough area the evidence suggests large parts of the terrace/fen gravels were available and open land during the Neolithic and Bronze Age with major alluviation restricted to later periods. Comparable evidence in other areas, for example, the Nene and Ouse in the Midlands (Robinson 1992), has similarly indicated only limited alluviation on the floodplains during the early to mid Holocene with water tables seasonally low. Although localized flooding may have taken place, the evidence suggests away from channels the

floodplain may have been relatively dry. Indeed, there may have been very little distinction between the floodplain and the higher ground of the terraces with the pollen evidence suggesting an environment of dense alder woodland. However, until substantial silting had taken place in the channels hydrological changes would not have been reflected in terms of the sediment sequences across the floodplain. With little sedimentation, the landsurfaces would have been subject to pedological and bioturbation processes over a considerable period.

- 2.6 The factors responsible for the hydrological changes and alluviation are subject to some debate. Although climatic and sea-level change has been widely cited, Robinson and Lambrick (1984) correlated changes within the Upper Thames valley with woodland clearance and agricultural activity in the catchment. In the Welland Valley in East Anglia there is some evidence to suggest a combination of peat formation and alluviation was occurring as early as the Neolithic on floodplain, coincident with rising base water levels and woodland clearance. Sediment accretion gradually encroached onto the higher parts of the terrace during the later Neolithic and Bronze Age periods. By the post-Roman period, major blanket alluviation of the area began and continued to dominate the landscape until recent times (*ibid*).
- 2.7 The Holocene sedimentary sequences associated with the River Cam, in the vicinity of the development area on the southern margin of the Fenland, appear to have been subject to limited study. The work already done in relation to the Rowing Lake project is therefore of some importance, and the potential for more extensive work is high. While general principles are applicable in the valley of the Cam, local conditions may produce differences of detail. Caution must be stressed when applying regional models to site sequences where local factors of hydrology, topography and past land-use may have influenced patterns of sedimentation. The 1996 evaluation incorporated examination of a number of aspects of the broader environment within which phases of human activity in the area were set. The location of the project area mostly adjacent to, but partly within, the floodplain of the Cam means that the localised presence of waterlogged feature fills and deposits relating to the alluvial history of the river can be added to the more usual sources of environmental data.

3 AIMS

- 3.1 In order to provide base-line data regarding the subsurface stratigraphy, one of the overall objectives of the Research Design is to develop a deposit model for the study area. Specifically the model aims to:

- Characterise the sequence of sediments and patterns of accumulation across site, including the depth and lateral extent of major stratigraphic units, and to characterise any basal land surface pre-dating these sediments.
- Identify significant variations in the deposit sequence indicative of localised features such as topographic highs or palaeochannels.
- Identify the location and extent of any waterlogged organic deposits and address the potential and likely location for the preservation of archaeological and palaeoenvironmental remains.

4 METHODS

- 4.1 In order to create the deposit model all relevant lithological data retrieved from both recent phases of trenching (CARL03 and CAST04), and the earlier investigation (CCC96), were examined. This included examination of measured archaeological section drawings, as well as sediment logs recorded from several profiles from each trench during the fieldwork. The data was inputted into geological modelling software (©Rockworks2004, ©Surfer8) for analysis and correlation of key stratigraphic units. Overall a total of 172 data points distributed across the development area were used to create the deposit model. The stratigraphic units have been used to demonstrate the nature and the extent of sediment accumulation patterns across site. Various cross sections and elevation plots have been produced in order to illustrate the main points for discussion (Figs 3-9).
- 4.2 With reference to trench identification, data retrieved from the evaluation carried out by Cambridge County Council Archaeological Field Unit have been prefixed with CCC. Trenches excavated by OA in the area of the Cut are prefixed by OA, and those in the area of the Storage Lake by TT.

5 RESULTS

- 5.1 The evidence from the evaluation trenches revealed that a range of different sediment types are present across the site. A number of commonly occurring stratigraphic units have been identified and are summarized in Table 1 below.

Basement topography and early Holocene land surface

- 5.2 ***Unit 1. Bedrock*** The basal geology of the site is Gault clay. The majority of trenches did not expose this deposit, which lies at depth. However bedrock was exposed at higher elevations at the southern part of the site in OA2A at 3.16m OD, and in the north-east in TT23-25, TT32 and TT42 at 4.12-4.84m OD. Here it is described as a very firm mid bluish grey clay.

- 5.3 **Unit 2. Fluvial gravels.** Coarse poorly sorted sandy gravels appear to extend across the majority of the site overlying bedrock, and in most locations on the floodplain are sealed by later Holocene deposits. Where bedrock was proven the gravels varied substantially in thickness from 0.10m and 1.10m. The coarse grained character of the deposits suggests accumulation under cold climate periglacial conditions within high-energy braided streams. Thin layers of soft clay occasionally noted within this unit might represent infilling of eroded Pleistocene palaeochannels. Variation in the deposits can be expected where channel shifting occurred. Any archaeological remains identified within the deposits are likely to be reworked by fluvial processes.
- 5.4 A model of the possible late Pleistocene topography has been created based upon the elevations of the surface of the gravels (Fig. 3). Variations in this surface may well have dictated the patterns of subsequent sedimentation that occurred during later periods.
- 5.5 The highest elevations occur in the north-western sector on the gravel terrace in the area of the proposed Storage Lake, reaching a high of 5.37 m OD (TT20 Fig. 3 and 7-9). Elevations rapidly reduce to the south and south-east with low points along the eastern extent of the development area at between 2.05 and 2.55m OD (TT4, TT15, TT17, TT26, TT27, TT30, TT31, and TT40 Fig. 6). Further to the south on the floodplain/terrace edge in the area to be occupied by the Cut, elevations vary considerably with an average of between 2.70 and 3.20m OD (Fig. 3 and 5). An area of high ground is located at the southern extreme of the site at 3.42-2.9m OD (OA2-3). Topographic lows, possibly indicating the location of relict late Pleistocene or early Holocene channels, occur in CCC10-11, OA8-10, OA12, OA15-17, OA19-20 at elevations down to 1.94m OD. To the north of Bait's Bite Lock Road higher areas are located between these 'channels' which may have persisted as 'islands' of drier ground during later periods. These areas have an average elevation of between 2.69 and 2.98m OD (OA 11-14, OA18). Within OA18, features dated to the Early Bronze Age were identified cutting into the surface of the gravels (OA 2004).
- 5.6 **Unit 3. Lower alluvium.** These deposits are highly variable although generally they consist of yellowish brown sandy clay, silts and silty clay, with occasional localised pockets of gravel clasts and Fe oxidation (Unit 3c). They occur extensively across the area of both the Storage Lake and the Cut and directly overlie the basal gravels.
- 5.7 In the area of the proposed Storage Lake these deposits were absent at the very highest areas to the northeast, but were present elsewhere (TT1, 2, 5, 6, 7, 9, 11, 12, 15, 16, 17, 20, 26, 27, 30, 31, 33, 34, 38, 40, 41, 42, 43, 46, Fig. 6-9). These were, on average, 0.20m thick, although reached 0.54m in TT27. On the floodplain these deposits were recorded in the majority of trenches although they were absent in OA14 and OA18

where the elevations of the underlying gravels are higher (Fig. 5). The deposits range in thickness from 0.04m in OA16 to 1.29m in OA8 although they generally average 0.45m. They are often described as mottled with bluish grey silty clay at lower elevations. Localised deposits of light bluish grey silt clay (Unit 3b) and yellowish brown fine silty sand (Unit 3a) containing occasional coarse gravels were noted at lower elevations on the floodplain, directly overlying the fluvial gravels. This unit most likely represents active channel sedimentation with sand bar formation in a meandering river system. A component may represent aeolian-derived (wind-blown) deposits reworked by fluvial processes. The finer grained nature of these deposits suggests lower energy deposition perhaps during the transition to anastomosing and more stable flow regime developing during the Late Glacial and Early Holocene. Previous assessment of environmental indicators from unit 3c (in OA8) indicated very poor preservation of pollen, molluscs and plant remains. A couple of badly-preserved bisaccate grains (from coniferous trees) were noted (OA 2004). The top of Unit 3, Unit 3d, tended to be slightly darker in colour (greyish brown or dark yellowish brown) to a depth of between 0.05 and 0.44m. This may represent a weathered surface that has been subject to some degree of soil formation. Several worked and burnt flints were retrieved from the upper 0.20m of this unit (OA8-9, CCC1, CCC3-5). Although most of the flint was undiagnostic, a blade retrieved from CCC1 has been dated to the Late Mesolithic or Neolithic period, and a backed knife from OA9 to the Late Neolithic or Early Bronze Age. Any recovered artefacts from this surface may be relatively in situ. However, the top of these deposits was also the interface from which several early Roman archaeological features were cut which may suggest a significant period of stability and limited sediment accretion. Assemblages from a number of different periods spanning the prehistoric period may therefore be found on this surface. Previous assessment of environmental indicators from Unit 3d (in OA8) produced charcoal flecks and very occasional charred cereal chaff, molluscs and insect fragments. Pollen however was poorly preserved. The molluscan evidence suggested an open landscape; possibly damp grassland/meadow (OA2004).

