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FORMER FORD STAMPING FACTORY, KENT AVENUE LONDON BOROUGH OF DAGENHAM

Desk-Based Geoarchaeological Deposit Model Report

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1. NON-TECHNICAL SUMMARY

A desk-based geoarchaeological deposit modelling exercise was instigated for the Former Ford Stamping Factory site in order to: (1) clarify the nature of the sub-surface stratigraphy, in particular the presence and thickness of alluvium and peat across the site, (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs, (3) to investigate the archaeological potential of the site, and (4) to devise a strategy for further geoarchaeological investigation. In order to address these aims, the stratigraphic data from existing stratigraphic records were used to produce a deposit model of the major depositional units across the site.

The results of the deposit modelling indicate that the sediments present beneath the site are similar to those recorded elsewhere in the Lower Thames Valley. A sequence of Shepperton Gravel is overlain by Holocene alluvial sediments, buried beneath modern Made Ground. The surface of the Gravel slopes downwards from north-west to south/south-east across the site, largely resting between -4 and -6m OD. The site clearly lies close to the floodplain/dryland edge, but the Gravel does not rise sufficiently high to definitively indicate the Taplow Gravel terrace. A similar sequence of deposits is recorded across the neighbouring Beam Park site to the east. The Shepperton Gravel (and occasional sand) is overlain by a tripartite sequence of Lower Alluvium, Peat and Upper Alluvium. The Peat generally ranges between 1.5 and 3m in thickness, reaching over 3.5m in five records.

Significant prehistoric archaeological remains have been found towards the top of the Peat close to the floodplain/dryland edge in the nearby vicinity. These finds include a Bronze Age causeway, constructed of gravel and burnt flint, stakes, spreads of fire-cracked pebbles, wattling and a brushwood trackway. The potential to find such remains at the Former Ford Stamping Factory site, particularly towards the northern edge therefore exists, although it is highlighted that the Gravel surface is comparatively low (-3m OD).

However, even in the absence of archaeological remains, the sediments have the potential to contain a wealth of further information on the past landscape, through the assessment/analysis of palaeoecological remains. It is therefore recommended that six targeted boreholes are put down on the site to ground-truth the existing model. The collected boreholes will also provide valuable material for palaeoenvironmental investigation.

2. INTRODUCTION

2.1 Site context

This report summarises the findings arising out of the desk-based geoarchaeological deposit modelling undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of land at the Former Ford Stamping Factory, Kent Avenue, London Borough of Dagenham (National Grid Reference: centred on TQ 49280 83203; Figures 1 & 2). Quaternary Scientific were commissioned by CgMs Consulting to undertake the geoarchaeological investigations. The site lies on the floodplain of the Lower Thames Valley, between the tributaries of the River Beam and Gores Brook; the northern boundary of the site borders the edge of the floodplain. The modern course of the River flows broadly north-west to south-east *ca*. 1km to the south of the site. The British Geological Survey (BGS) show the site underlain by Lambeth Group bedrock, described as 'clay, silt and sand' on the southern part of the site, and London Clay to the north. The bedrock is overlain by Holocene alluvium across the vast majority of the site (described as 'clay, peaty, silty, sandy'), with deposits of the Wolstonian (Marine Isotope Stages (MIS) 6-10) Taplow Gravel terrace towards its northern border. In fact, the alluvial deposits of the Lower Thames and its tributaries are almost everywhere underlain by Late Devensian (MIS 2) Late Glacial Gravels (in the Thames valley, the Shepperton Gravel of Gibbard, 1985, 1994), and this gravel is widely recorded in boreholes in the vicinity of the site.

2.3 Palaeoenvironmental and archaeological significance

The existing geotechnical borehole records in the area of the site indicate considerable variation in the height of the Gravel surface, and the type, thickness and age of the subsequent Holocene deposits within the vicinity of the site. Such variations are significant as they represent different environmental conditions that would have existed in a given location. For example: (1) the varying surface of the Gravel may represent the location of pre-Holocene river terraces, former channels and bars; (2) the presence of peat represents former terrestrial or semi-terrestrial land-surfaces, and (3) the various alluvial units represent periods of changing hydrological conditions. Thus by studying the sub-surface stratigraphy across the site in greater detail, it will be possible to build an understanding of the former landscapes and environmental changes that took place across space and time.

Organic-rich sediments (in particular peat) also have high potential to provide a detailed reconstruction of past environments on both the wetland and dryland. In particular, they provide the potential to increase knowledge and understanding of the interactions between hydrology, human activity, vegetation succession and climate. Significant vegetation changes include the Mesolithic/Neolithic decline of elm woodland, the Neolithic colonisation and decline of yew woodland; the Late Neolithic/Early Bronze Age growth of elm on Peat, and the general decline of wetland and dryland woodland during the Bronze Age. Such investigations are carried out through the assessment/analysis of palaeoecological remains (e.g. pollen, plant macrofossils & insects) and radiocarbon dating. For example, at Hornchurch Marshes, *ca*. 2km to the southeast (Batchelor, 2009; Branch *et al*., 2012) analysis of fine-grained mineral-rich sediments and peat revealed the presence of freshwater during the Late Mesolithic, at which point peat accumulation began, corresponding to a regional reduction in sea level. Significant changes in both the wetland and dryland environment were recorded here, including the establishment of alder carr woodland, yew; the decline of both elm during the Neolithic, and decline of lime during the Neolithic & Bronze Age. A subsequent transition to estuarine conditions was dated to *ca*. 3900 cal BP, coinciding with a decline in woodland cover and the expansion of plant communities typically found within reed swamp. Analysis of borehole sequences from Barking Riverside, *ca*. 2km to the southwest (see Figure 1), indicated that peat accumulation began at *ca*. 6000 cal BP (late Mesolithic), and continued until at least *ca*. 3500 cal BP (Bronze Age) (Green *et al*., 2014). The peat at Bridge Road meanwhile, *ca*. 3km to the east, was found to be of Late Neolithic to Bronze Age date (Meddens & Beasley, 1990). Palaeoenvironmental analysis here revealed that during its accumulation, dense alder carr woodland dominated the wetland, with oak, lime and hazel on the surrounding dryland (Meddens & Beasley, 1990). Palaeoenvironmental assessment carried out immediately to the west of the site revealed a thin sequence of peat and alluvial deposits dating to the Bronze Age. This indicated similar vegetation communities, but the local environment became more open in response to wetter conditions and clearance (Krawiec, 2014). Peat deposits have also been recorded accumulating from the Late Mesolithic to the Iron Age East of Ferry Lane on the High Speed 1 route (Bates & Stafford, 2013).

Finally, areas of high gravel topography, soils and peat represent potential areas that might have been utilised or even occupied by prehistoric people, evidence of which may be preserved in the archaeological (e.g. features and structures) and palaeoenvironmental record (e.g. changes in vegetation composition). This is of particular significance at the present site, since <750m to the west at Hays Storage Services Ltd. (Divers, 1996), a 4m wide Bronze Age causeway, constructed of gravel and burnt flint (MLO59097, TQ 4850 8320 was identified (Divers, 1996; see Figure 1). In addition, a series of prehistoric archaeological features were identified less *ca*. 3km to the east at Bridge Road (Meddens & Beasley, 1990; Beasley, 1991), whilst. The features recorded at Bridge Road included stake holes and spreads of fire-cracked pebbles associated with the foreshore of a former channel, and later, stakes, wattling and a brushwood trackway associated with peat formation (Meddens & Beasley, 1990; Beasley, 1991). Radiocarbon dating of the trackway at Hays Storage Service Ltd. suggested that the causeway was in use for over 100 years between 1520 and 1400 BC (Divers, 1996). The trackway was orientated NNE/SSW and recorded at a depth of -1.70m OD, and traced for 23m within the upper level of a peat deposit also dated to the Bronze Age.

