Diglis Basin Worcester

Geoarchaeological Field Assessment

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Geoarchaeological Assessment Report

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Summary

In August 2005 Oxford Archaeology (OA) was commissioned by CgMs Consulting, on behalf of The Barton Wilmore Planning Partnership, to undertake a geoarchaeological assessment at the former site of Diglis Dock, Worcester. The primary objective of the assessment was the creation of a sub-surface deposit model in order to provide baseline data regarding the sediment sequences, palaeo-topography, and ultimately the archaeological potential of the site. Following an initial assessment of existing geotechnical data (OA 2005b), ten purposive boreholes were drilled at selected locations across the site. The boreholes were targeted on specific sub-surface features and sequences in order to ground truth the stratigraphic correlations made during the preliminary assessment and provide suitable samples for assessment of palaeoenvironmental indicators.

The model demonstrates that significant thicknesses of late Pleistocene fluvial sands and Holocene alluvial silt clays are sealed beneath extensive deposits of made-ground. Significant local detail is present within the sediment stack associated with networks of probable late Pleistocene braided channel systems that cross the site. By the early Holocene most of these sub-surface features appear to have been silted up leaving a slightly undulating area of low-lying ground. For much of the Holocene it is likely the floodplain would have remained relatively dry, as evidenced in many other lowland river systems where flooding and alluviation appears to have been largely a later prehistoric phenomenon. The site is likely to have been seasonally inundated by flooding with alluvial accretion by historic times.

The floodplain environment could have been seasonally exploited for use as pasture, and early prehistoric activity could potentially be preserved buried at depth beneath thick alluvium deposits. The (geo)archaeological potential of the site, however, is considered to be low. No evidence for anthropogenic activity was noted within the purposive boreholes. Significant organic or peat deposits appear to be absent severely limiting the potential for radiocarbon dating and palaeoenvironmental reconstruction. Pollen assessment on a number of samples from the minerogenic clay silts demonstrated extremely poor preservation.

1 INTRODUCTION

1.1.1 In August 2005 Oxford Archaeology (OA) was commissioned by CgMs Consulting, on behalf of The Barton Wilmore Planning Partnership, to undertake a geoarchaeological assessment at the former site of Diglis Dock, Worcester. The primary objective of the assessment was the creation of a sub-surface deposit model in order to provide baseline data regarding the sediment sequences, palaeo-topography, and ultimately the archaeological potential of the site.

1.1.2 Subsurface deposit modelling has the ability to reconstruct past geographies (palaeo-geographies) 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, often due to thick deposits of made-ground and alluvium effectively masking earlier deposits that frequently lie at depth. Previous evaluation trenching at Diglis Basin (OA 2005) was limited by the presence of contaminated ground, unmapped services, and the thickness of made-ground which resulted in only minimal exposure of the underlying alluvial sequences.

1.1.3 Following an initial assessment of existing geotechnical data (OA 2005b), ten purposive boreholes were drilled at selected locations across the site. The boreholes were targeted on specific sub-surface features and sequences in order to ground truth the stratigraphic correlations made during the preliminary assessment and provide suitable samples for assessment of palaeoenvironmental indicators

1.1.4 This report synthesises all geoarchaeological work undertaken to date, presents an updated deposit model based on the results of the purposive borehole survey and palaeoenvironmental work, and assesses the overall inferred (geo)archaeological potential of the site.

2 BACKGROUND

2.1 Location, geology and topography

2.1.1 The evaluated area is centred at SO850538 and is approximately 1.2 ha. The Diglis Basin Complex lies to the south of Worcester City centre on the east side of the River Severn and alongside the Worcester and Birmingham Canal that extends away to the north-east through the City Centre **(Fig, 1)**.

2.1.2 The site is situated on the floodplain of the River Severn, on the eastern side of the river. Previously it was a confluence of the Frog Brook and the River Severn, until the Brook was canalised as part of the canal. The solid geology comprises Mercia Mudstone, which is overlain by glacial sands and gravels sealed beneath alluvium (BGS, Sheet 199).

2.1.3 The development site had previously been one of a number of industrial compounds situated off the Diglis Dock Road. The site comprised of hard standing and concrete floors associated with the remains of demolished industrial units. The study area lies between +15.5 m OD and +16.0 m OD.

2.2 Archaeological and historical background

2.2.1 Prehistoric activity has been detected within the area of Diglis Basin in the form of artefacts recovered during river dredging. These artefacts include a Bronze Age sword recovered below Diglis in 1902 and a Bronze Age flint digger found in dredged material dumped near Diglis Dock in 1956.

2.2.2 The Roman settlement of Worcester lies approximately 350m to the north of the site, which was first discovered when the castle motte was removed in 1833. The majority of the Roman activity would appear to be industrial in nature, and the rivers and its edges would have played an important role during this period. It has been suggested that a Roman harbour lies within the site, located close to the mouth of the Frog Brook. This assertion is based on the results of discoveries made during excavation of the river in the mid-19th century. The remains were found at depth, between +4 m and +6m OD. However, likely variations in the local topography indicated that the level at which any remains could occur was not predictable. Analysis of pollen samples from two test pits excavated in 1993 suggests that Roman deposits may be more widely distributed across the development site. The DBA concluded that there was limited evidence for the actual presence of a Roman harbour. The Roman road from Worcester to Gloucester is thought to have passed through the development site, in the area of the link road to the rear of Berwick Street.

2.2.3 No medieval remains are recorded from the site, though the floodplain would probably have been used during this period. A hermitage dedicated to St. Ursula is recorded from the general area of Diglis, although it's exact location is unknown. The name Diglis first occurs in the records as the place name "Dudleg" in 1232. The low-lying floodplain area is likely to have comprised marshland pasture in the early medieval period. In 1535 Diglis formed part of the Bishop of Worcester's demesne, and the Prior of Worcester took a rent of £6 from pastureland.

2.2.4 Historical sources suggest the presence of a mill (the Frog Mill) to the northeast of site along the banks of the Frog Brook in the Fifteenth century. There is also evidence to suggest that the brook was dammed and diverted for Worcester castle leat roughly at the same time. The mill is known to have continued in use into the seventeenth century. It was still operational in 1678, but by 1660 the mill pound had silted up.

2.2.5 In 1815 the Frog Brook was canalised into the Birmingham and Worcester Canal. The arrival of the canal meant that the area experienced rapid development, with industrial activity and porcelain production becoming established in the area.

2.3 Geoarchaeological and environmental background

2.3.1 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 Severn and British lowland river systems in general.

2.3.2 During the Pleistocene Britain was effected 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. The River Severn, its tributaries, and many other major River systems, adopted their current drainage pattern**,** between the Anglian glaciation and Devensian Stage (c. 450,000 –10, 000 yr BP). Deposits relating to this period presently exist as of wedges of sand and gravel sequences on the 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 15,000 and 10,000 yr B.P., when sea level may have been between 25m and 150m lower than present day. These systems consisted of unstable channels separated by shifting sandbars, probably loaded with silt and eroding wind-blown loess soils (Brown, 1997; Macklin, 1999).

2.3.3 The surface of the valley bottom gravels formed the template onto which alluvial sedimentation occurred later, 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 anastomising 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. During the early and Mid Holocene little alluviation appears to have taken place on the floodplain with water tables seasonally low, although small scale flooding may have taken place (Robinson 1992:200). The floodplain environments for much of the middle Holocene probably consisted of quite dense alder woodland. Although the precise timing of woodland clearance may have varied from significantly site-to-site.