- 5.8 A model of the possible early-mid Holocene topography has been created based upon the elevations of the surface of the Lower Alluvium (Fig. 4). Although similar to the plot created for the surface of the gravels the model demonstrates the infilling of lower lying area previously occupied by Pleistocene channels. The topographic highs previously noted, created by the underlying gravels, are still apparent though are now less prominent landscape features (Fig. 4 and 5).

The Holocene floodplain sediment sequences

- 5.9 The Holocene sediment sequences on the floodplain generally consist of fine-grained silt-clays, interbedded with peats. These deposits were encountered across the

floodplain and terrace edge within the majority of the interventions excavated, overlying the Pleistocene gravel and silts. Overall the evidence from the trenches indicated that there was a considerable degree of consistency in sequence order and thickness from one trench to another. Some local variation in sediment packages were noted in relation to underlying gravel surface topography but essentially a predominant mode of vertical sediment accretion was found. The sequences of Holocene 'alluvium' were seen to thicken in a downstream direction (towards the north-northeast). South of Fen Road these sediments appeared to thin and disappear rapidly. Initial impressions indicate that a shallow water body probably existed to the north of Fen Road while the margin of this feature lay immediately south of the road.

- 5.10 ***Unit 4. Lower Peat.*** This unit was only recorded in low-lying elevations directly overlying the fluvial gravels in CCC10-11 (Fig. 5). It is described as a layer or a sequence of several broadly contemporary layers of peat or organic mud up to 0.20m thick. It was recorded at levels between 1.92-2.28m OD. Formation is likely to have occurred in a vegetated, semi-terrestrial wetland fen environment perhaps with phases of low energy sediment input in marginal areas adjacent to active channels.
- 5.11 In CCC11 a thin sandy layer overlay this unit, while in CCC10 deposits correlated with Unit 5 overlay it. The date of this unit is uncertain although a radiocarbon date obtained on woody fragments from the peaty deposit produced a Middle Iron Age date (2380±60BP). The overlying coarse grained deposit in CCC11 however initially indicated an early Holocene date for what was thought to be an relict channel and this raises questions over the validity of the radiocarbon date. Unfortunately no other material was available at the time for verification. Any archaeological remains found in association with this unit are likely to be relatively in situ and well-preserved. However, initial assessment of pollen at this location suggests a low abundance and poor preservation despite the waterlogged conditions and preservation of wood. This may imply very slow formation of the deposit (ibid).
- 5.12 ***Unit 5. Mere/alluvial deposits.*** These deposits were quite variable consisting of light grey calcareous silt, sandy silt, silt clay (Unit 5c), intercalated with mid grey and yellowish or greyish brown silty or sandy clay (Unit 5b). Localised deposits of mid to light grey gravely calcareous silt, sandy silt, and silty clay were noted at the base of the sequence in OA11-13. Charcoal flecks were noted in many of the exposures.
- 5.13 These deposits occurred in the majority of trenches to the north of OA10 (OA11-20, CCC6-11, Fig. 5), where they appear to infill a low-lying basin. They were not identified south of this area indicating that the southern extent lies between OA10 and OA11. The deposits for the most part directly overlie Units 2 and 3 and vary between

0.05m and 0.40m in thickness. The deepest sequences occur in OA19 and OA17 at 0.46m and 0.40m respectively, although the average thickness is 0.25m.

- 5.14 The sequence from OA19 has been previously assessed for preservation of environmental indicators. Pollen, diatoms, molluscs and ostracods were well-preserved although preservation of plant remains was poor (OA 2004). The character of the deposits and evidence from the environmental assessment suggests low energy deposition, perhaps in an area open shallow freshwater influenced by periodic flooding. This area may have existed as a poorly drained backswamp that persisted throughout the year rather than just seasonally. Such calcareous deposits are characteristic of Fenland meres and may have accumulated quite rapidly. The sediment is likely to have been deposited from flooding episodes, which transported material from in-channel locations (CCC 1996). Artefacts associated with these deposits may be relatively in situ and well preserved though some level of reworking may be expected associated with the coarser grained sediments and adjacent to active channels.
- 5.15 At present the dating of these deposits is unclear. It is possible that, locally, parts of the sequence may have been deposited during the earlier prehistoric period (see 5.1.29). However, in OA18 detailed examination of the sediment logs suggests a thin layer of light grey calcareous sandy silt correlated with Unit 5 may extend across the surface of the gravel island sealing features of Early Bronze Age date. This indicates that, at least in this location, the upper levels of Unit 5 may date to the later prehistoric period. It should be noted that deposits correlated with this unit exhibit a high degree of variability both laterally and with depth. The presence of topographic features such as elevated areas and channels may well have influenced sediment accumulation patterns across this area. Although the environments of deposition may be similar sedimentation may not have been occurring contemporaneously across this area. Features cut into the top of Unit 5 (CCC96) and sealed by the organic Unit 6 indicate sedimentation had ceased by the early Roman period. At this point accumulation appears to have extended to elevations high enough to bury any previous islands of higher ground.
- 5.16 **Unit 6. Upper peat.** These deposits vary from dark brownish black clayey peat to dark grey or greyish brown organic silty clay and appear to extend across a large part of the floodplain area, overlying Units 3 and 5, and partially infilling and sealing archaeological features of early Roman date. In the area of the proposed Cut this unit was present in all trenches apart from OA1-2. In OA4-5, OA15, OA18-20, CCC7, CCC9-11 this unit lies directly beneath and is partly incorporated into modern ploughsoil. Elsewhere it is overlain by Unit 7 (Fig. 5). The thickness of this unit

- averages 0.15m, though reaches 0.32m in OA17. Elevations range from 2.7-3.62m OD.
- 5.17 In the area of the proposed Storage Lake, organic deposits with a maximum thickness of 0.47m were noted in TT1, TT4, and TT9 and may be the lateral equivalent (Fig.6). For the purposes of this assessment they have been grouped with Unit 6, although this would require confirmation by radiocarbon dating. Similarly organic deposits infilling Roman ditches in CCC12, CCC30 and CCC31 up to 3.62m OD may also be equivalent.
- 5.18 The descriptions suggest a range of depositional environments may be represented. The more organic parts of the deposits may represent wetland environments such as reed swamp or fen vegetation. Any archaeological material associated these deposits is likely to have minimal modification in terms of lateral transportation, though a high degree of reworking may be present near channel edge locations.
- 5.19 Assessment of environmental indicators from OA8 suggests preservation of pollen to be better than in Unit 4 and dominated by grasses and sedges indicative of grassland and wetlands. Cereal pollen was present (oats and/or wheat) showing arable farming was occurring in the vicinity. In OA19 charred cereal grain and charcoal was noted.
- 5.20 **Unit 7. Upper silt clay.** This unit comprises mid yellowish brown to greyish brown minerogenic silty clay directly overlying Unit 6. It was present in many of trenches along the line of the Cut (Fig. 5). It was not present in OA1-5, OA15, OA18, OA19, OA20, CCC7, CCC9-11. It averages 0.05-0.15m in thickness, although occurs up to 0.33m in OA12. Elevations range from 2.88m OD in OA17 to 3.69 in OA7. In the area of the proposed Storage Lake a lateral equivalent occurs in the low lying areas in TT1, TT4, TT9 and TT10 between 0.05m and 0.43m in thickness (Fig. 6).
- 5.21 Assessment of environmental indicators from OA8 suggests preservation of plant remains is poor in this unit. Pollen while also similarly poorly-preserved was dominated by grasses and sedges suggesting an open environment. Molluscan remains were more abundant and suggestive of damp grassland/meadowland (OA 2004). The character of the deposits suggests low energy accumulation by overbank seasonal flooding and sediment accretion on the low lying terrace edge and floodplain. Any archaeological material present within these deposits may be relatively in situ and well-preserved.
- 5.22 **Unit 8. Subsoil.** This unit consists of a mid greyish brown silt clay loam that extends across the gravel terrace in the area of the Storage Lake. It lies directly beneath the

modern ploughsoil and seals features of Iron Age and Roman date. It ranges in thickness from 0.05m and 0.28m, and may represent a remnant ploughsoil.