2.4 Aims and objectives

A desk-based geoarchaeological deposit modelling exercise was instigated in order to: (1) clarify the nature of the sub-surface stratigraphy, in particular the presence and thickness of alluvium and peat across the site, (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs, (3) to investigate the archaeological potential of the site, and (4) to devise a strategy for further geoarchaeological investigation. In order to address these aims, the stratigraphic data from existing stratigraphic records were used to produce a deposit model of the major depositional units across the site (see Methods).

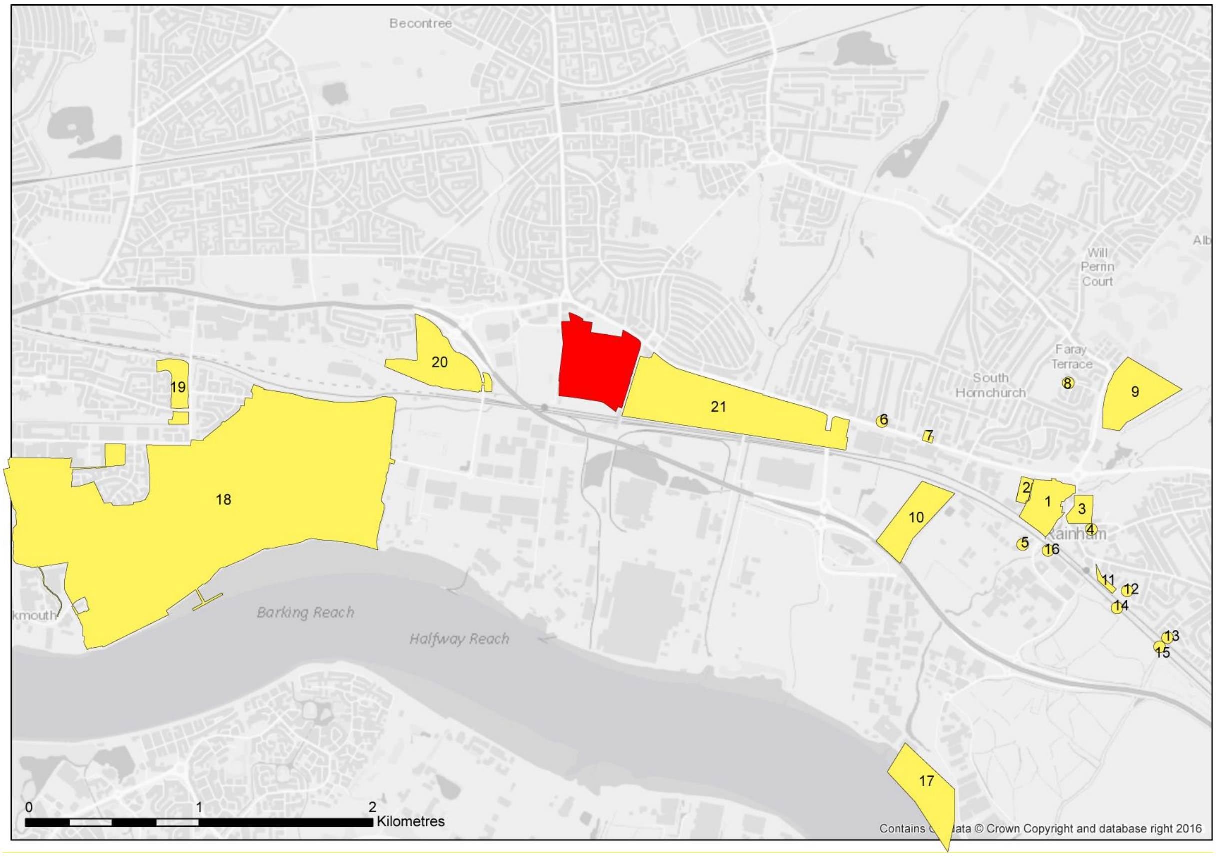

Figure 1: Location of the Former Ford Stamping Factory, London Borough of Havering (highlighted in red) and selected other archaeological and palaeoenvironmental sites: (1) Dovers Corner (Batchelor & Young, 2016); (2) the Passivhaus Housing Development (NRD13; Dyson, 2013); (3) Bridge Road (RA-BR89; Meddens & Beasley, 1990; Beasley, 1991); (4) Viking Way (RA-VW 96; Beasley, 1996); (5) Union Railways (URA97; MoLAS, 1997); (6) the former Manser Works (MNM03; Potter, 2003); (7) 155-163 New Road (NRI07; Pre-Construct Archaeology, 2007); (8) the Lessa Sports Ground (LSA98; MoLAS, 1998, 2001); (9) Scott & Albyn's Farm, Rainham Road (RNH96; HO-CP95; Hertfordshire Archaeological Trust, 1995, 2000); (10) Hornchurch Marshes (MOY03; Branch et al., 2012; Batchelor 2009), (11) the former Rainham Squash and Snooker Club (RSQ04; Archaeological Solutions Ltd, 2005); (12) the former Rainham Football Club (RA-FG95; Thames Valley Archaeological Society, 1995); (13) Brookway Allotments (RA-BA92; Newham Museum Service, 1992); (14) 24.455, East of Ferry Lane, HS1 (Bates & Stafford 2013); (15) 24.755, East of Ferry Lane, HS1 (Bates & Stafford 2013); (16) Rainham Creek (Bates & Stafford 2013); (17) Frog Island (MER11; Batchelor *et al.*, 2011); (18) Barking Riverside (Green et al., 2012); (19) Renwick Road (Green et al., 2012); (20) Goresbrook Park (CgMs, 2016a)/ Hays Storage Services Ltd. (Divers, 1996); (21) Beam Park (Young & Batchelor, 2016).

Figure 2: Location of boreholes across the Former Ford Stamping Factory site.

3. METHODS

3.1 Deposit modelling

The deposit model for the site was based on a review of over 160 borehole records. Sedimentary units from the boreholes were classified into six groups: (1) Bedrock (London Clay / Lambeth Group), (2) Gravel, (3) Lower Alluvium. (4) Peat, (5) Upper Alluvium and (6) Made Ground. In addition, 596 geoarchaeological, archaeological and geotechnical records were collated to examine key deposits across the wider area. The classified data for groups 1-6 were then input into a database within the RockWorks 16 geological utilities software, the output from which was displayed using ArcMAP 10. Models of surface height were generated for the Gravel, Lower Alluvium, Peat and Upper Alluvium using an Inverse Distance Weighted algorithm (Figures 3-5, 7 and 9). Thickness of the Peat, total Holocene alluvium (incorporating the Lower Alluvium, Peat and Upper Alluvium) and Made Ground (Figures 6, 8 and 10) were also modelled (also using an Inverse Distance Weighted algorithm). Borehole transects are displayed in Figures 11 (site wide) & 12 (wider area).

In general, both the distribution and density of boreholes across the site is good; however, not all boreholes record the entire Holocene alluvial sequence, and thus for selected stratigraphic units the reliability is better in certain areas of the site. The reliability of the models generated using RockWorks is therefore variable. In general, reliability improves from outlying areas where the models are largely supported by scattered archival records towards the core area of boreholes. Because of the 'smoothing' effect of the modelling procedure, the modelled levels of stratigraphic contacts may differ slightly from the levels recorded in borehole logs and section drawings. As a consequence of this the modelling procedure has been manually adjusted so that only those areas for which sufficient stratigraphic data is present will be modelled. In order to achieve this, a maximum distance cut-off filter equivalent to a 50m radius around each record is applied to all deposit models. In addition, it is important to recognise that multiple sets of boreholes are represented, put down at different times and recorded using different drilling/descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries.

4. RESULTS, INTERPRETATION & DISCUSSION OF THE GEOARCHAEOLOGICAL DEPOSIT MODELLING

The results of the deposit modelling are displayed in Figures 3 to 12. Figures 3 to 10 are surface elevation and thickness models for each of the main stratigraphic units. Figures 11 and 12 are two-dimensional transects across the site and wider area respectively. The results of the deposit modelling indicate that the number and spread of the logs is sufficient to permit modelling with a high level of certainty across the vast majority of the site. Areas of exception include beneath the basement of a former building on the southwestern part of the site (which truncates the entire sequence down to the Shepperton Gravel surface), and north-western/eastern areas.