2.3.4 The onset of sedimentation has been modelled for three major lowland river systems, the Upper Thames, the Ouse and the Nene suggesting flooding and alluvial accretion was largely occurred during later prehistoric Iron Age and historic periods (Robinson 1992). The factors responsible for the hydrological changes and alluviation are subject to some debate. Although climatic change has been widely cited, Robinson and Lambrick (1984) correlated changes within the Upper Thames valley with agricultural activity in the catchment.

2.3.5 Until substantial silting had taken place in the channels however hydrological changes would not have been reflected in terms of the sediment sequence across the floodplain. This model implies that for a large part of the Holocene, the floodplain would have been relatively dry at least seasonally. With little sedimentation, the landsurface would have been subject to pedological and bioturbation processes over a considerable period. The topography of the gravel surface created by the braided streams in the late Pleistocene and early Holocene was uneven and undulating with topographic highs or 'islands' of sands and gravel. These islands may have remained areas of drier ground within the floodplain during seasonal flooding. And would have been the last areas to be buried by alluvium.

2.3.6 There is much evidence to suggest extensive utilization of floodplain resources and water management in the later periods. Many major river valleys of Southern England see the development of seasonally inundated floodplain grassland and pastureland from the Iron Age onwards.

2.4 Previous work

2.4.1 The site, of which this study area forms a part, has been the subject of a Desk-Based Assessment (DBA), which was included in the Environmental Statement presented with the planning application (EC Harris 3rd revision 2003).

2.4.2 The DBA indicated that the ground level of the site has been considerably altered over the past 200 years. This make-up comprises 1.2 m - 3.4 m of imported materials overlying alluvial deposits, which overlie the glacial sands and gravels. Initial examination of existing bore-hole records indicated that a broad palaeochannel may cross part of the development site, possibly a former channel of the river Severn. It was thought possible that significant buried remains could be present along the banks of any such channel or within its fills, in particular at its confluence with the Frog Brook.

2.4.3 A two-trench archaeological field evaluation has previously been undertaken within the Worcester and Birmingham Canal Conservation Area. No significant archaeological remains were identified (Archenfield Archaeology 2003). Deposits interpreted as 'natural alluvial deposits' (of 'pinkish-red slightly gravel/silty clay') were recorded in the evaluation trenches at a consistent level of approximately 15m OD. These lie higher than would be expected from information given in the First Edition Ordnance Survey maps (surveyed 1884-5), where the local surface of the meadows is noted as +13.4 m. The bore-hole logs are also not completely clear. Consequently the separation between the re-deposited alluvium and the natural marl in this area is not clearly established.

2.4.4 In June 2005 OA carried out a field evaluation within the proposed development area at Diglis Basin (OA 2005). The evaluation encountered thick deposit of made-ground in most of the trenches to a depth beyond which it was not possible to continue because of safety issues. There was no evidence of any archaeology, except for late Victorian/modern wall foundations within the made-ground deposits. Natural deposits of alluvium were only reached in a few of the trenches, and in some of these there were indications of possible disturbance.

3 AIMS

3.1.1 The primary objective of the investigation was the development of a deposit model specific to the site. This model will provide base-line data regarding the character and archaeological potential of the sub-surface stratigraphy. Specifically the investigation aimed to:

- Characterise the sequence of sediments and patterns of accumulation across site, including the depth and lateral extent of major stratigraphic units, and the character of any potential land surfaces/buried soils within or 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 to assess the potential for the preservation of palaeoenvironmental remains and material for scientific dating.
- Clarify the relationships between sediment sequences and other deposit types, including periods of 'soil', peat growth, archaeological remains, and the effects of relatively recent human disturbance, including the location and extent of made-ground.

4 METHODOLOGY

4.1.1 A preliminary assessment of 43 geotechnical records was carried out by OA in August 2005. The locations are illustrated in **Fig 2.** The lithological data was entered into geological modelling software (© Rockworks 2004) and was used to correlate and model the main stratigraphic units across the area, with specific emphasis on identifying variations in the character and thickness of organic or alluvial deposits and the surface of the Pleistocene gravels.

4.1.2 At this stage no core or sample data was available to verify any of the observations made. All information comprised paper copies of boreholes and consequently a range of problems have been previously identified with this type of data set (Bates *et al* 2000). In order to ground truth and refine the deposit model a series of 10 targeted boreholes were proposed at agreed locations with the county archaeologist **(Fig.2)**.

4.1.3 The boreholes were drilled using a cable percussion technique, allowing for the retrieval of continuous U4/100 samples, from the base of the made-ground to the top of the Pleistocene gravels. Cutting shoe samples were also retained, in addition to bulk samples where core samples could not be retrieved due to the unconsolidated nature of the sediments. Each borehole location was surveyed in using a GPS, ensuring co-ordinates and levels relative to National Grid and Ordnance Datum were retrieved.

4.1.4 All cores were extruded and logged by a qualified geoarchaeologist using standard sediment terminology (Jones *et al* 1999) including information about depth, texture, composition, colour, clast orientation, structure (bedding, ped characteristics etc), contacts between deposits Note was also be made of any visible ecofactual, or artefactual inclusions e.g. pottery, daub or charcoal fragments. This information was then entered into the computer modelling software to check and refine the correlations made in the original deposit model.

4.1.5 Two representative sedimentary sequences were selected for the assessment of the preservation of palaeoenvironmental remains (plant macro remains and pollen). The selection of the sequences was based on the perceived character, interpretative importance and chronological significance of the strata under investigation. Environmental sampling procedures were in accordance with the OA Environmental Sampling Guidelines and Instruction Manual (OA, July 2002), which is based on guidelines presented by English Heritage (2002).

5 RESULTS

5.1 Summary of stratigraphic sequence

5.1.1 The alluvial sequences in the vicinity of the site are associated with the River Severn. The stratigraphy was relatively consistent with that proposed for the preliminary model and comprised the following major units:

- **Modern made ground**: Sandy gravels, brick, concrete, ash and associated diesel contamination.
- **Alluvium**: Grey brown silty clay to clayey silt, some gravel towards base.
- **Fluvial sands:** loose reddish brown clayey sands and sands with occasional rounded to sub-rounded gravel clasts.

- **Sandy Gravels**: Sands to sandy flint gravels, brown to grey fine to coarse sub-angular to sub-rounded.
- **Bedrock:** Stiff reddish grey clay silts/ silts.

5.2 Pre-Holocene deposits and basement topography

5.2.1 Bedrock: The underlying bedrock across the site is recorded as Mercia Mudstone (BGS Map Sheet 199). A firm clay marl was reached in the majority of the boreholes with the surface lying between +7.09m OD (BH32) and +15.57m OD (BH02), and was recovered as a very stiff grey mottled reddish brown clay with occasional pockets of pale green grey silt. The modelled bedrock surface reflects the shifting patterns of later Pleistocene high energy braided river systems that cut down into its surface **(Fig. 2)**.

5.2.2 Fluvial gravels: Coarse to medium sandy gravels to clayey gravels appear to extend across the site overlying bedrock and sealed by late Pleistocene and Holocene alluvial deposits. These deposits are thickest towards southwest (BH19, BH23 and BH24), which is part of the network of Pleistocene braided channels, where they are a maximum of 3.4m in thickness.

5.2.3 The modelled gravel surface **(Fig. 3)** is uneven and undulating, although averages +11m OD. The highest elevations were recorded within the northeast sector of the site possibly showing the higher ground of the terrace gravels at levels of up to +15.92m OD (BH02). The lowest elevations to +7.74 m OD occur in the eastern sector, within BH11, BH18, BH19 and BH36 representing a potential palaeochannel running from the west before turning sharply towards the south (Palaeochannel A). A second low-lying area is located towards the northeast, around BH33, BH3, BH39 and BH4, possibly representing a second palaeochannel (Palaeochannel B). A topographic high, or gravel 'island', was noted to the southwest with the surface at elevations of approximately +15m OD (BH27, OA1).