- 5.23 ***Unit 9. Top soil/ ploughsoil.*** This unit extends across the whole of the terrace and floodplain and is described as a dark greyish brown silty clay loam. The thickness varies between 0.16m and 0.43m.

6 DISCUSSION AND POTENTIAL

- 6.1 With reference to the original aims of this assessment the following points are worthy of note.
- 6.2 The sediments underlying the present ground surface at the site vary considerably in lithology from clay silts to sands and gravels. Additionally, a varying organic content may also be present including rooting, organic material and peaty layers. These observations indicate that a variety of depositional environments are represented by these sediments. Coarse elements, including sands and gravel, suggest deposition associated with active channels with medium to high energy depositional environments. Clay-silts suggest lower energy, floodplain surface environments. Variation in organic content indicates the possibility that conditions fluctuated in certain locations to include periods of peat formation. The range of different depositional environments and energy levels associated with these deposits indicate that varying potential exists for the preservation of archaeological and palaeoenvironmental material within the area.
- 6.3 The sediment sequences have been correlated into 9 major stratigraphical units. To summarise the sequence, the basal deposits comprise bedrock (Unit 1) overlain by coarse sandy gravels (Unit 2) probably deposited in cold climate braided stream systems during the Pleistocene. These deposits extend over the entire development area. Any artefactual material is likely to have been reworked by fluvial processes.
- 6.4 Overlying the gravels a sequence of fine-grained silts, sands and clays were noted (Unit 3). These suggest a reduction in the flow regime and may represent the shift during the late Pleistocene and early Holocene to anastomising and meandering river systems. These deposits are quite extensive, covering a large part of the development area, although they were thickest on the floodplain and absent at the highest elevations to the north-west. Overall, the fine-grained nature of these deposits suggests lower energy deposition and increased potential for in situ archaeological remains, although it should be noted no artefactual material was recovered from the lower levels of these deposits during the evaluation phases. The upper surface of Unit 3 appears to represent a stable weathered horizon that may have undergone soil-forming processes. As such

artefactual material will have suffered minimal lateral transport and this horizon has potential for the recovery of in situ prehistoric archaeological remains. A number of prehistoric worked flints have been recovered during the various evaluation phases from this horizon in trenches to the south of Fen Road.

- 6.5 To the north of OA10 (on the floodplain) this weathered horizon was not identified with certainty. A localized sequence of peat/organic mud (Unit 4) was identified in two trenches (CCC10, CCC11) overlying the basal gravels. Between OA11 and CCC12, Units 2, 3 and 4 were overlain by a complex sequence of intercalated minerogenic sediments and grey, carbonate rich deposits (Unit 5). Initial impressions indicate that a permanent shallow water body, perhaps a poorly drained backswamp probably existed to the north of Fen Road while the margin of this feature lay somewhere between OA10 and OA11. The predominantly fine-grained nature of these deposits suggest artefactual material may be relatively in situ although some localized reworking may have occurred in the vicinity of active channels. The dating of this sequence is somewhat problematic and although a broad prehistoric date can be inferred it has been suggested that sedimentation may not have occurred contemporaneously across this area (5.15). Sedimentation however appears to have ceased by the early Roman period as evidenced by features of this date cut into the surface of this unit.
- 6.6 Overlying Unit 3 south of Fen Road, and Unit 5 to the north, an extensive deposit of peat/organic silt clay was noted (Unit 6) A lateral equivalent of this unit was also noted at lower lying elevations in the area of the proposed Storage Lake. This deposit sealed and infilled features dated to the early Roman period and indicates a subsequent expansion of fen environments. This unit was, in turn, overlain by an intermittent minerogenic silt-clay (Unit 7) indicative of seasonal overbank flooding and alluviation from adjacent river channels. Archaeological remains associated with these deposits are likely to be relatively in situ. On the floodplain and terrace edge the sequence is capped by modern ploughsoil (Unit 9), whereas on the higher ground of the terrace a possible remnant ploughsoil (Unit 8) was identified at the interface between Units 1/3 and 9. This deposit seals features of Roman date.
- 6.7 Overall the sequences examined across the development area suggests the greatest depths of fine-grained alluvium appear to relate to the late Pleistocene to early Holocene period (Unit 3). During the middle and later Holocene accretion appears to have been localised and confined to perhaps minor inputs onto the weathered horizon 3d (OA1-10) as well as the infilling of the low-lying areas with carbonate rich deposits (Unit 5). However, it was not always easy to identify precisely the interface between the Pleistocene and Holocene deposits which were often lithologically very similar. More extensive development of fen conditions appears to have occurred during the late

Roman period (Unit 6) which may have extended onto the terrace edge in the area of the Storage Lake, followed by a widespread episode of overbank flooding and alluviation (Unit 7).

- 6.8 Along the line of the proposed Cut a number topographic lows in the surface of the gravels may indicate the locations of relict Pleistocene or Early Holocene channels. In areas at the edges or between the channels, sand bars, eyots or elevated gravel ridges may have existed which persisted as 'islands' of drier ground during later periods before they were buried by later alluvial deposits. As such they may have acted as a foci for activity and provided a platform from which the abundant resources of wetland environment could be exploited. A number of topographic high points have been noted in this assessment. Prior to the deposition of Unit 3 these appear as significant landscape features (Fig. 3), although as the channels gradually become infilled and sediment accretion extends to higher elevations these areas become less apparent (Fig. 4). Locally however in terms of floodplain, and indeed Fenland topography, even apparently minor elevated areas may have been significant.
- 6.9 The following areas have been identified as having enhanced archaeological potential due to their topographic position.
- OA18. During the evaluation stage, early Bronze Age activity was recorded on an elevated gravel area within OA18 (OA 2004). As such this area has significant archaeological potential.
 - OA 11-14 Additional areas that demonstrate some potential although no archaeological remains were identified during the evaluation phases.
 - The area between OA10 and OA11 has been identified as the edge of permanent body of water or backswamp. Prehistoric worked flint has been recovered from a possible weathered landsurface in the vicinity.
 - TT1, TT4, TT9-10. The low-lying topography at the edge of the gravel terrace in the eastern sector of the proposed Storage Lake. Here there is some potential for recovery of earlier prehistoric remains given the marginal situation at the interface between dry ground and the floodplain wetlands. Although no remains earlier than the late Iron Age were recovered in the vicinity the alluvial sequences were not exposed or sampled in their entirety due to the high water table.
- 6.10 The majority of the deposits investigated on the floodplain appear to be preserved in waterlogged anaerobic conditions. However, previous assessment of environmental indicators (including pollen, diatoms, plant macro remains, ostracods and molluscs)

has produced variable results. Assessment of the localised organic deposit (Unit 4) in CCC10-11 indicated preservation of pollen was generally poor. Conditions were however conducive for preservation of woody fragments, including a 1.0m long piece of 'bog oak' (CCC96). This indicates some potential for the survival of wooden structures associated with this deposit. Pollen preservation appeared to be slightly better in the more extensive upper peat (Unit 6) along with limited charred and waterlogged plant remains and molluscs (OA 2004). Better preservation however was found to be contained within organic deposits infilling archaeological features. Of the minerogenic deposits, the lower levels of Unit 3 (of probable late Pleistocene or early Holocene date) on the whole appeared to be sterile, although the upper weathered surface (Unit 3d) was more productive producing occasional charred plant remains and molluscs. The calcareous mere/alluvial deposits (Unit 5) produced significantly better results and contained abundant molluscs and ostracods. Surprisingly, given the calcareous conditions, pollen was also moderately to well- preserved.