The full sequence of sediments recorded in the boreholes comprises:

Made Ground
Upper Alluvium – widely present
Peat – widely present
Lower Alluvium – widely present
Gravel – widely present

4.1 Gravel

Gravel was present in all the boreholes that penetrated to the bottom of the Holocene sequence. The modelling exercise indicates that the surface of the Gravel falls from the northern part of the site, where it is recorded between -2 and -3m OD (e.g. A-BH803; A-BH811) to between -4 and -6m OD across much of the rest of the site (Figures 3 & 11).

This unit most likely represents the Shepperton Gravel deposited during the Late Glacial (MIS2; 15,000 to 10,000 BP) and comprises the sands and gravels of a high-energy braided river system which, while it was active would have been characterised by longitudinal gravel bars and intervening low-water channels in which finer-grained sediments might have been deposited. Such a relief pattern would have been present on the valley floor at the beginning of the Holocene when a lower-energy fluvial regime was being established.

Where the Gravel rises towards the north of the site, this is consistent with the position of the site on the edge of the floodplain. Whilst clearly rising, the elevation of the Gravels do not appear to reach those anticipated for the surface of the older Wolstonian Taplow Gravel terrace (MIS 6-10; 352,000 to 130,000 BP) which in this area forms the edge of the floodplain; Gibbard (1994) shows the surface of the Mucking (Taplow) Gravel falling to around 1m OD in the area of South Hornchurch (p 54). However, it is difficult to differentiate the deposits of the Taplow and Shepperton Gravel on the basis of elevation alone.

Beyond the margins of the site to the east, the surface of the Taplow Gravel can be more confidently recognised, where it reaches between *ca.* 1.5 and -1m OD on the northern part of the Beam Park site (Figure 4 & 12). From here, the Gravel surface falls to between -6 and -9.5m OD on the southern part of the site, representative of the Shepperton Gravel. Two particularly deep depressions are recognised: Towards the south-west of Beam Park the Gravel surface is consistently recorded at between *ca*. -7.5 and -9.58m OD; although the extent and orientation of this depression is not yet fully understood, due to the absence of data to the south, it is possible that this feature represents a former channel that might have been orientated broadly west-east. Towards the north-west of Beam Park, three borehole records indicate thick alluvial deposits resting directly on Bedrock at up to -14m OD. It is possible that these records are erroneous, but it is of note that similarly deep depressions are recorded adjacent to the terrace edge at Barking Riverside (Green *et al*., 2014).

4.2 Sand

A horizon of sand is the lowest unit in the Holocene alluvial sequence, and where present, it rests directly on the surface of the underlying Shepperton Gravel. Where it is identified, it can be interpreted as being deposited under low to moderate energy fluvial conditions, most likely within former channel features. On the present site, Sand is recognised in 17 sequences, and vary in thickness between 0.2 and at least 1.2m (Figure 11). However, its absence in the other sequences does not necessarily mean it is not present as an individual unit; it is rarely possible to confidently separate Sand from Shepperton Gravel or indeed the silty sandy deposits of the Lower Alluvium, due to the nature of the coring methods and less precise method of description. In the case of the modelling exercise, differentiation between the Sand and Gravel is made based upon the presence of more than rare occurrences of Gravel within the sediment.

4.2 Lower Alluvium

The Lower Alluvium rests directly on either the Shepperton Gravel or Sand and was recorded in the majority of those records that penetrated sufficiently deeply across the site. The surface of the Lower Alluvium (Figures 5 & 11) tends to slope downwards from north-west (-2m OD) towards the south and east (-5m OD).

The deposits of the Lower Alluvium are described as a predominantly silty or clayey tending to become increasingly sandy downward in most sequences. The Lower Alluvium frequently contains detrital wood or plant remains, and in many cases is described as organic and with occasional Mollusca remains. The sediments of the Lower Alluvium are indicative of deposition during the Early to Mid-Holocene, when the main course of the Thames was probably confined to a single meandering channel. During this period, the surface of the Shepperton Gravel was progressively buried beneath the sandy and silty flood deposits of the river. The richly-organic nature of the Lower Alluvium suggests that this was a period during which the valley floor was occupied by a network of actively shifting channels, with a drainage pattern on the floodplain that was still largely determined by the relief on the surface of the underlying Shepperton Gravel.

4.3 Peat

Overlying the Lower Alluvium / Sand or in some cases Shepperton Gravel in the vast majority of the boreholes is a unit of Peat. The peat is indicative of a transition towards semi-terrestrial (marshy) conditions, supporting the growth of sedge fen/reed swamp and/or woodland communities across the floodplain. On the basis that 1m of peat represents up to 1000 years of peat accumulation (a figure typical of fen peat in alluvial floodplains), peat may have been accumulating in areas of the site for up to 4000 years. Nearby sites such as Hornchurch Marshes (Batchelor, 2009; Branch et al., 2012), Barking Riverside (Green et al., 2014) and Bridge Road (Meddens & Beasley, 1990; Beasley, 1991) have all recorded Peat accumulation from the late Mesolithic to Bronze Age.

The Peat generally varies in thickness between 1.5 and 3m in thickness, with the thickest horizons generally occurring on the western and south-western parts to the site (Figures 6 & 11). Horizons exceeding 3.5m in thickness are recorded in A-BH3030, A-BH618, A-BH807, A-VBH715 & A-VBH719. Peat was absent in a small number of sequences, largely located on the northern margins of the site (A-BH803, A-BH603, A-BH805 & A-BH504) towards the northern part of the site. Within these sequences, mineral-rich deposits were recorded ranging in size from clay to gravel sized clasts. The surface of the Peat is relatively even, generally lying between -1 and -2m OD (Figure 6 & 11).

The Peat also has the potential to contain archaeological remains as demonstrated by significant trackway/causeway findings at both Hays Storage Dagenham (Divers, 1996) and Bridge Road, Rainham (Meddens & Beasley, 1990; Beasley, 1991). Generally, these remains have been recorded towards the top of the Peat and relatively close the floodplain edge.

4.4 Upper Alluvium

The Upper Alluvium rests directly on the Gravel (towards the north) or the peat/Lower Alluvium (towards the south), and was recorded in all records across the site with the exception of selected sequences towards the northern boundary of the site. The deposits of the Upper Alluvium are described as predominantly silty or clayey which are very occasionally organic-rich. The surface of the Upper Alluvium is relatively even, generally lying at between -1.0 and 2m OD (Figure 8 & 11). The sediments of the Upper Alluvium are indicative of deposition within low energy fluvial and/or semi-aquatic conditions during the Holocene. The high mineral content of the sediments may reflect increased sediment loads resulting from intensification of agricultural land use from the later prehistoric period onward, combined with the effects of rising sea level.

In areas of high Gravel topography on the very northern margins of the site, it is possible that the silty or clayey deposits might instead represent brickearth (rather than Upper Alluvium). This was the case at Beam Park, though there, the Gravel surface was recorded above 0m OD.

The combined Holocene alluvial sequence, incorporating the Lower Alluvium, Peat and Upper Alluvium ranges between 3 & 5m in thickness, and is generally thicker where the Shepperton Gravel surface is lower towards the south of the site (Figure 9).

4.5 Made Ground

Between 1 & 2m of Made Ground caps the Holocene alluvial sequence across the vast majority of the site, reaching up to 5m in isolated areas (Figure 10).