5.2.4 The coarse grained character of the deposits suggests accumulation under cold climate periglacial conditions within high energy braided streams. Layers of clay sands occasionally noted within this unit might represent infilling of eroded Pleistocene palaeochannels. Variation in the deposits can be expected where channel shifting has occurred. Any archaeological remains identified within these deposits are likely to be reworked by fluvial processes.

5.2.5 Fluvial sands: This unit consists of mid reddish brown clayey sands and sandy silts infilling former channels. They are thickest towards the northwest of site (BH6, OA7 and OA8) where they vary from 0.7m to 2.2m, and are found at elevations between +12.58m and +9.15m OD.

5.2.6 The deposits reflect moderate energy deposition associated with a phase of channel infilling. The clay matrix may have been deposited by the washing down of finer particles or water saturation. The change from gravel to sand and silt dominated facies indicates a reduction in flow regime probably occurring at the end of the Pleistocene and during the early Holocene. The presence of finer silty clay sediments with the top of these features may suggest that these features continue to be in-filled during the Holocene.

5.2.7 The surface of the gravel and fluvial deposits essentially defines the topography of the early Holocene landscape **(Fig, 4).** Bates (1998) refers to this as the 'topographic template' and suggests that variations in the template largely dictated the patterns of subsequent landscape evolution, as flooding and sedimentation ensued during later periods.

5.2.8 On initial examination of the Diglis Basin data the elevations of Holocene land surface exhibits very limited localised variation with most of the sub-surface features mentioned previously being in-filled. The surface was relatively uniform with surface heights of between +12m to +12.5m OD, with lower elevations towards the south of 11m OD in the area of former Late Pleistocene channel activity. In addition an area of lower elevations in the northeast section of site around BH4 may represent part of a former channel that had not entirely silted up and still remained as a prominent landscape feature **(Fig. 4)**.

5.3 The Holocene sediment sequence

5.3.1 Alluvium: The thickest deposits of fine grained silt clay alluvium lie to the southeast and northwest, associated with the lowest elevations in the surface of the gravels. It is generally described as a minerogenic grey brown silty-clay to clay. The thickness of the alluvium ranges from a maximum of 4.4m (BH04) to the north and are absent to the northeast (BH02). The greater thicknesses of alluvium are associated with the low elevations within the sandy gravels and associated with the infilling of sub-surface features.

5.3.2 The fine grained texture of these deposits suggests low energy deposition by overbank flooding. Consequently any archaeological material present therein should be considered relatively *in situ*, although a higher level of lateral transport is likely associated with the coarse grained sandier deposits.

5.3.3 Where the presence of organic deposits had been previously recorded in the interim statement within the geotechnical records (OA 2005b), the purposive boreholes identified only chemical staining and reddish brown alluvium. The absence of organic deposits from the sequence suggests that the site area could not have been continually waterlogged and may have been seasonally dry and free from flooding.

5.3.4 Made-Ground. Variably thick deposits of made-ground exist predominantly running northwest to southeast across the site. These deposits were recorded as sandy gravels/sandy clays with brick, concrete, ash and associated diesel contamination overlain by tarmac and concrete. During the evaluation it was noted that the made-ground contained Victorian building remains, metal objects, ceramics and glass.

5.3.5 These deposits are thickest in areas of low elevations of sandy gravel across the site and in areas with the greater thicknesses of alluvium is present, which varies between 0.05m and 4.70m. There is evidence for the made-ground being directly deposited upon the alluvium. In some cases the weight of made-ground would have likely compressed the underlying deposits, in others (BH29A) truncation is evident.

5.4 Palaeoenvironmental assessment

5.4.1 Three sediment sequences were selected for palaeoenvironmental assessment from boreholes BH1, BH11 and BH12, representing the two potential palaeochannels and an area of high ground. These deposits did not preserve waterlogged material and many samples were heavily contaminated with petrol-chemicals. No material suitable for radiometric dating was identified within the sequence. Therefore only a limited program of pollen assessment was proposed in order to identify whether pollen was preserved within the sequence and if changes in the vegetation history of the area could be identified.

5.4.2 The pollen assessment revealed poor preservation throughout the sequence, with generally only the more resilient types of pollen preserved in the upper part of the sequence (Appendix 2). Where pollen was preserved in sufficient numbers to be significant, a largely open environment was identified, with oak and isolated stands of elm, birch, alder and willow in the vicinity. Pollen was not preserved within the lower part of the sequence.

6 DISCUSSION

6.1.1 The deposit model has served well in identifying the main sub-surface stratigraphy and the topography of the early Holocene land surface of the site. However, without the preservation of environmental evidence or material suitable for radiocarbon dating, only a broad model of deposition can be applied to the sequence. This model is supported by general comparisons with other major lowland river regimes of the East Midlands and Southern England.

6.1.2 During the Pleistocene networks of braided river channels were being cut into the underlying bedrock, these channels would have been swollen in summer by glacial meltwater. In the winter, these rivers would have deposited the thick deposits of sandy gravels during periods of lower energy flow conditions. The ground would have been frozen, supporting a treeless vegetation with large open areas of bare ground. This would have supported vegetation tolerant to extreme cold conditions similar to those found today within the sub-arctic tundra.

6.1.3 These deposits cover the Middle to Upper Palaeolithic periods that were characterised by flint industries based on hand axes, and core and flake technologies. They are the only traces of the semi-nomadic hunter-gathers communities that would have visited Britain on a seasonal basis during this period. There is little evidence to suggest that Britain was permanently occupied at this time. There is scare evidence of activity from this period recorded within the surrounding area and therefore the site potential is considered to be low. Any artefactual material recovered from these deposits is likely to have undergone a significant amount of reworking.

6.1.4 During the late Glacial period (c.13,000-10,000 yr BP) this braided system of channels would have started to infill with lower energy sands and finer granular gravel. As the glaciers retreated further north the energy input into the river systems would have decreased and finer grained sandy deposits would have started to accumulate within the channels.

6.1.5 The onset of the early Holocene saw rapid warming and the silting up of former Pleistocene channels (**Fig. 4**). Climatic amelioration, increased surface stability and soil formation would have allowed more diverse vegetation to become established. Eventually the spread of oak, elm, ash and lime would have formed a dense forest cover, with the wetter valley bottoms dominated by species such as alder and willow.

6.1.6 The surface of the gravel and infilled channels represent the early Holocene land surface. Artefactual material or features of prehistoric date could potentially be located at this level. No evidence of human activity, however, was identified within the mid to dark brown silty clay deposits that overly the gravels and sands within the OA boreholes.

6.1.7 Alluviation generally appears to have been limited during the early and middle Holocene within many of the major lowland river systems of Southern England Water tables were seasonally low, although local flooding is likely to have occurred. In the Upper Thames, for example, water levels did not started to rise until the middle Iron Age (Robinson, 1992), which resulted in flooding during the late Iron Age leading to major alluviation in the Roman and Medieval periods (Robinson, 1992). This implies that for a large part of the Holocene, the floodplain could have been relatively dry at least seasonally. Previous investigations have shown that archaeological activity tends to be focussed around the edges of the floodplain on the gravel terrace or associated with gravel islands that remained free from flooding. Early prehistoric activity is typically found associated with the edges of wetland environments, especially peat deposits, or gravel islands within the floodplain, that would provide attractive locations in which to exploit the rich resources of these environments. The site area would have offered an open dry environment with only limited resources, lacking the diverse resources of a true wetland environment, and therefore would have been less attractive for early prehistoric communities.