- 6.11 Overall, on the basis of the samples assessed there is clear potential for more detailed environmental work that could contribute to the landscape history of the site. Extensive recording and environmental sampling of representative sediment sequences, at a resolution adequate for analysis, was undertaken during the evaluation phases along the line of the proposed Cut. However, it is clear in the low-lying area infilled by Unit 5 there is much variability. There is also some question of the dating of various parts of this sequence. The potential for radiocarbon dating material from the current set of samples is limited. Given the inferred environments of deposition it is not considered appropriate to date single fragments of charcoal or cereal grain/chaff. Unfortunately only limited exposure of alluvial deposits was achieved in the area of the Storage Lake due to a high water table. No samples were retrieved for assessment of palaeoenvironmental potential.

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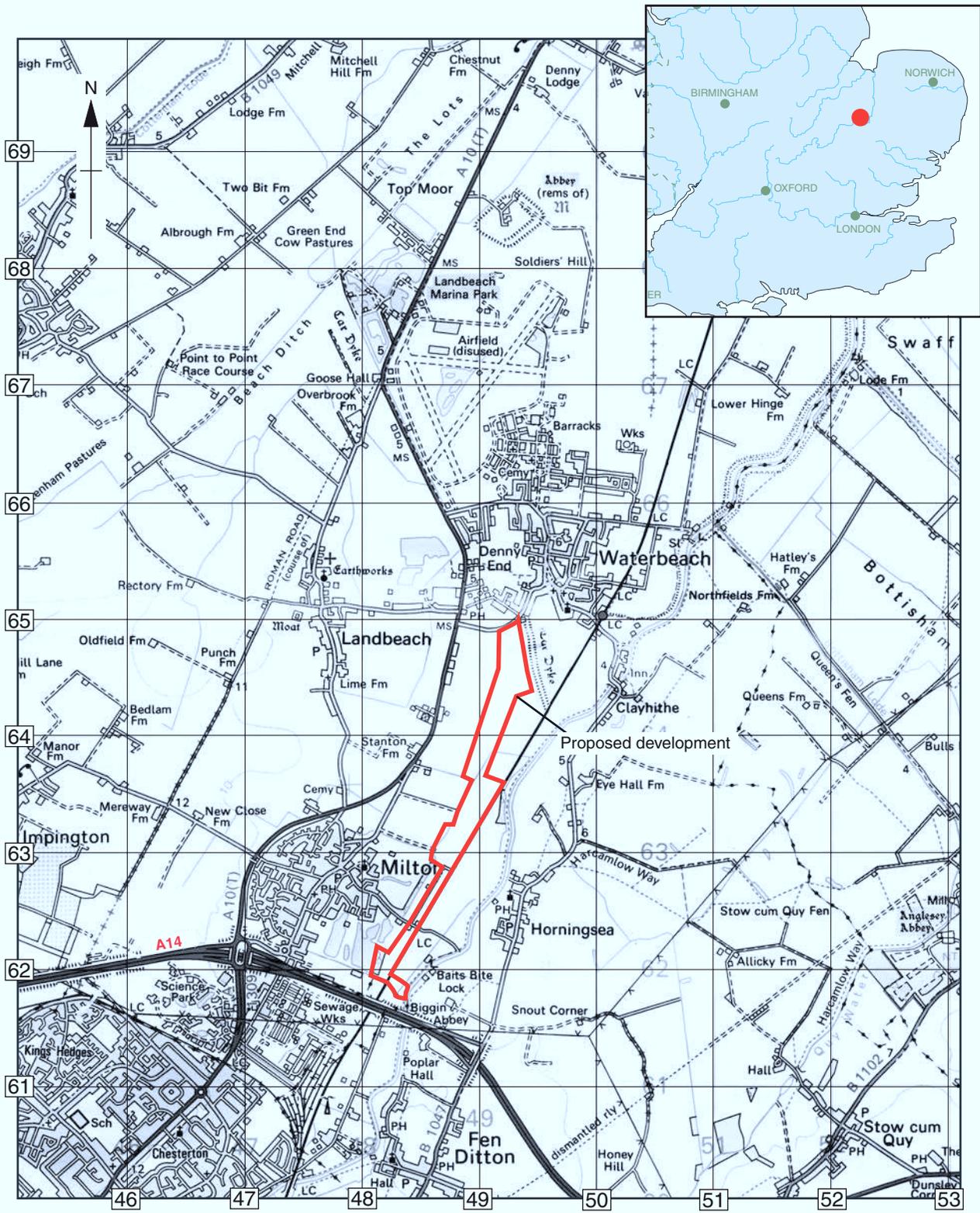
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Table 1 Summary of Stratigraphic Units

Unit	Sediment Description	Sedimentary Environment	Inferred date	Equivalent alluvial parcel (CCC 96)	Geoarchaeological parameters (residuality)	Location	
9	Topsoil	Dark brownish grey silty clay loam	Floodplain and terrace topsoil - Arable cultivation	Modern	1000		Extends across whole site
8	Subsoil	Mid greyish brown silt clay loam	Subsoil lying directly beneath topsoil. Probably a remnant Ploughsoil.	Post Roman	-		Seals IA-RB features on higher ground of gravel terrace. TT2, TT5-9, TT11-13, TT15-17, TT20, TT22-28, TT30-38, TT40-43, TT46, CCC14-17, CCC19-21, CCC26, CCC37
7	Upper Alluvium	Mid yellowish brown to greyish brown minerogenic silty clay	Low energy overbank seasonal flooding and sediment accretion on low lying terrace edge and floodplain	Post Roman	1001	Artefacts may be insitu and well preserved.	Seals features on floodplain and terrace edge OA 6-14, OA16-17, CCC1-6, CCC8, TT1, TT4, TT9-10
6	Upper Peat	Dark brown to black peaty loam, peaty clay to dark greyish brown organic silty clay.	Vegetated semi-terrestrial wetland fen environment with phases of low energy sediment input in marginal areas adjacent to active channels.	Late Roman	1002	Artefacts may be insitu and well preserved	Seals and infills features on floodplain and terrace edge OA3-20, CCC1-12, CCC18, TT1, TT 4, TT9
5	Mere/alluvial deposits	5c Light grey calcareous silt, sandy silt, silt clay with abundant shell fragments, charcoal flecks 5b Minerogenic mid grey and yellowish or greyish brown silty or sandy clay. Charcoal flecks. 5c. Mid to light grey gravely calcareous silt, sandy silt, and silt-clay.	Low energy sediment accretion in areas of well-vegetated permanent standing water (shallow lake or back-swamps) occasionally inundated by flooding from the adjacent active channels.	Prehistoric? - IA-Rom	1005/1004	Artefacts may be insitu and well preserved though some level of reworking may be expected associated with coarser grained sediments and adjacent to active channels	Localised deposits in low-lying floodplain areas north of Fen Road. OA11-20, CCC6-11
4	Lower Peat	Peat/organic mud	Vegetated semi-terrestrial wetland fen environment with phases of low energy sediment input in marginal areas adjacent to active channels.	Prehistoric?	1006	Artefacts may be insitu and well preserved.	Localised deposit in low-lying floodplain area north of Fen Road CCC10-11