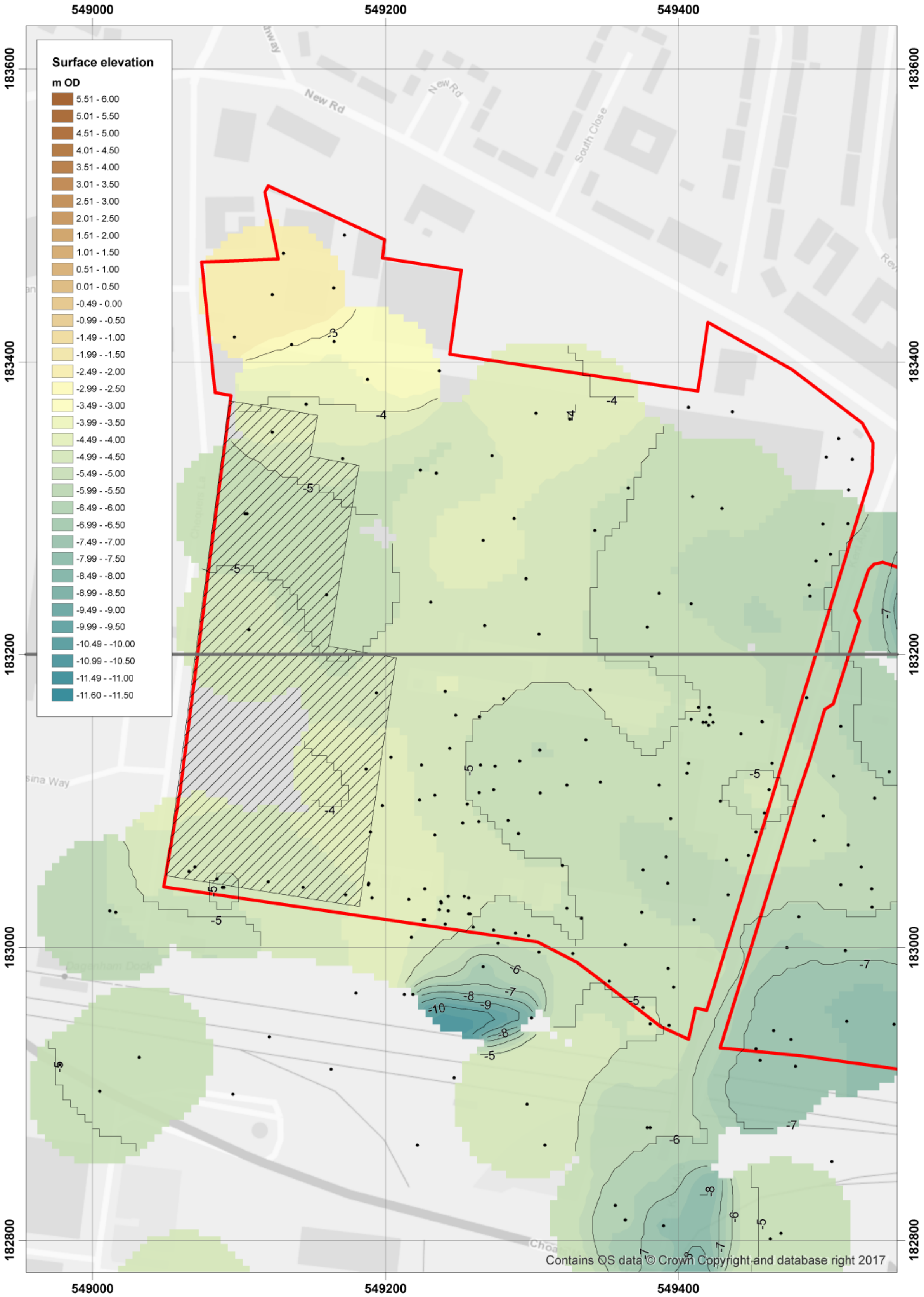

Figure 3: Top of the Gravel (m OD)

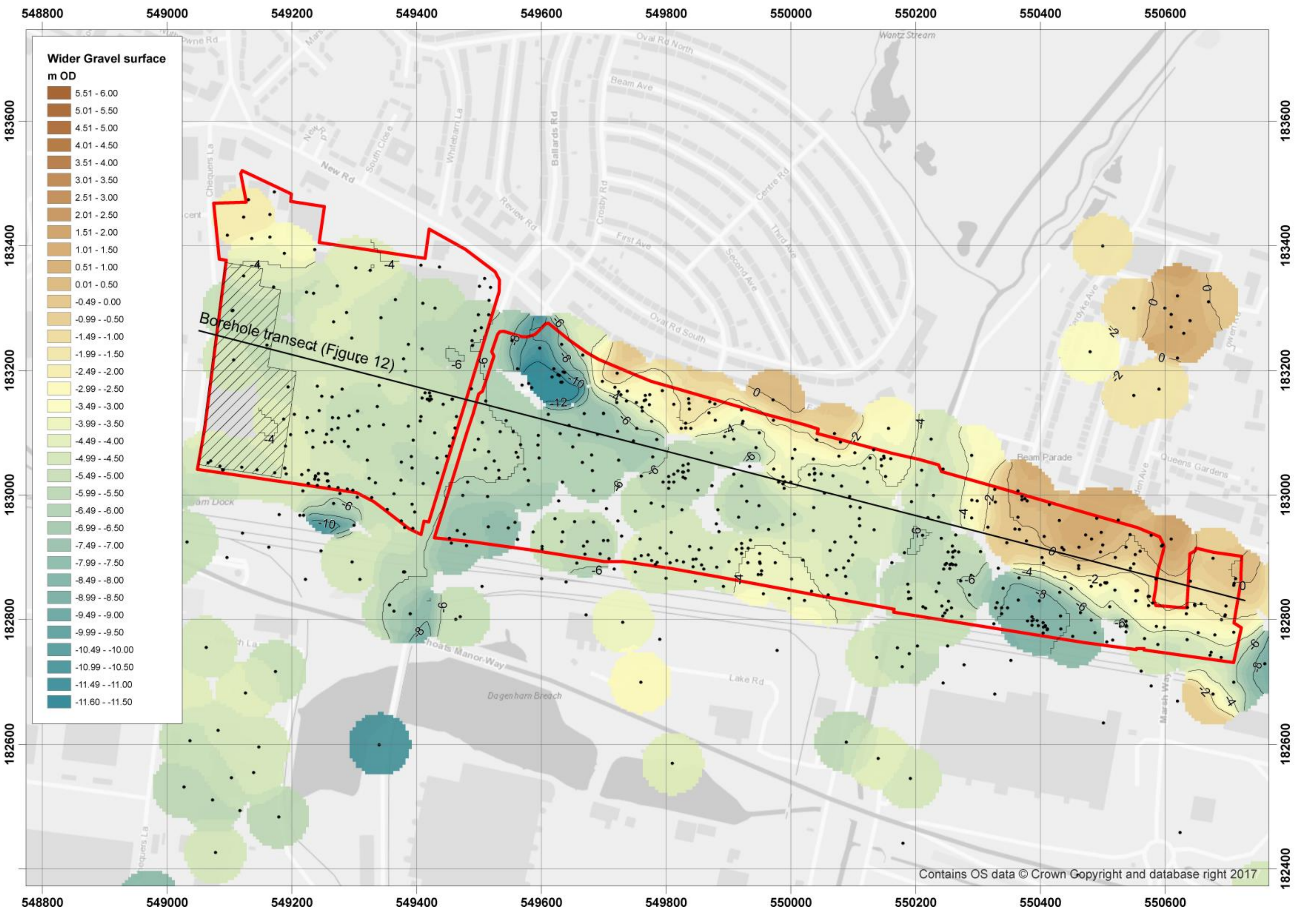

Figure 4: Top of the Gravel across the wider area (m OD) (site outline in red)