6.1.8 The organic deposits identified previously within geotechnical boreholes 11 and 30 on closer investigation within the purposive boreholes appear to be a result of chemical staining or reddish brown clay deposits (the reddish colour most likely the result of reworked mudstone). Unfortunately due to the absence of material suitable for dating it is not possible to establish accurately when flooding and alluviation first started to occur with the site area. The absence of organic deposits within the sequence suggests the site area remained relatively dry at least seasonally.

6.1.9 Perhaps some time after the Late Iron Age/Roman period overbank alluvial accretion occurred. This floodplain environment could have offered seasonal pasture, perhaps too wet for more permanent activity. The archaeological activity associated with this type of environment is likely to be of low intensity.

6.1.10 In historic times the site area appears to have been drained and raised above the level of flooding for use in industrial production. The site is now covered by extensive thickness of made-ground deposits that extend across the development area. These deposits are thickest within areas of lower sandy gravel elevations and particularly within the route of the former late Pleistocene river channels.

7 CONCLUSION

- The assessment has confirmed the presence of a late Pleistocene braided system of channels that likely mark the transition from the late glacial to early Holocene conditions. These channels appear not to have been active during the prehistoric period and are therefore of lower archaeological significance than previously believed.
- A possible buried early prehistoric land surface (Mesolithic-Iron Age) was identified between +11m to +12m OD overlying the sandy gravels. It is possible that this surface was not submerged until after the late Iron Age and therefore would have been relatively dry throughout most of the prehistoric period. However no archaeological or palaeoenvironmental evidence was recovered from this deposit and therefore its potential is considered to be low.
- The archaeological potential of the site area following alluviation is considered to be low as much of the site would have been part of the River Severn

floodplain, with open grassland conditions that would have been frequently inundated by flooding. The site area would have only been suitable for seasonally use and most likely as pasture.

- The palaeoenvironmental potential of the site area and underlying sediment sequence has proved to be low. No organic or waterlogged deposits were identified within the sequence that could provide suitable material for dating or environmental reconstruction. Pollen was poorly preserved preventing any meaningful statements to be made about the changing vegetation history or the impacts of human activity within the site area.

- The assessment has identified several inconsistencies with deposit characteristics that were recorded during the geotechnical investigations and those encountered during the purposive borehole survey. The assessment has highlighted the potential problems when using geotechnical records for archaeological purposes and reinforcing the need for ground truthing any inferences.

- The assessment achieved good coverage of the site appropriate to the task of identifying the main sedimentary units and mapping their extent across the area. The conclusions made within the assessment were based on a comprehensive data set and incorporate the results of previous archaeological work in the area.

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APPENDIX 1 Borehole Records

Table 1: Borehole inventory

Borehole Logs	Easting	Northing	Elevation m O.D.	Made ground	Alluvium	Fluvial sands	Gravel	Bedrock
BH01	385074.3	253907.7	15.97	1	0.65	-	-	2.85
BH02	385111.7	253819.6	15.97	0.05	-	-	0.35	4.1
BH03	385056.5	253754.4	15.75	2.7	2.6	0.70	1.1	0.6
BH04	385017.9	253834.6	15.85	1.7	4.3	0.70	1.2	1.1
BH05	384988.7	253725.4	15.58	3.2	1.8	-	2	2
BH06	384976	253769.6	15.47	3.7	0.8	2.6	0.45	1.45
BH07	384925.9	253865.9	15.81	2.7	2.2	-	2.6	0.7
BH08	384902.3	253856.6	15.78	2.7	2.1	-	2.7	1.6
BH11	384908.3	253704.8	15.32	2.6	1.2	1.7	1.5	2
BH12	384850.9	253798.1	15.8	4.7	-	-	2.8	2.6
BH14	384983.3	253679.9	16.22	4.1	1.4	0.5	2	1
BH15	384928.1	253686.9	14.99	4.7	-	-	1.9	2.5
BH17A	384848.3	253660.1	15.03	2	0.8	1.2	2.5	0.15
BH18	384827.8	253670.6	14.88	3.1	1.6	2.4	1.4	2.25
BH19	384793	253657	15.56	1.2	3.3	0.8	3	0.7
BH21	384974.2	253618.3	15.61	4.2	1.3	-	1.2	1.6
BH23	384822.7	253580.1	15.38	3	1.4	-	3.3	1.4
BH24	384800.8	253569.1	15.46	2	2.4	-	3.4	1.5
BH25	384872	253513.4	15.64	4.5	-	-	0.5	1.35
BH26	384918.7	253486.3	16.04	2.2	4.3	-	2.15	1.35
BH27	384792.5	253482	15.99	1.65	-	-	0.85	2.5
BH29A	384954.8	253604.7	15.89	5.2	0.3	-	0.7	2.8
BH29B	384945.7	253602.8	16.06	2	1.5	-	-	-
BH30	384973.2	253567.3	16.01	2.5	3.7	-	0.45	0.05
BH31	384999.3	253517.9	15.75	3.1	2.1	-	2.55	1.25
BH34	385065.3	253617.2	15.75	2.9	0.5	2.6	1.55	1.45
BH35	385073.7	253569.2	15.71	4	1.2	0.8	1.5	1.5
BH36	384959.4	253702.3	15.38	2.2	1.8	2.25	1.25	1.5
BH37	384948.5	253833.8	16.29	3	2.75	-	2.7	1.05
BH38	384940.1	253522.9	16.03	4	2	-	1.6	1.4
BH39	385019.9	253768.2	15.58	2.65	3.35	2	1.5	-
OA1	384786.5	253481.8	15.371	3.05	2.25	0.06	0.7	-
OA2	384880.9	253585	15.514	3.1	0.80	1.35	0.75	-
OA3	384923.9	253619.6	15.474	3	0.36	1.22	0.82	-
OA5	384955.7	253689	15.65	2.95	0.75	0.56	1.49	-
OA6	384970	253709.3	15.305	3.1	1.48	-	1.02	-
OA7	384848.7	253727.1	14.676	1.1	0.80	0.92	1.39	-
OA8	384919.1	253726.3	14.989	2.4	-	1.54	2.19	-
OA9	384991.9	253742.8	15.42	2.95	1.47	-	0.74	-
OA11	384965	253603.3	15.995	3.5	0.80	1.45	0.15	-
OA12	384991.8	253831.8	16.319	1.8	2.76	0.7	0.88	-

APPENDIX 2 Pollen assessment

Alex Brown (University of Reading)

INTRODUCTION

Twelve samples were prepared for pollen analysis from three borehole sequences from Diglis Basin, Worcestershire. Two samples were prepared from borehole BH1, four from borehole BH11 and six samples from borehole BH12. Analysis of these samples provides the opportunity to examine vegetation dynamics and patterns of landscape change and land use by humans within the surrounding landscape. It is also hoped that any preserved pollen will provide broad dates for any vegetation changes in the borehole sequences, and, in particular, whether the sequences of sands within the base of the boreholes is of potential late glacial/early Holocene age.

METHOD

Sub-samples of sediment 1 cm thick and 1 cm^3 in volume were processed for pollen analysis. Samples were chemically prepared using standard laboratory preparation techniques as outlined in Moore *et al* (1991), using HCl, NaOH, sieving, HF (2hours), Acetic acid and Acetolysis to remove carbonates, particles >180 µm, silicates and cellulose. Samples were stained and mounted in a safranin-kaisers glycerol jelly mix. Tablets containing *Lycopodium* spores were added to a known volume of sediment, enabling calculation of pollen concentrations. Samples were analysed under a Leica DME trinocular microscope at x400 magnification, with critical determinations at x1000 magnification. A minimum of 100 pollen grains was identified per sample, excluding aquatics and *Sphagnum*. Pollen and spores were identified using the key and photographic plates in Moore *et al* (1991), cross-referenced, where required, with the pollen reference collection in the Department of Archaeology, University of Reading. All taxa follow current nomenclature established in Bennett (1994) and Bennett *et al* (1994). Indeterminable grains were recorded according to Cushing (1967), as corroded, degraded, crumpled or broken.