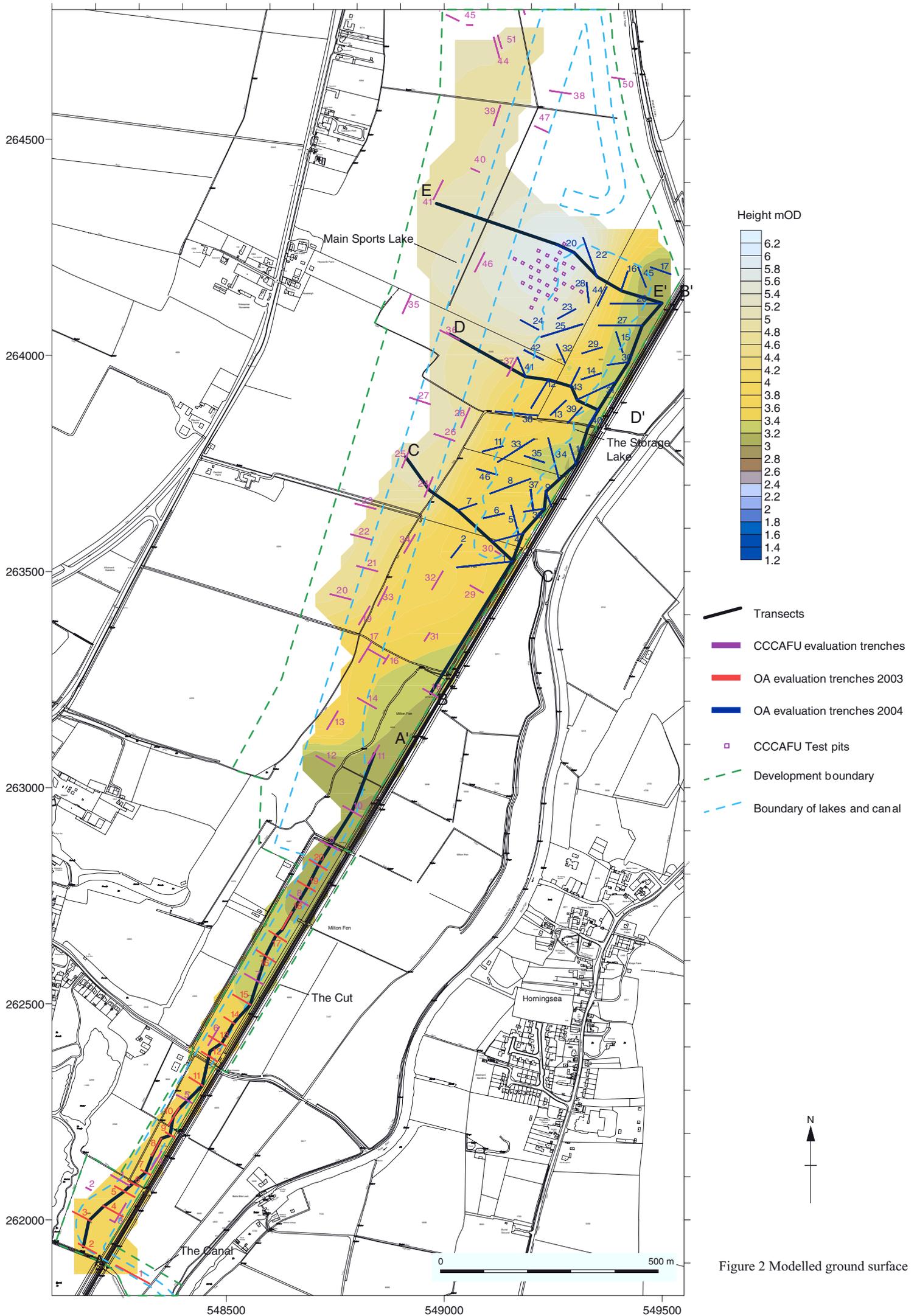
Unit		Sediment Description	Sedimentary Environment	Inferred date	Equivalent alluvial parcel (CCC 96)	Geoarchaeological parameters (residuality)	Location
3	Lower alluvium	3d. Greyish brown or dark yellowish brown sandy clay, silty clay, silt, silty sand with occasional gravelly lenses. The upper surface is cut by IA-Roman features, and on the floodplain locally it contains prehistoric worked flint	Weathered upper surface of Pleistocene deposits (3c, 3b, and 3a). Stabilised/ terrestrial surface, (soil formation?), possibly subject to low energy sediment input from adjacent channels.	Prehistoric - IA/Rom?	1003	Any recovered artefacts from the surface of these deposits may be relatively insitu and associated with a phase of soil formation.	Present across a large part of the development area apart from the highest ground to the northwest. OA1-13, OA15-17, OA19-20, CCC1-5, TT1-2, TT5-7, TT9, TT11-12, TT15-17, TT20, TT26-27, TT30-31, TT33-34, TT38, TT40-43, TT46 Unit 3d is present in the area of the Cut in OA1-10, CCC1-5 south of Fen Road. It is intermittently present at lower elevations in the area of the Storage Lake.
		3c. Mid yellowish brown sandy clay silt, silty clay	Active channel sedimentation with sand bar formation in meandering river system A component may represent aeolian derived deposits reworked by fluvial processes	Late Pleistocene-Early Holocene?	-	Any recovered artefacts associated with the coarser sediments will be rolled and suffered some movement from original place of discard.	
		3b. Light bluish grey sandy and silty clay					
		3a. Loose structureless yellowish brown silty sand					
2	Fluvial gravels	Coarse poorly sorted yellowish brown sandy gravel	High-energy fluvial environment Probably cold climate braided channel systems with low sand and gravel ridges. Low scrub vegetation on more stable eyots.	Pleistocene	-	Any recovered artefacts will be rolled and have suffered mechanical damage	Extends across entire development area.
1	Bedrock	Firm bluish grey clay	Gault Clay	-	-		Bedrock exposed at higher elevations where fluvial gravels thin. OA2, TT23-25, TT32, TT42