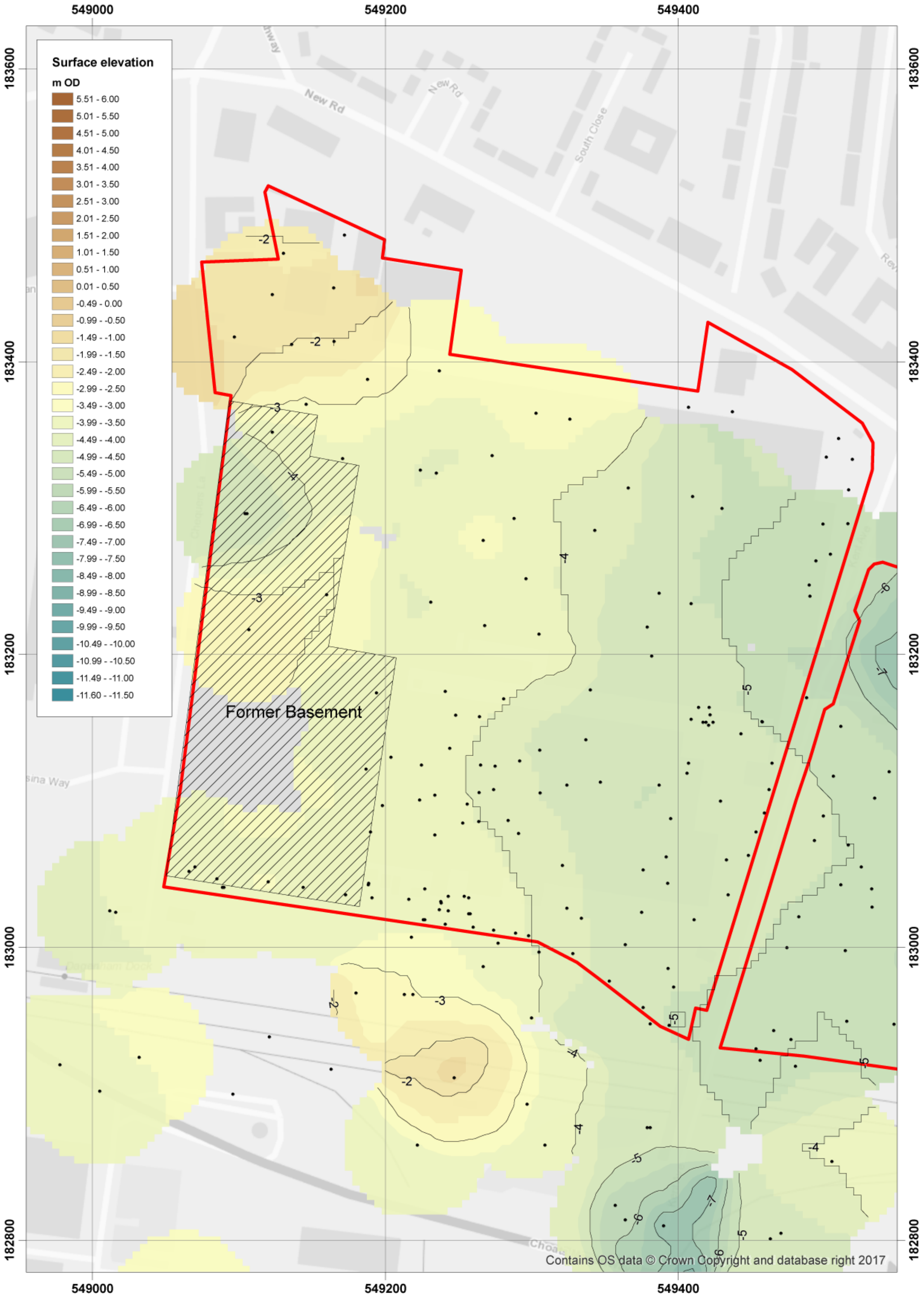

Figure 5: Top of the Lower Alluvium (m OD)

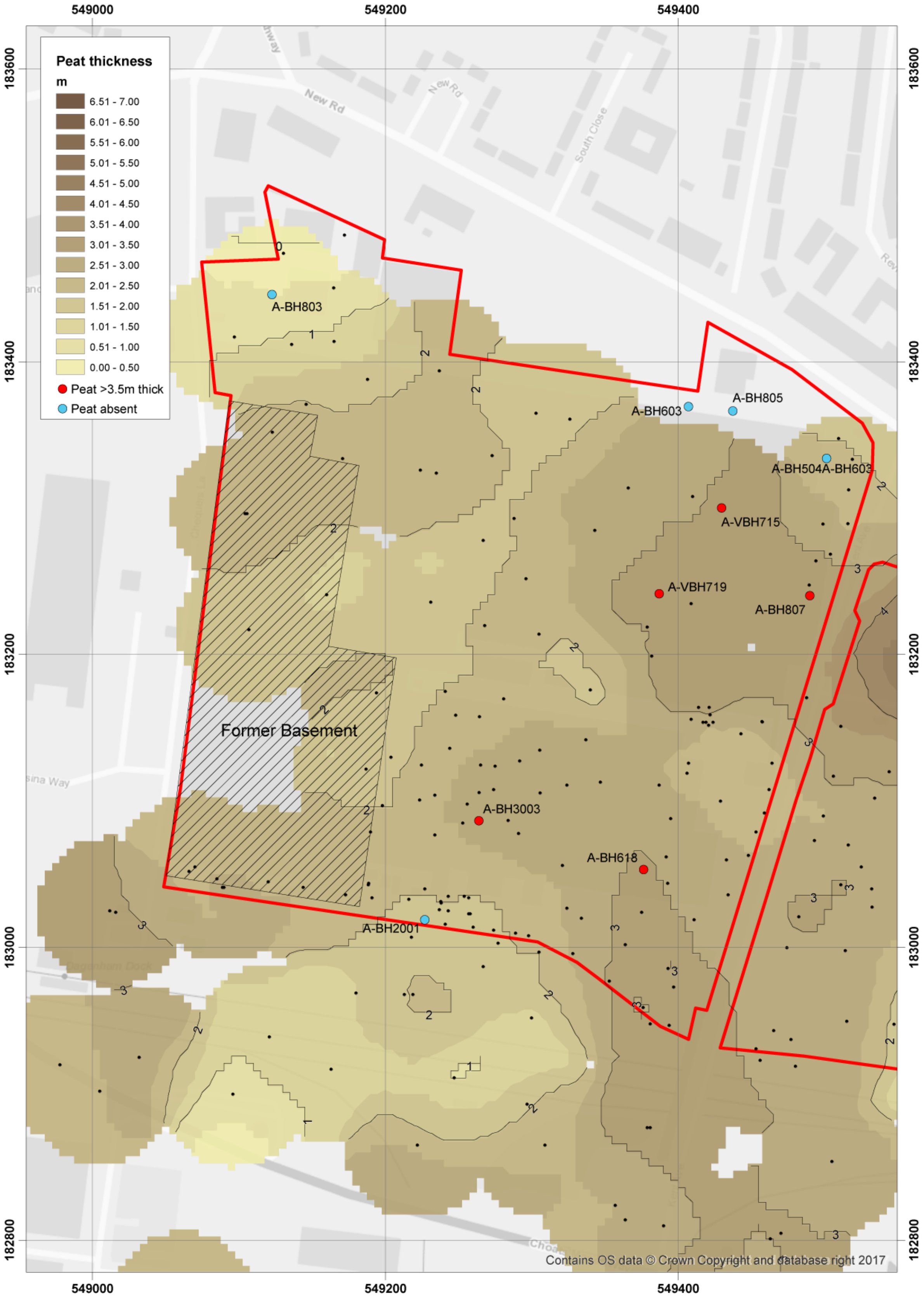

Figure 6: Thickness of the Peat (m)