RESULTS AND DISCUSSION

The results are presented in table 1. All pollen percentages are expressed as a percentage of total land pollen, excluding aquatics, which are expressed as a sum of the total land pollen plus aquatics.

Borehole 1: Pollen preservation and concentrations are uniformly poor. Pollen and spores present are of those taxa particularly resistant to decay processes. As such, no useful comments can be made on the vegetation environment, or the potential date of the sediments.

Borehole 11: Pollen preservation and concentrations are uniformly poor. Pollen and spores are absent from the base of the sequence. Only sample 4.26m produced a count of 100 pollen grains. This sample is dominated by pollen of Lactuceae (41%), Cyperaceae (10%), *Aster*-type (7%) and spores of Pteropsida (16%) and *Pteridium aquilinum* (7%), whilst arboreal pollen contributes little to the overall pollen sum, suggesting a predominantly open environment. However, the dominance of pollen and spores of Lactuceae and Pteropsida, which are particularly resistant to decay processes, combined with the high percentages of indeterminable grains, suggests that the pollen assemblage is biased in favour of those taxa with resistance to decay processes. No meaningful comments can be made on the vegetation environment through the sequence, or the potential date of the sediments.

Borehole 12: Pollen preservation and concentrations are uniformly poor. Only sample 2.90m produced a count of 100 pollen grains. This sample is dominated by Poaceae (18%), *Quercus*

(16 %), *Artemisia*-type (16%) and *Filipendula* (11%), with lesser quantities of *Aster*-type (6%) and Lactuceae (6%), suggesting a largely open environment, but with oak and isolated stands of elm, birch, alder and willow in the vicinity. The remaining samples from borehole 12 are dominated by pollen of Lactuceae and spores of Pteropsida. Both taxa are particularly resistant to decay processes, reflecting the poor preservation conditions encountered in these samples. Sample 3.08m produced a count of 80 pollen grains and spores, and is dominated by pollen of Lactuceae and spores of Pteropsida. Indeterminable grains occur in relatively low frequencies. The pollen assemblage suggests, like 2.90m, a relatively open environment with isolated stands of oak and alder. However, no meaningful comments can be made on either i) vegetation change through the sequence, ii) evidence for human impact, or iii) potential dates for the sediments.

CONCLUSIONS AND RECOMMENDATIONS

Pollen preservation and concentrations are uniformly poor throughout the three borehole sequences analysed. Pollen and spores present are largely of taxa resistant to decay processes, presenting the problem of biased pollen assemblages. Where counts of 100 pollen grains were achieved, this indicated a predominantly open environment with little tree cover, though no meaningful comments can be made on either patterns of vegetation change though the sequences, evidence for human impact, or of the potential date of the sediments. None of the sequences have any identifiable potential for further pollen analysis. As such, it is recommended that no further pollen analysis should be undertaken on these borehole sequences.

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Table 2: Results of pollen assessment

Borehole		**BH1**		**BH11**				**BH12**					
Depth (cm)		**4.10**	**5.02**	**3.80**	**4.26**	**4.75**	**5.60**	**2.23**	**2.63**	**2.90**	**3.08**	**4.18**	**5.10**
Betula	Birch	-	-	-	3.0	-	-	-	-	1.0	-	-	-
Pinus sylvestris	Pine	-	-	-	1.0	-	-	-	(1)	3.0	(1)	-	(1)
Corylus avellana-type	Hazel	(1)	(7)	(1)	2.0	-	-	-	(2)	-	-	-	(1)
Ulmus	Elm	-	(2)	-	-	-	-	-	-	2.0	-	-	-
Quercus	Oak	-	(3)	(1)	-	-	-	-	(3)	16.0	(2)	-	-
Tilia	Lime	-	-	-	-	-	-	-	-	-	-	-	-
Alnus glutinosa	Alder	(1)	-	-	-	-	-	-	(1)	1.0	(1)	-	-
Salix	Willow	-	-	-	-	-	-	-	-	2.0	-	-	-
Frsngula		-	-	-	-	-	-	-	-	1.0	-	-	-
Poaceae	Grass family	-	-	-	5.0	-	-	-	(7)	18.0	(8)	-	(2)
Hordeum group	Barely group	-	-	-	-	-	-	-	-	1.0	-	-	-
Cyperaceae	Sedges	-	(5)	-	10.0	-	-	(4)	(5)	2.0	(9)	-	-
Ranunculus acris- type	Meadow buttercup	-	-	-	3.0	-	-	-	-	1.0	-	-	-
Chenopodiaceae		-	-	-	2.0	-	-	-	(1)	4.0	(2)	-	-
Caryophyllaceae	Pink family	-	-	-	-	-	-	-	-	-	(1)	-	-
Rosaceae	Rose family	-	-	-	-	-	-	-	-	3.0	-	-	-
Filipendula	Meadowsweet	-	-	-	-	-	-	-	-	11.0	-	-	-
Fabaceae	Pea family	-	-	-	-	-	-	-	-	1.0	-	-	-
Medicago	Medicks									1.0	-	-	-
Apiaceae	Carrot family	-	-	-	-	-	-	-	(1)	-	-	-	-
Mentha	Mints									1.0	-	-	-
Plantago lanceolata	Ribwort Plantain	-	-	-	1.0	-	-	-	-	2.0	-	-	-
Lactuceae	Lettuces	(13)	(3)	(29)	41.0	(1)	-	(11)	(16)	6.0	(39)	-	(3)
Aster-type	Michaelmas-daisies	-	-	(3)	7.0	-	-	(1)	(1)	6.0	(3)	-	(1)
Artemisia-type	Mugworts	-	-	-	-	-	-	-	-	16.0	-	-	-
Pteropsida	Ferns	(4)	(2)	(3)	16.0	(1)	-	(1)	(7)	1.0	(13)	(2)	(23)
Polypodium	Polypodies	-	-	-	1.0	-	-	(2)	(2)	-	-	(2)	-
Pteridium aquilinum	Bracken	(1)	(1)	-	7.0	-	-	(1)	(3)	-	(1)	(1)	-
Dryopteris filix-mas	Male Fern	-	-	-	1.0	-	-	-	-	-	-	-	-
Indeterminables		11	25	28	23.6	3	-	23	11	10.7	6	9	6
Sum trees + shrubs		-	-	-	6.0	-	-	-	-	26.0	-	-	-
Sum herbs		-	-	-	69.0	-	-	-	-	73.0	-	-	-
Sum fern spores		-	-	-	25.0	-	-	-	-	1.0	-	-	-
Total pollen sum		20	25	37	100	2	0	20	50	100	80	5	31

Table 1: Results of palynological assessment of boreholes BH1, BH11 and BH12. All pollen percentages are expressed as a percentage of total land pollen, except aquatics and *Sphagnum*, which are expressed as a percentage of total land pollen + aquatics and *Sphagnum*. Numbers in brackets are the actual numbers of grains where a full count was not achieved.