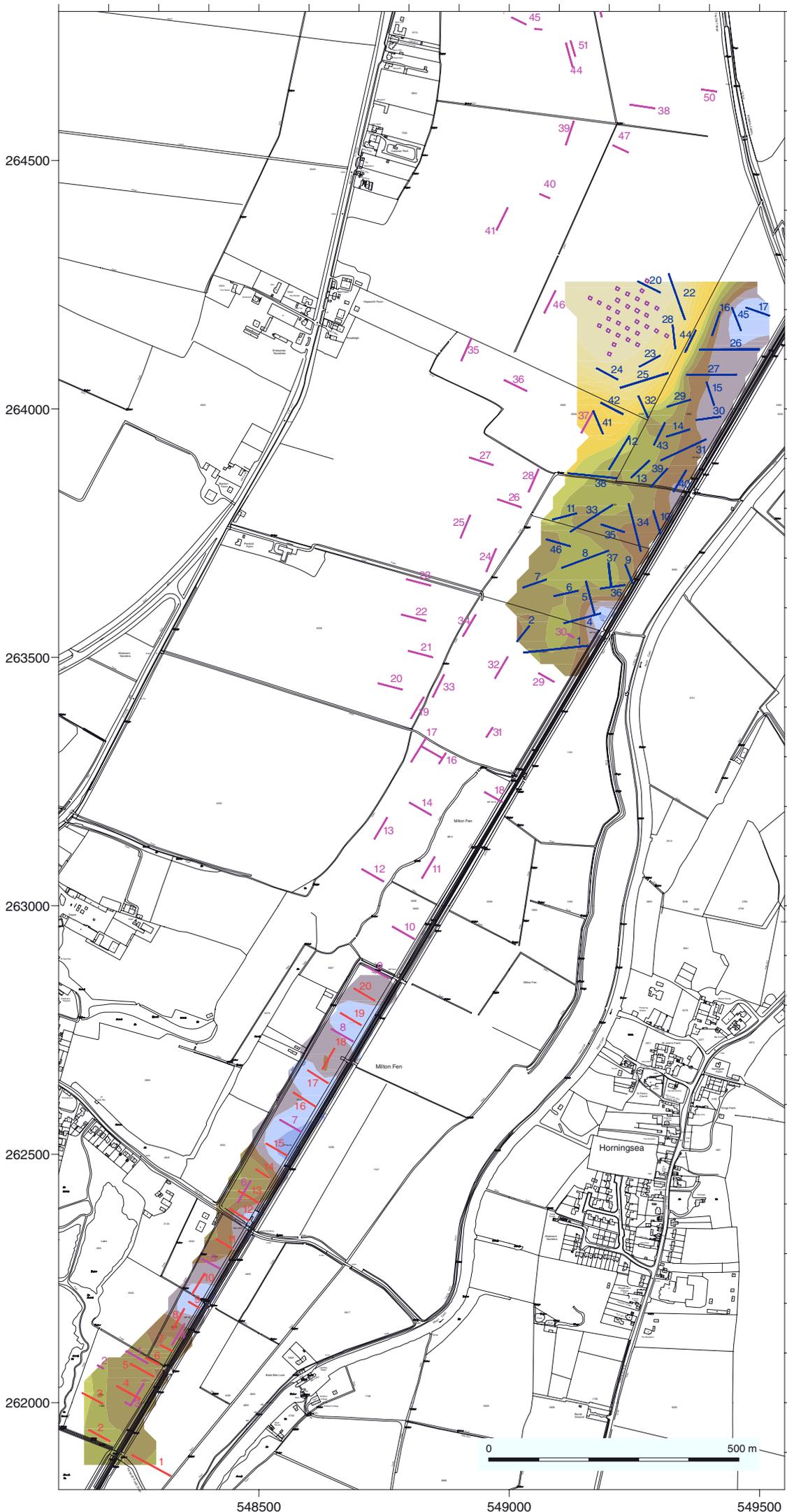


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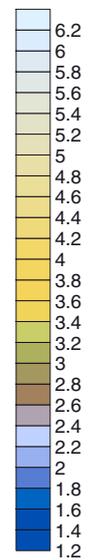
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Figure 1: Site location





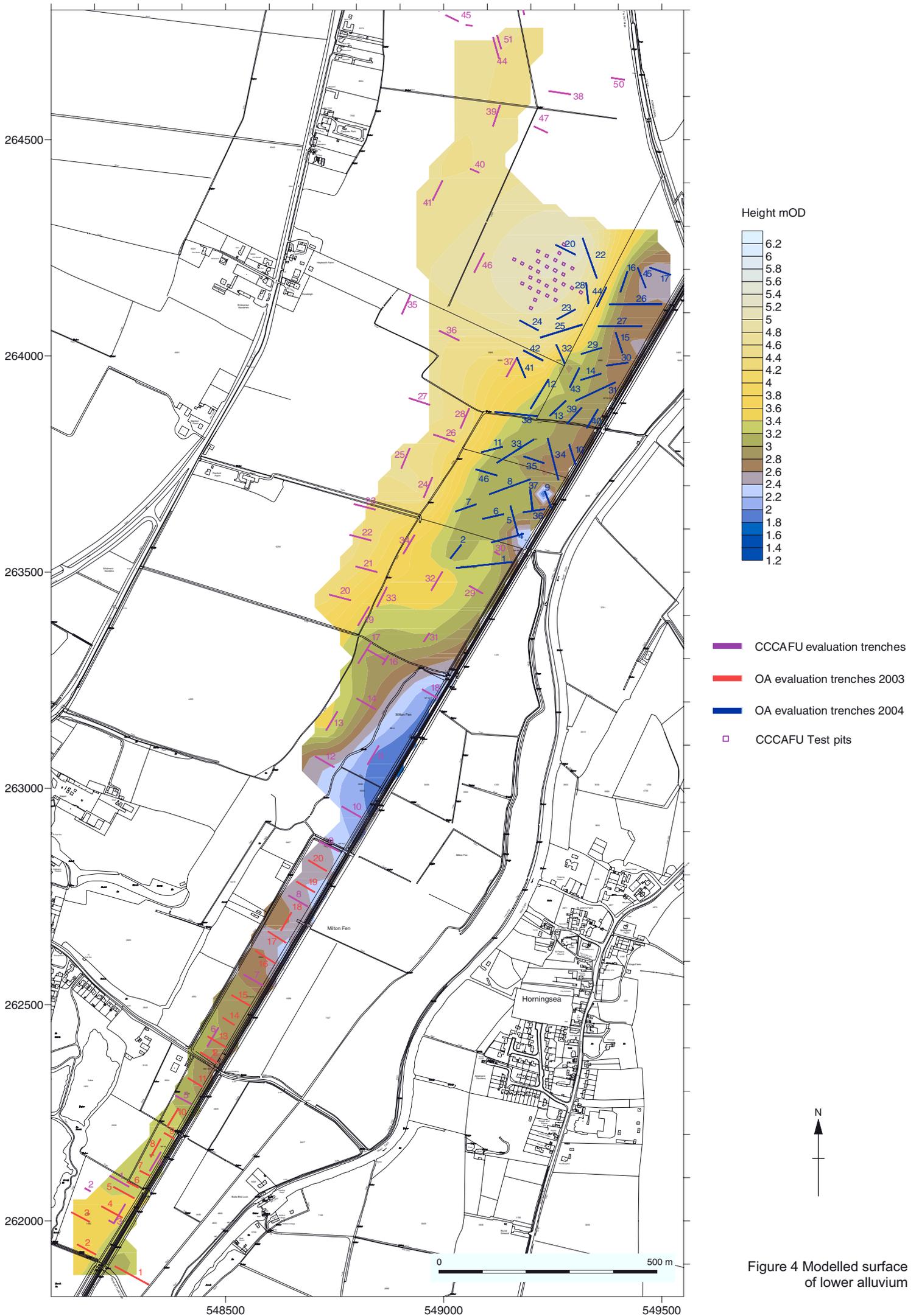
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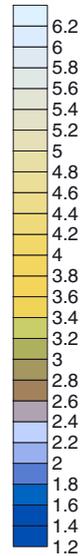
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- OA evaluation trenches 2003
- OA evaluation trenches 2004
- CCCAFU Test pits



Figure 3 Modelled surface of fluvial gravels/bedrock



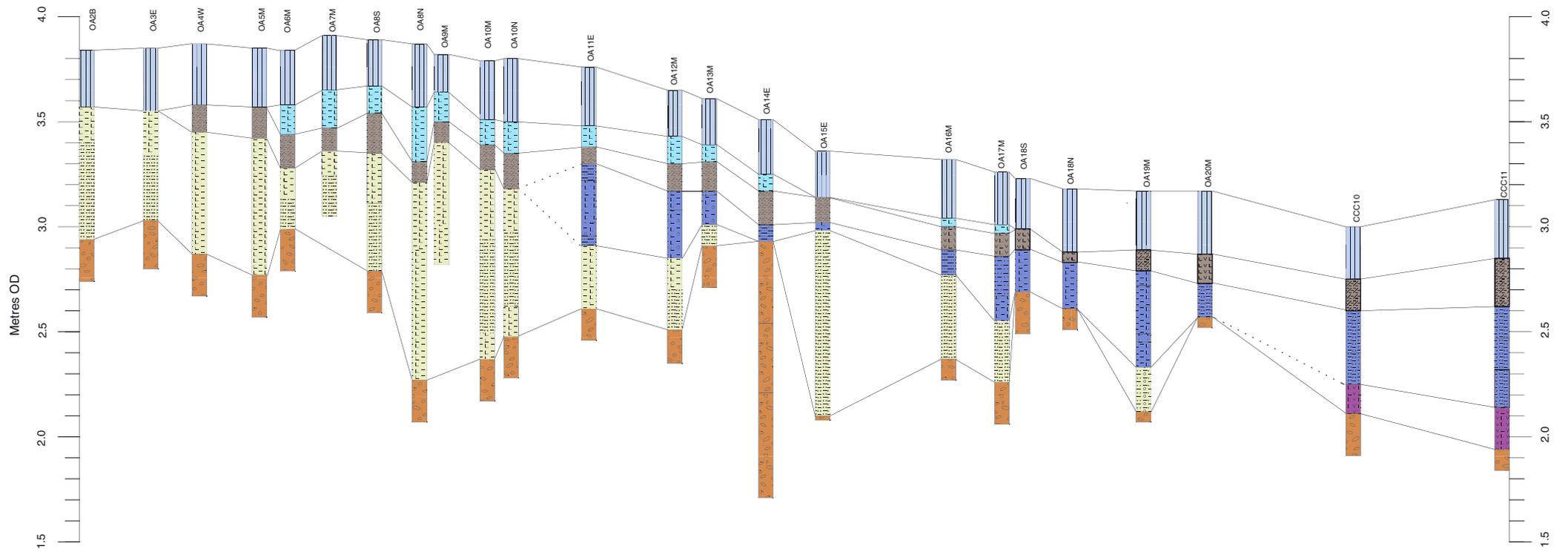
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- CCCAFU Test pits