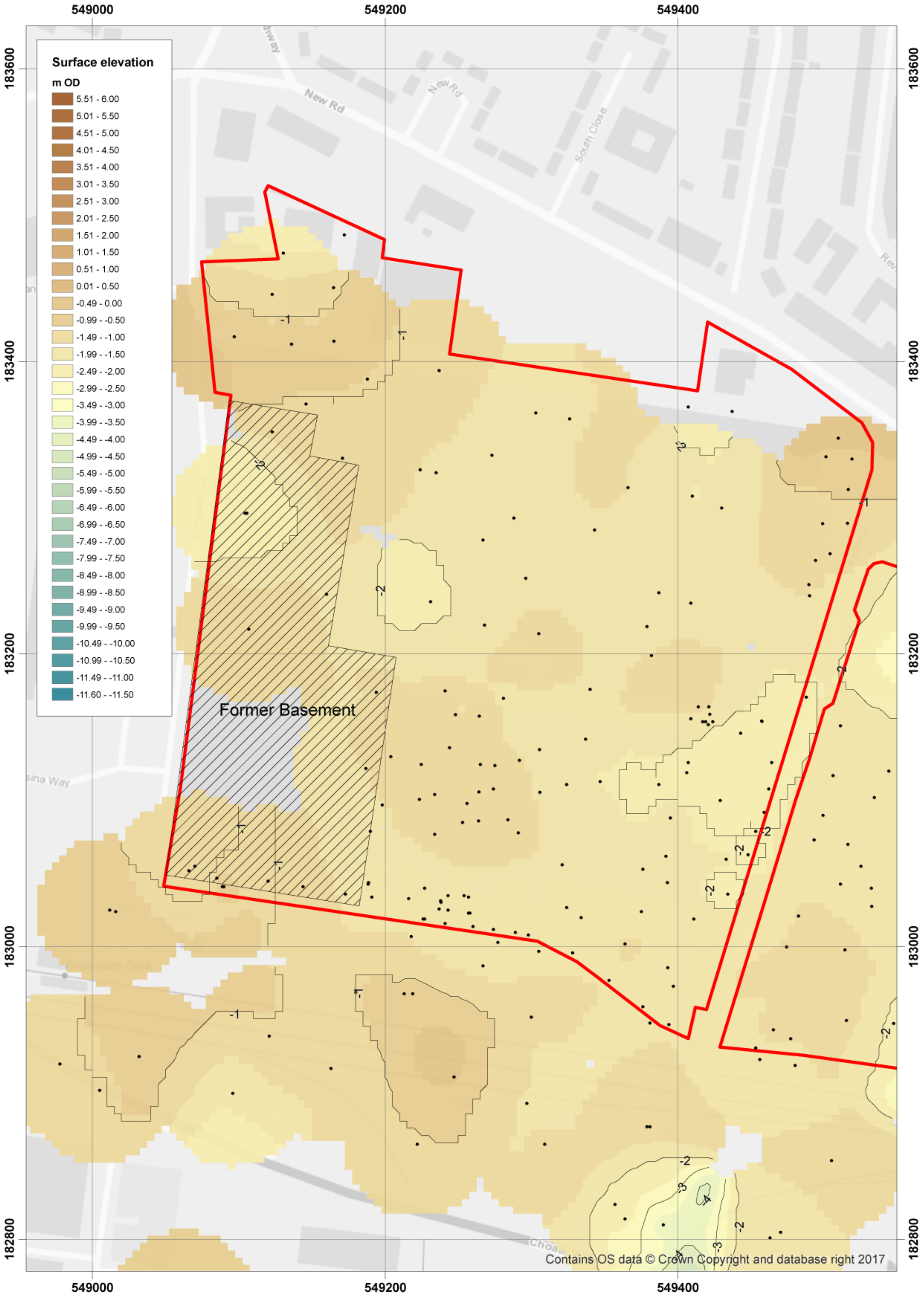

Figure 7: Top of the Peat (m OD)

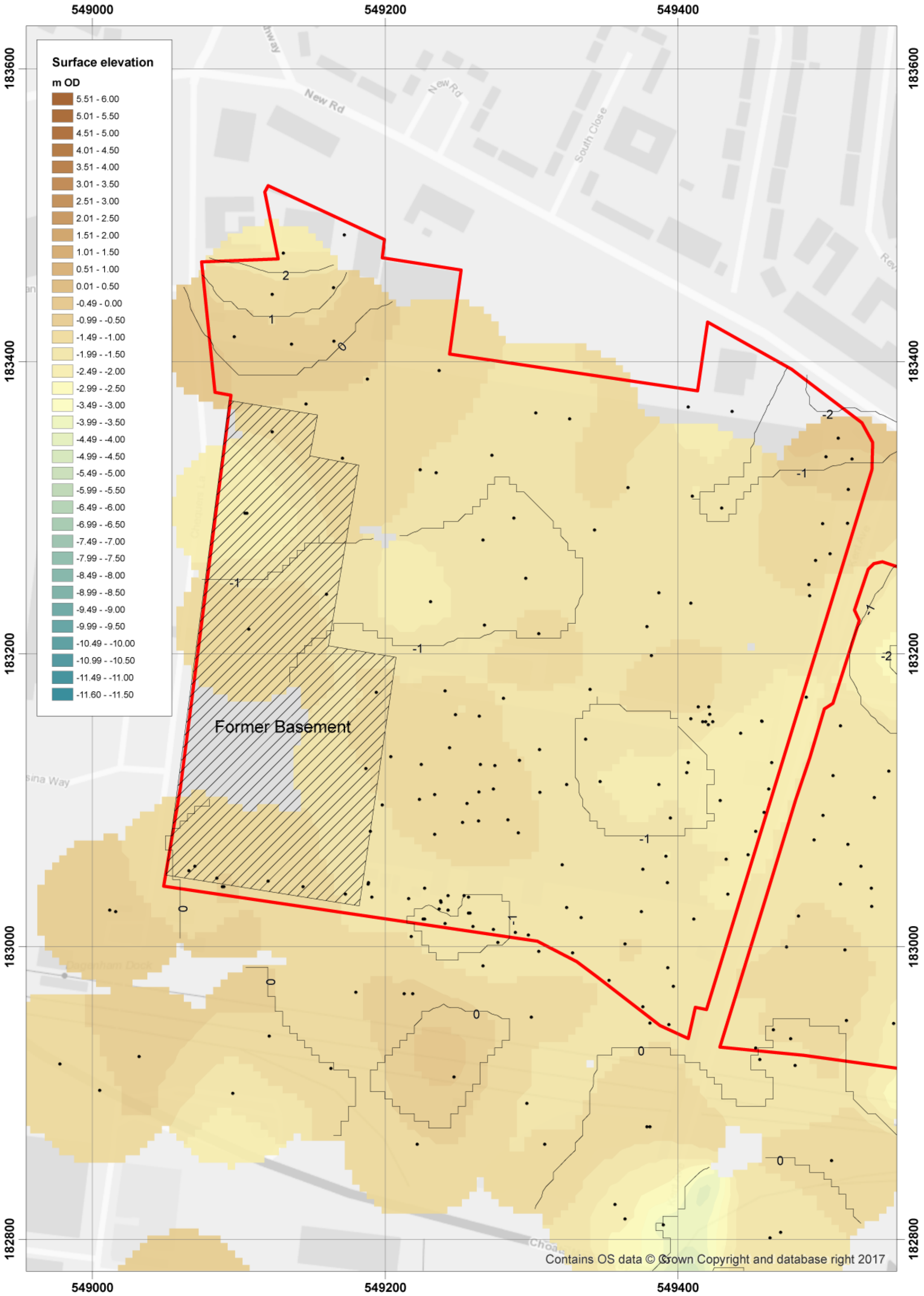

Figure 8: Top of the Upper Alluvium (m)