Servergo:/oaupubs1_RtoZ*WCM101341*WODIGBEV*Diglis Basin*SML*11.01.06

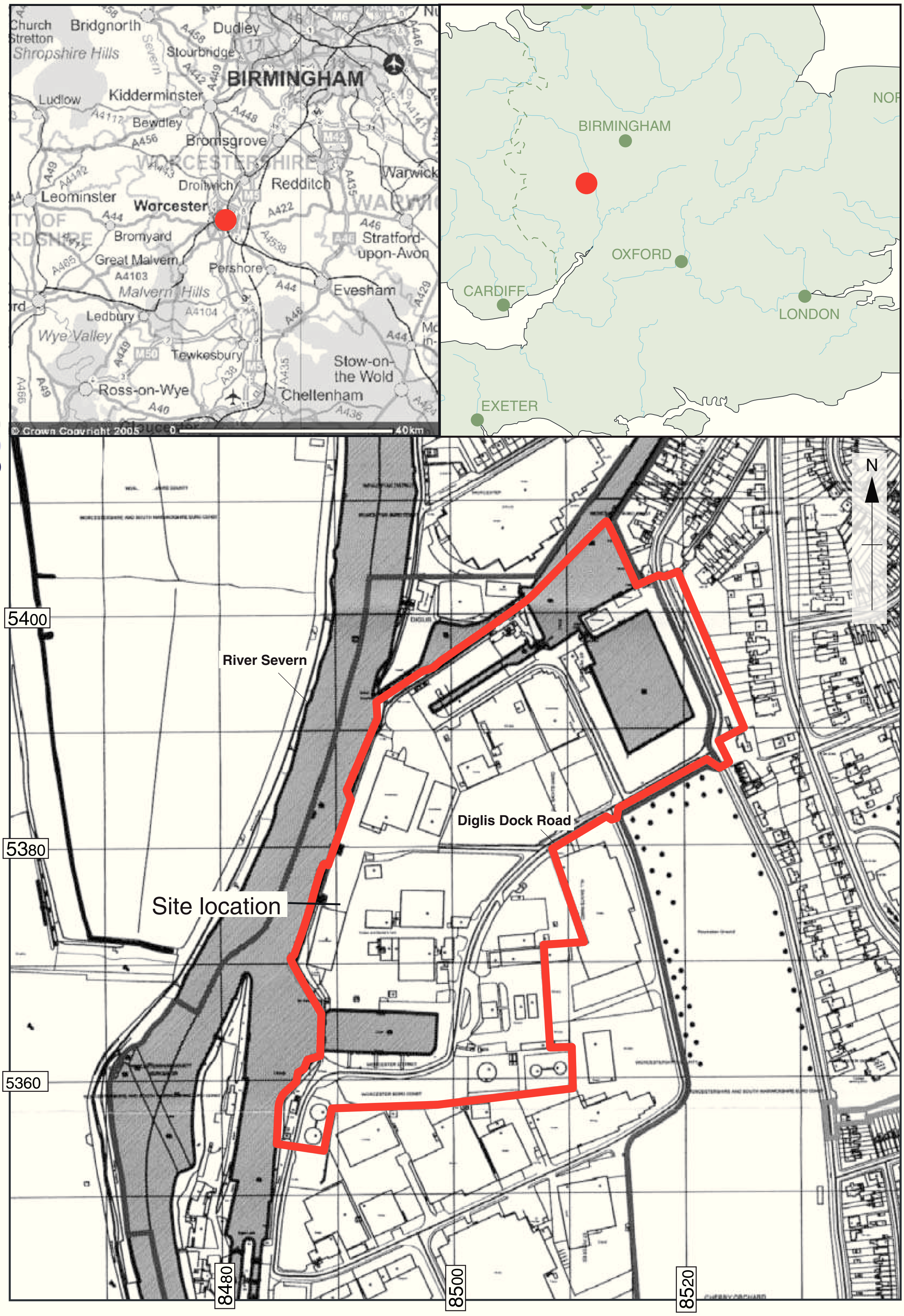

Figure 1: Site location

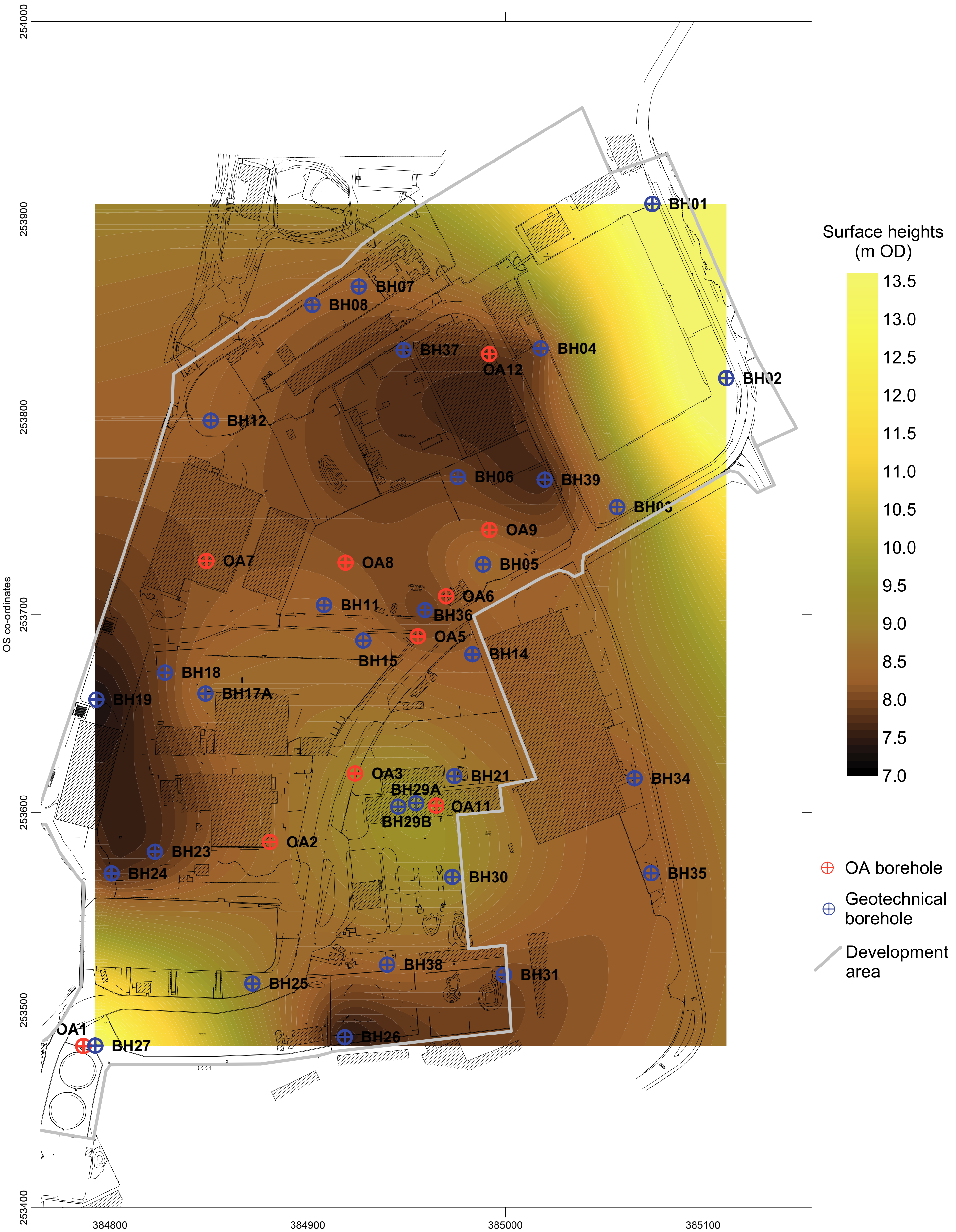

Figure 2 - Modelled bedrock surface (m OD)