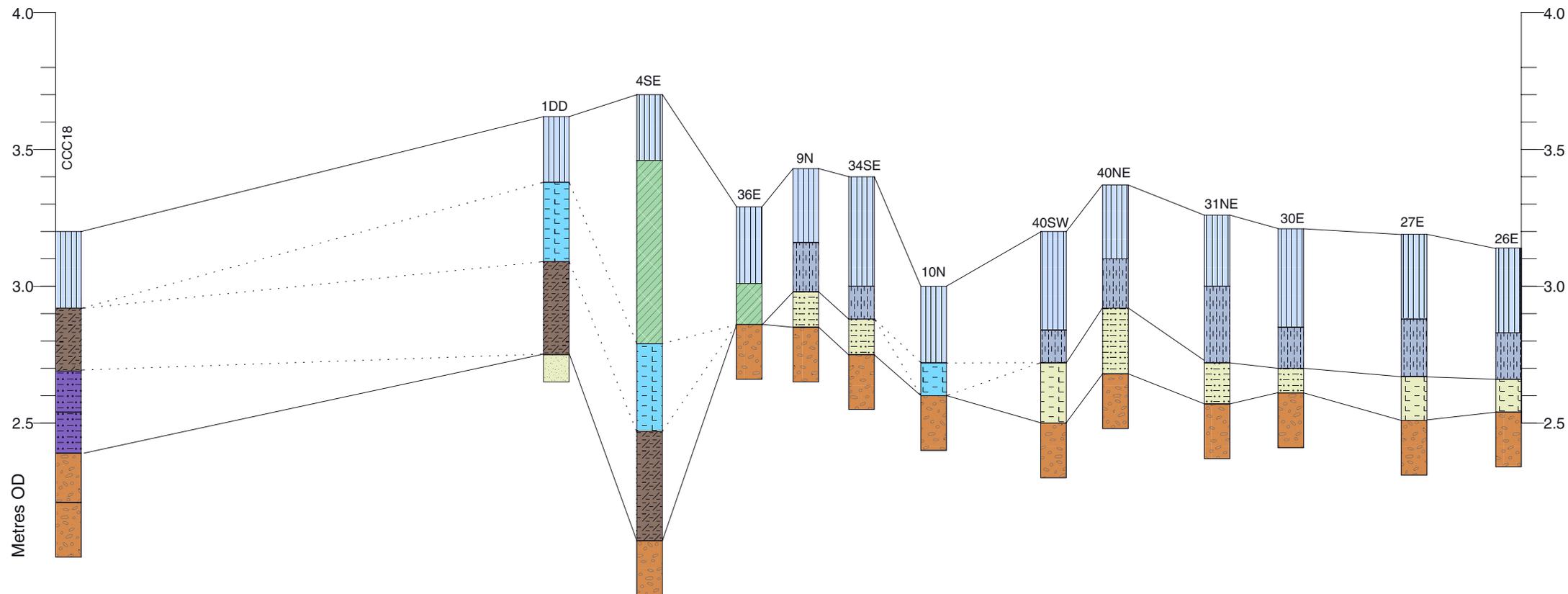
Figure 4 Modelled surface of lower alluvium



KEY

Stratigraphic Units		Lithology	
9	Topsoil	[Pattern]	Subsoil
9	Made ground	[Pattern]	Peat
8	Subsoil	[Pattern]	Sand
7	Upper alluvium	[Pattern]	Silt
6	Upper peat	[Pattern]	Clay
5	Mere/Alluvial deposits	[Pattern]	Gravel
4	Lower peat	[Pattern]	Topsoil
3	Lower alluvium	[Pattern]	Organic
2	Fluvial gravel		

Figure 5: Southwest-northeast transect (The Cut) A - A '



KEY

Stratigraphic Units		Lithology	
9	Topsoil	[Pattern]	Subsoil
9	Made ground	[Pattern]	Peat
8	Subsoil	[Pattern]	Sand
7	Upper alluvium	[Pattern]	Silt
6	Upper peat	[Pattern]	Clay
5	Mere/Alluvial deposits	[Pattern]	Gravel
4	Lower peat	[Pattern]	Topsoil
3	Lower alluvium	[Pattern]	Organic
2	Fluvial gravel	[Pattern]	Made ground

Figure 6: Southwest-northeast transect (The Storage Lake) B - B'

KEY

Stratigraphic Units		Lithology	
9	Topsoil		Subsoil
9	Made ground		Peat
8	Subsoil		Sand
7	Upper alluvium		Silt
6	Upper peat		Clay
5	Mere/Alluvial deposits		Gravel
4	Lower peat		Topsoil
3	Lower alluvium		Organic
2	Fluvial gravel		Made ground

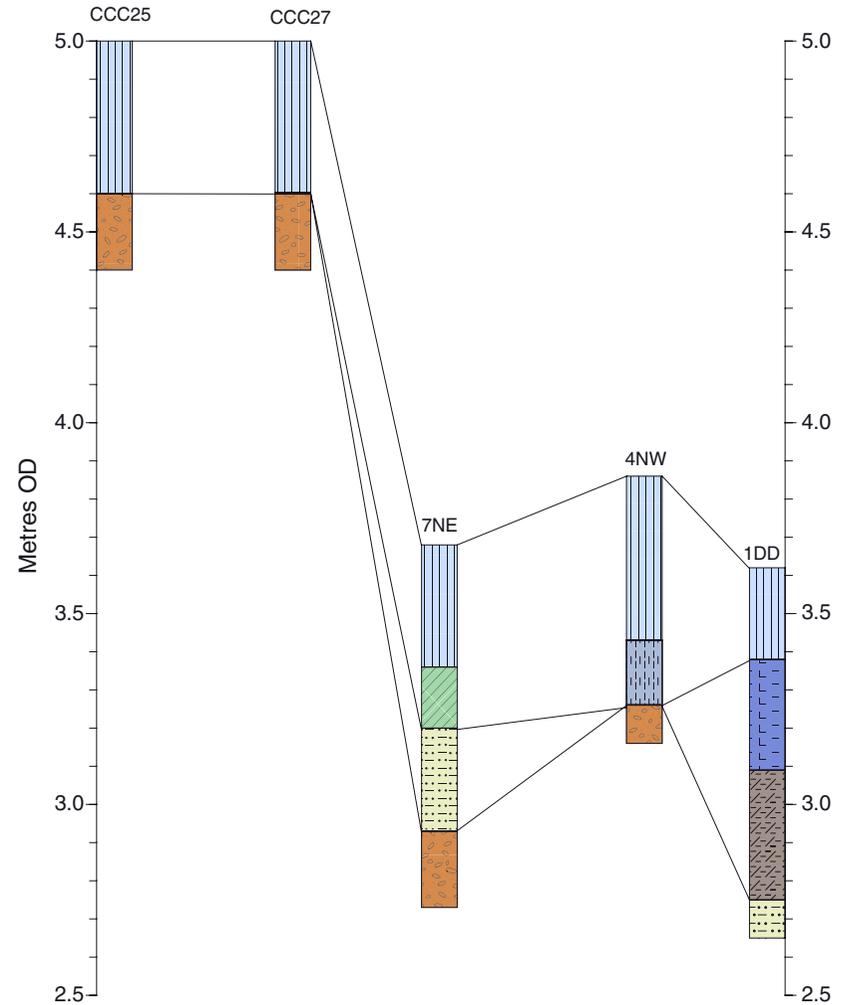


Figure 7: Northwest-southeast transect (The Storage Lake South) C - C'