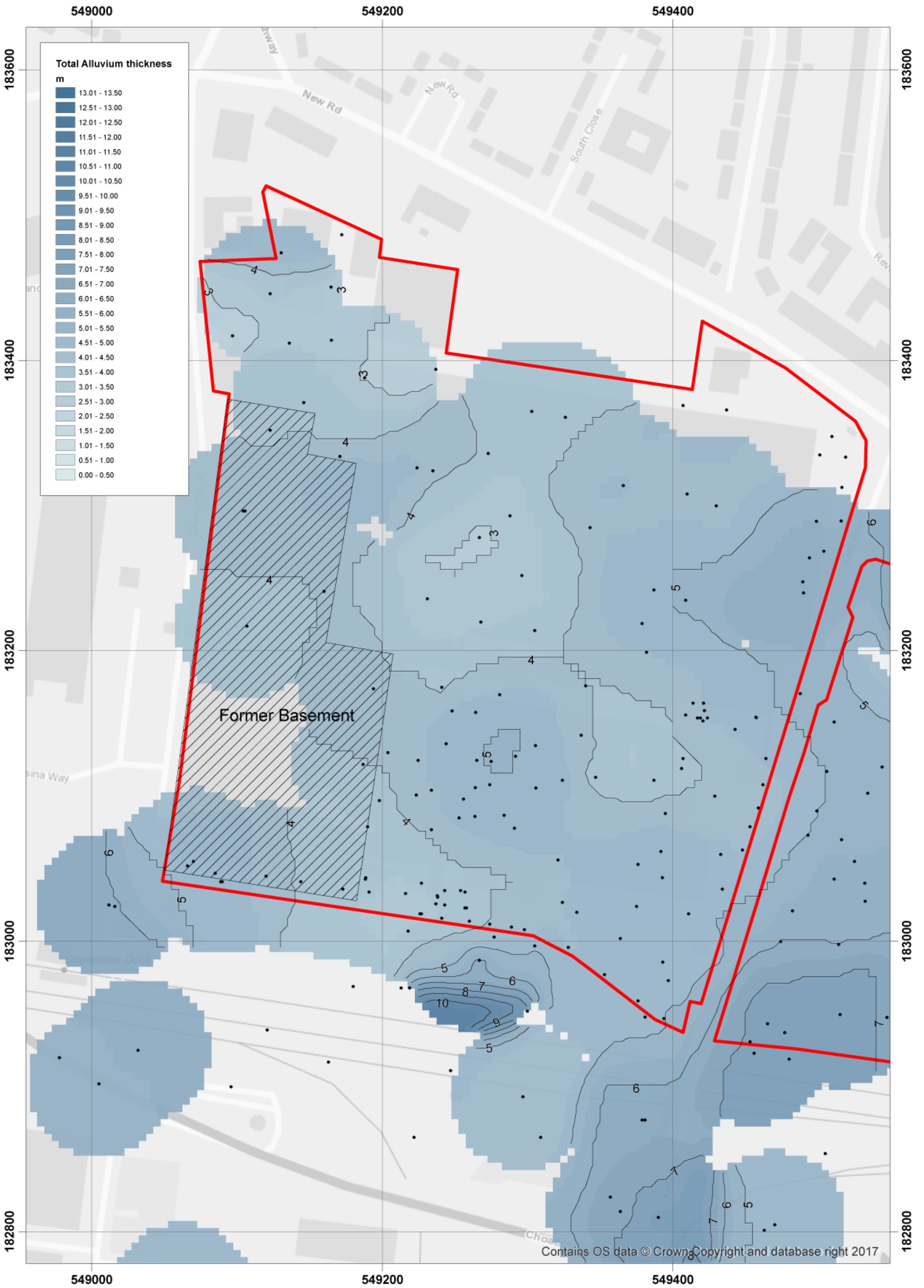

Figure 9: Thickness of the Total Alluvium (Lower Alluvium, Peat and Upper Alluvium) (m)

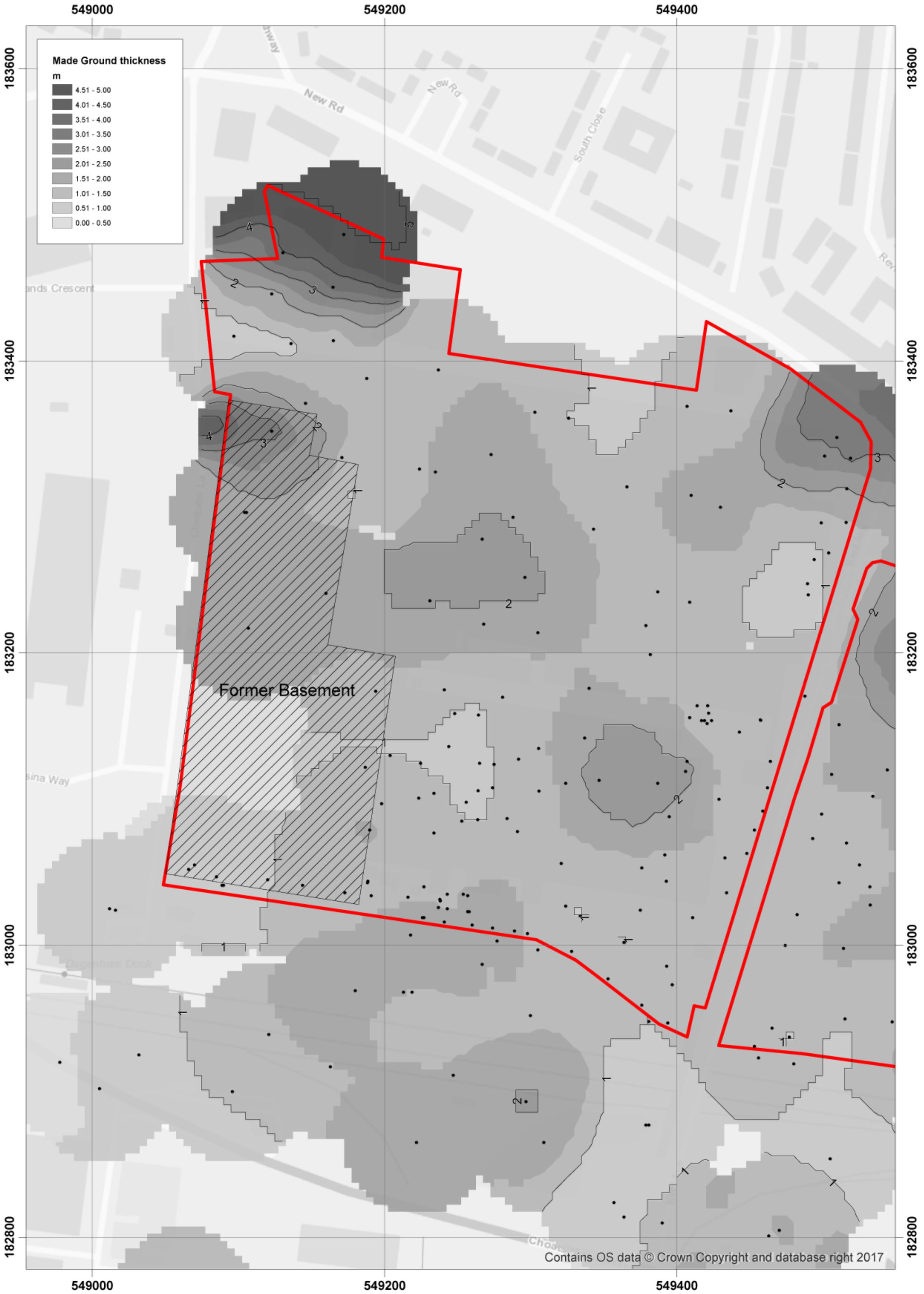

Figure 10: Thickness of Made Ground (m)