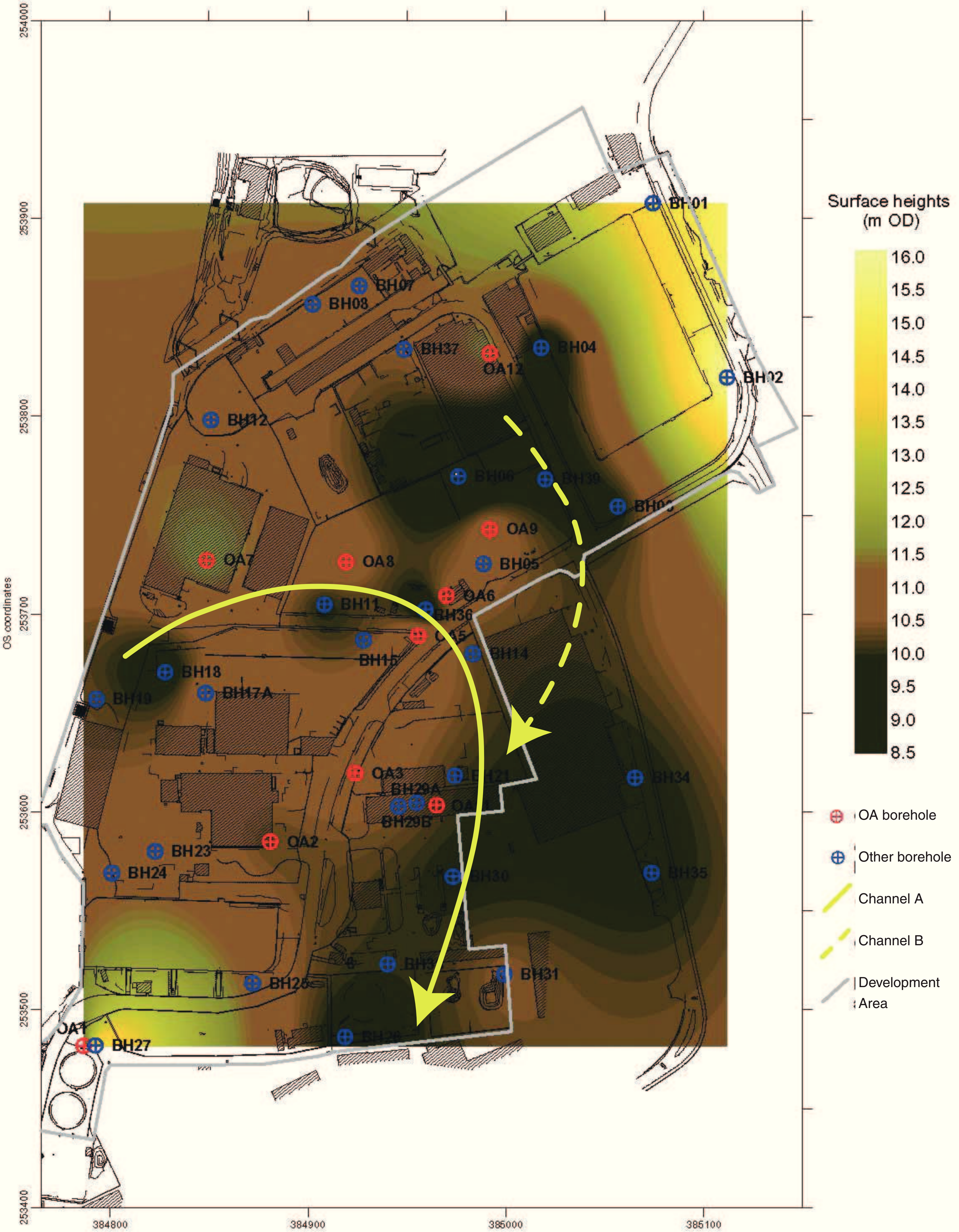

Figure 3: Modelled gravel surface showing a system of late Pleistocene channels (m OD)

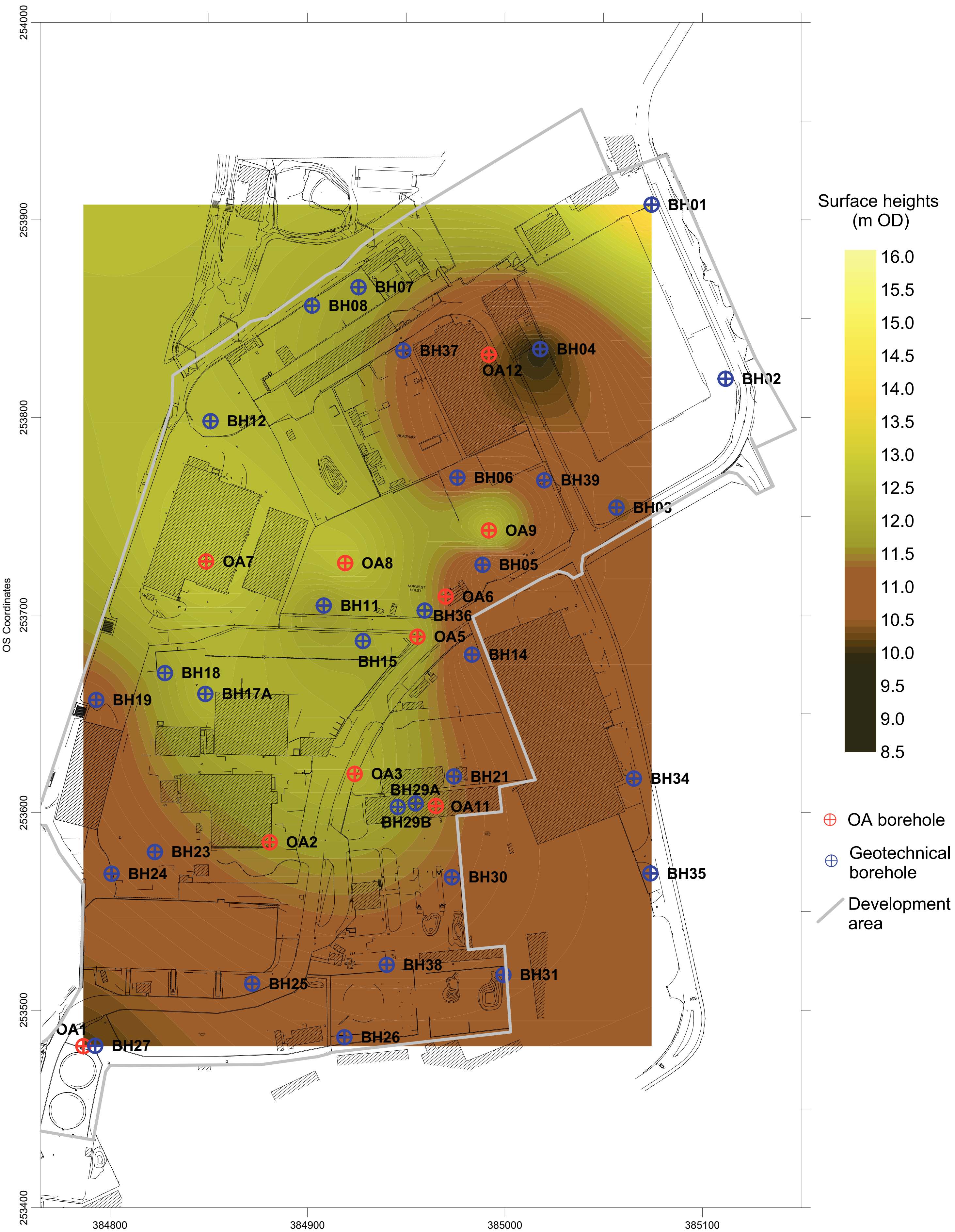

Figure 4 - Early Holocene land surface (m OD)