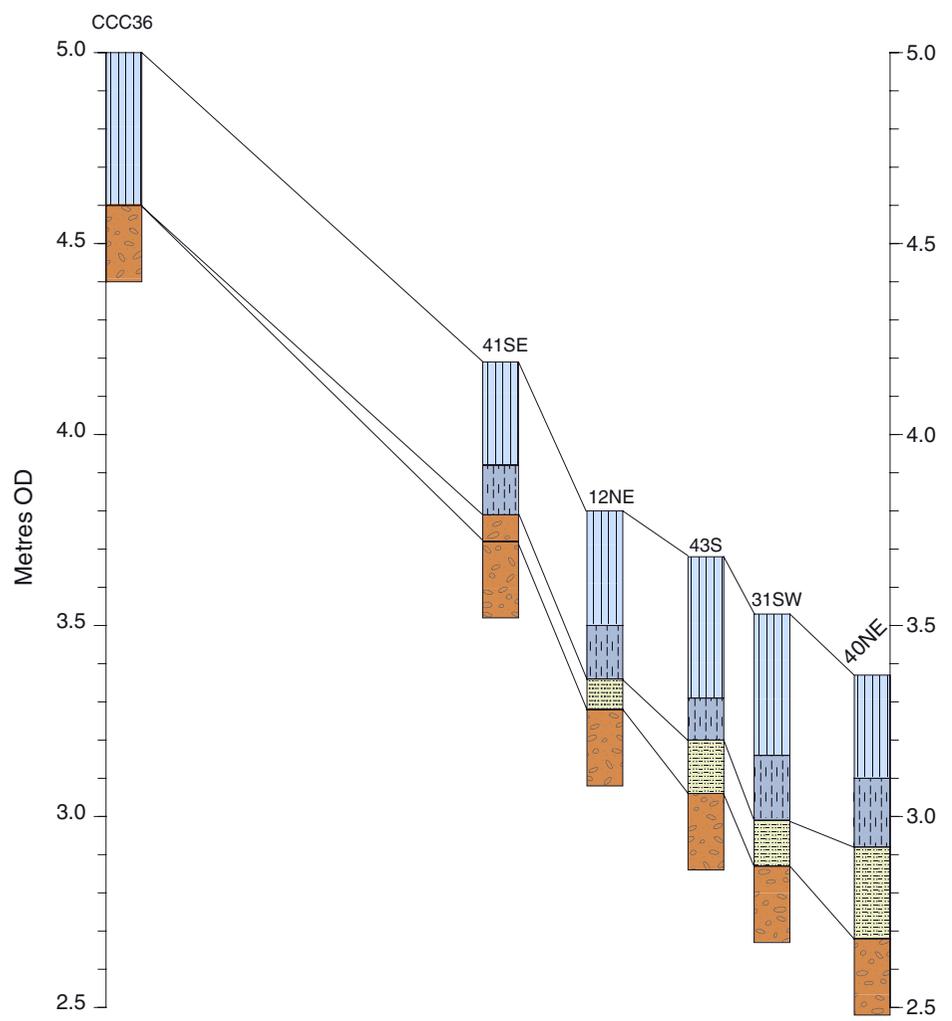
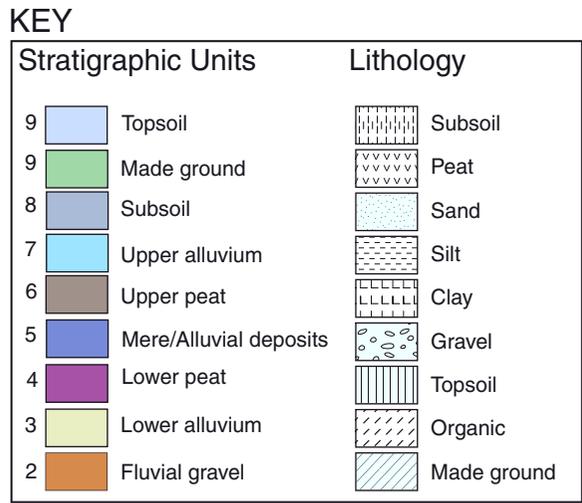


Figure 8: Northwest-southeast transect (The Storage Lake central) D - D '

KEY

Stratigraphic Units		Lithology	
9	Topsoil		Subsoil
9	Made ground		Peat
8	Subsoil		Sand
7	Upper alluvium		Silt
6	Upper peat		Clay
5	Mere/Alluvial deposits		Gravel
4	Lower peat		Topsoil
3	Lower alluvium		Organic
2	Fluvial gravel		Made ground

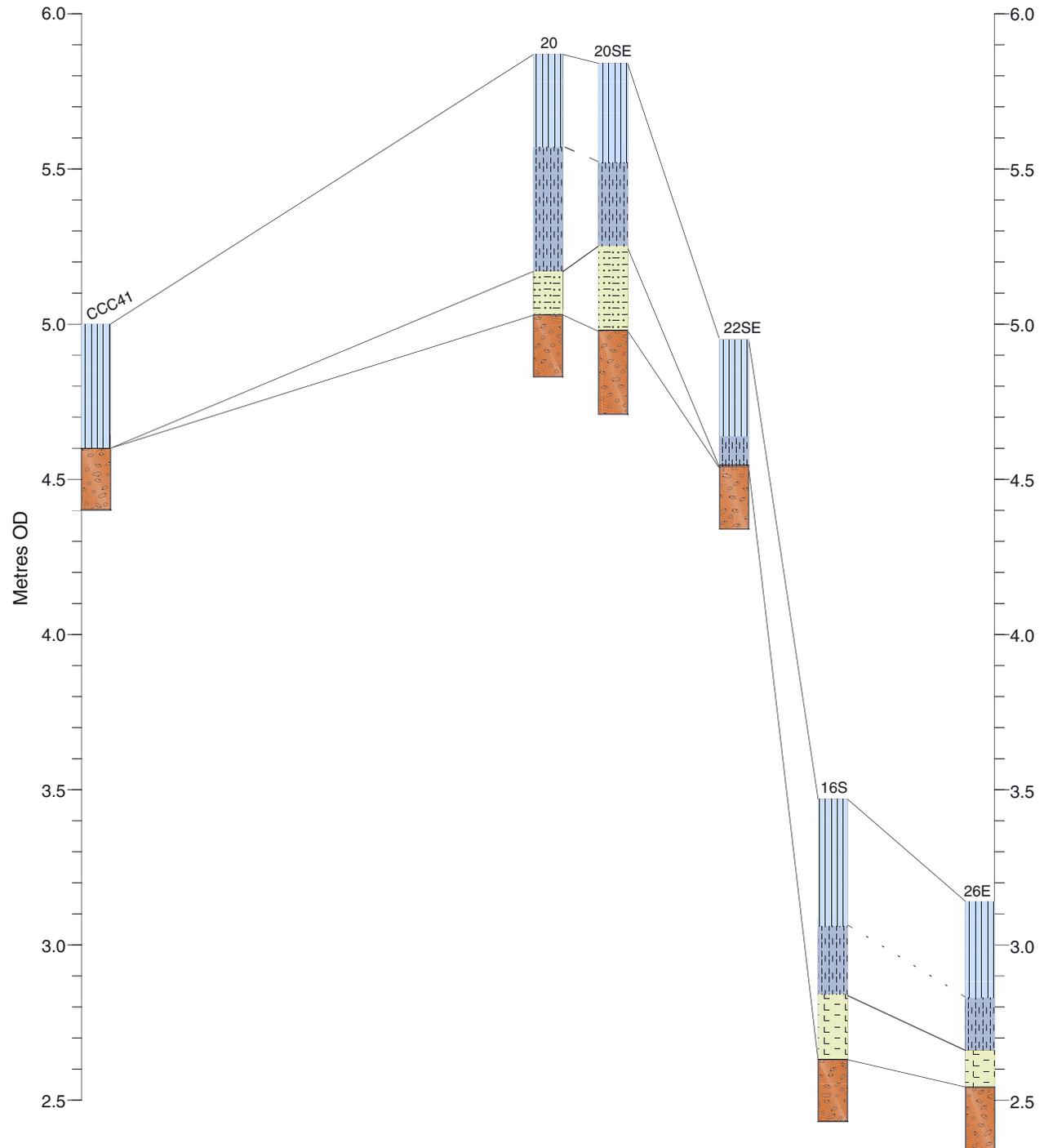


Figure 9: Northwest-southeast transect (The Storage Lake north) E - E'



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