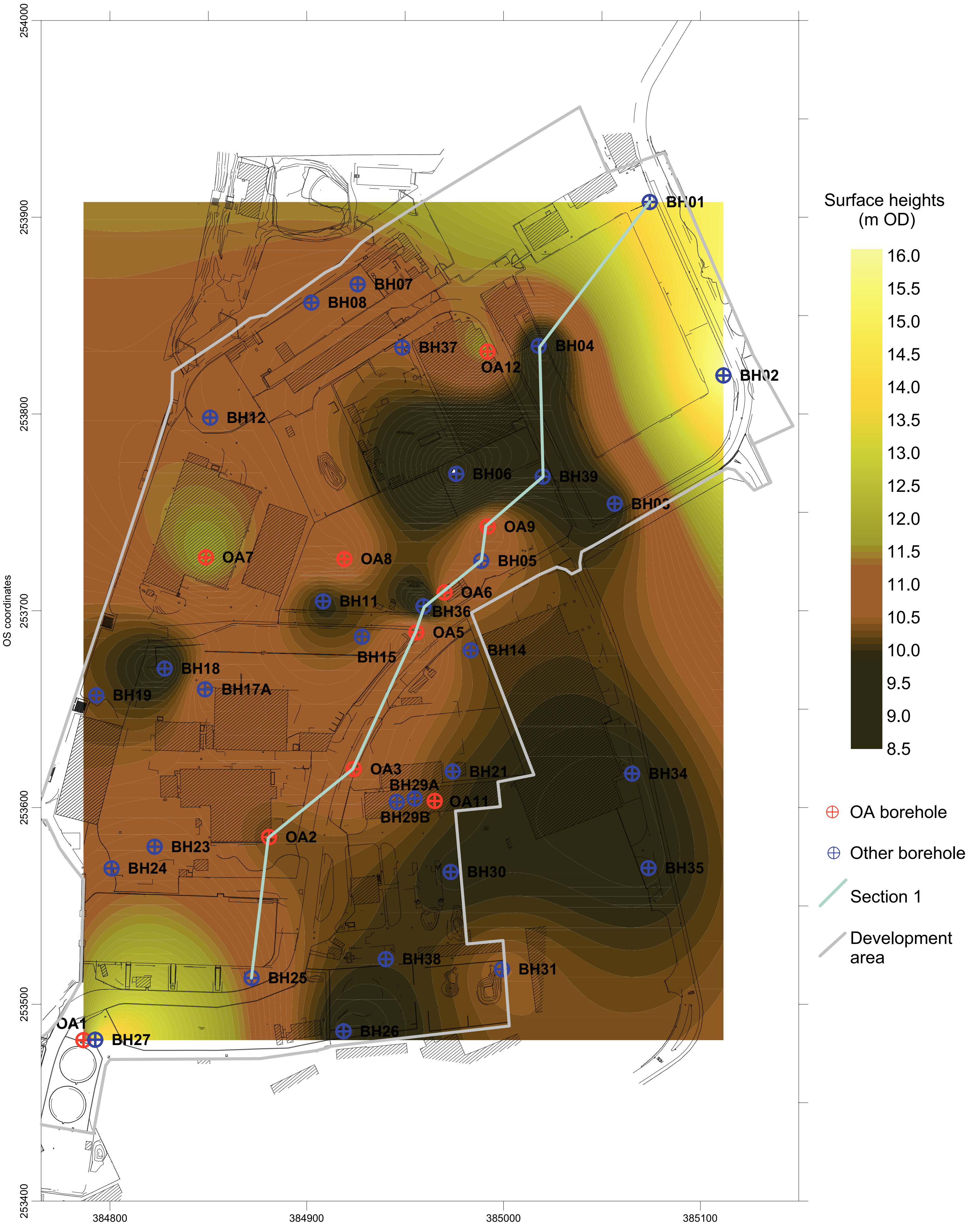

Figure 5 - Cross section location over modelled gravel surface (m OD)

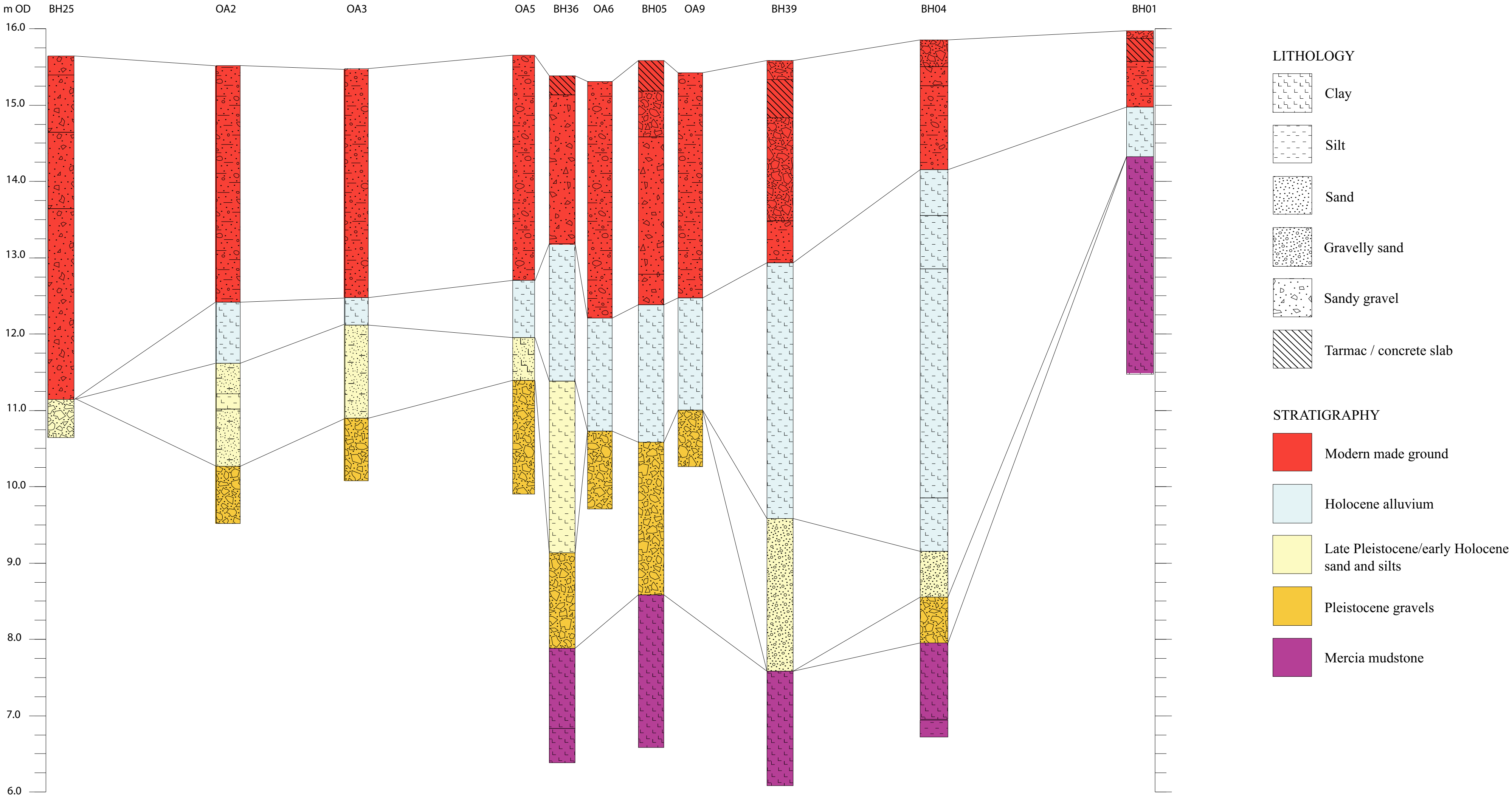

Figure 6: Southwest-northeast cross section

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