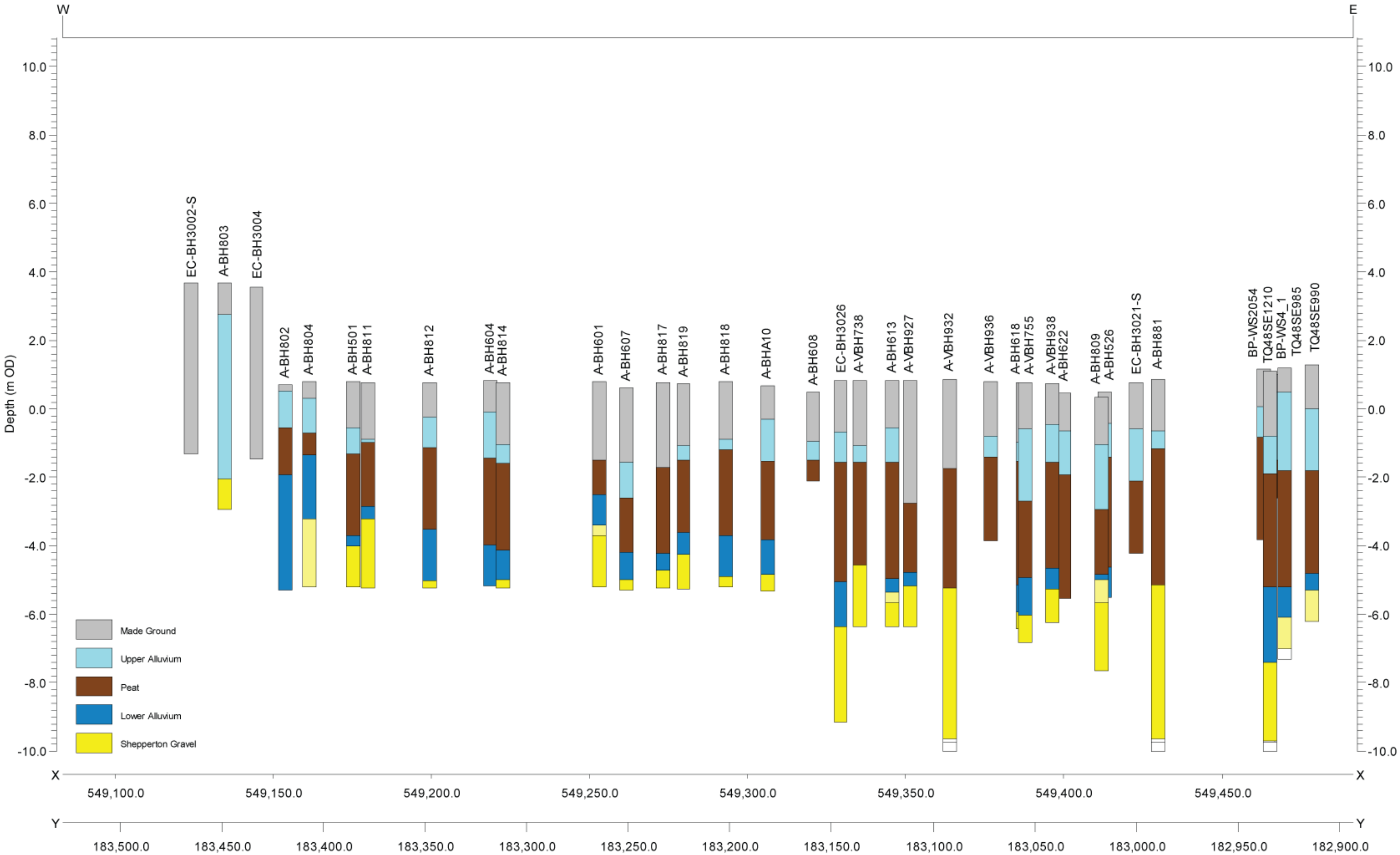

Figure 11: Site-wide borehole transect

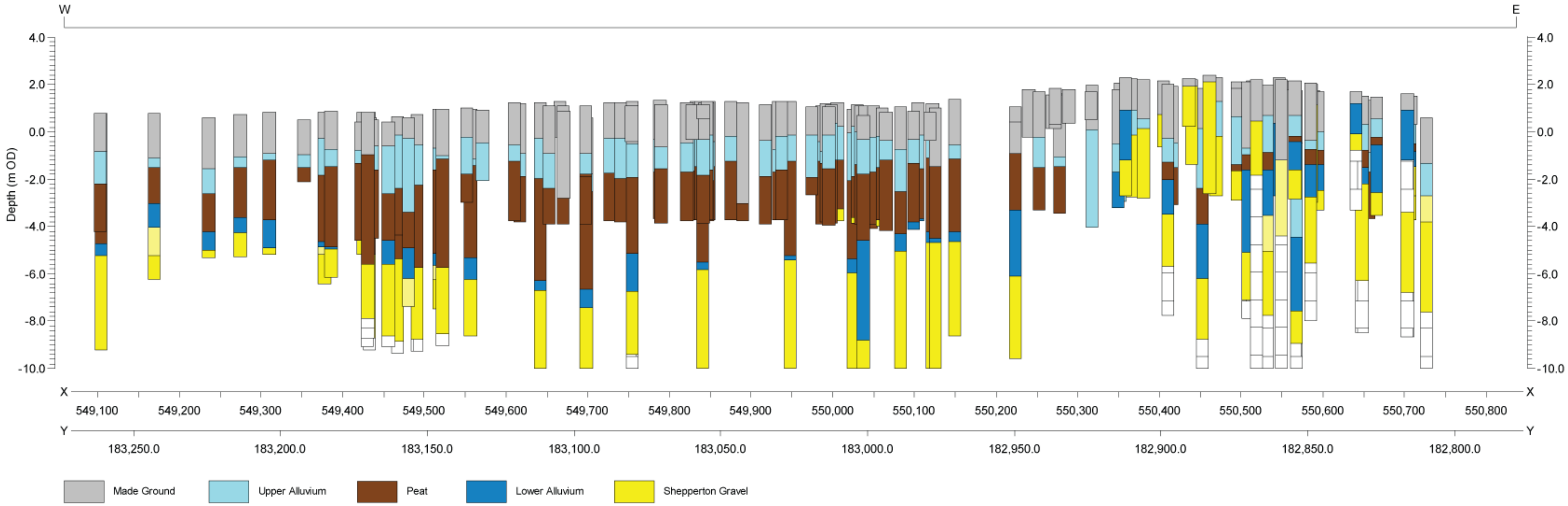

Figure 12: Borehole transect across the wider area

5. DISCUSSION, CONCLUSIONS & RECOMMENDATIONS

A desk-based geoarchaeological deposit modelling exercise was instigated for the Former Ford Stamping Factory site in order to: (1) clarify the nature of the sub-surface stratigraphy, in particular the presence and thickness of alluvium and peat across the site, (2) to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs, (3) to investigate the archaeological potential of the site, and (4) to devise a strategy for further geoarchaeological investigation. In order to address these aims, the stratigraphic data from existing stratigraphic records were used to produce a deposit model of the major depositional units across the site.

The results of the deposit modelling indicate that the sediments present beneath the site are similar to those recorded elsewhere in the Lower Thames Valley. A sequence of Shepperton Gravel is overlain by a sequence of Holocene alluvial sediments, including peat, buried beneath modern Made Ground. The surface of the Gravel slopes downwards from north-west to south/south-east across the site, largely resting between -4 and -6m OD. The site clearly lies close to the floodplain/dryland edge, but the Gravel does not rise sufficiently high to definitively indicate the Taplow Gravel terrace. A similar sequence of deposits is recorded across the neighbouring Beam Park site to the east. The Shepperton Gravel (and occasional sand) is overlain by a tripartite sequence of Lower Alluvium, Peat and Upper Alluvium. The Peat generally ranges between 1.5 and 3m in thickness, reaching over 3.5m in a total of five records.

Significant prehistoric archaeological remains have been found towards the top of the Peat close to the floodplain/dryland edge at Bridge Road, Rainham (Meddens & Beasley, 1990; Beasley, 1991), Hays Storage, Dagenham (Divers, 1996) and more recently within brickearth in the north-eastern corner of Beam Park (PCA, in press). At Bridge Road, these included a Bronze Age causeway, constructed of gravel and burnt flint, stakes, spreads of fire-cracked pebbles, wattling and a brushwood trackway. The potential of identifying such remains at the Former Ford Stamping Factory, particularly towards the northern edge therefore exists, though it is highlighted that the Gravel surface is comparatively low (-3m OD).

However, even in the absence of archaeological remains, the sediments have the potential to contain a wealth of further information on the past landscape, through the assessment/analysis of palaeoecological remains (e.g. pollen, plant macrofossils and insects) and radiocarbon dating. So called environmental archaeological or palaeoenvironmental investigations can identify the nature and timing of changes in the landscape, and the interaction of different processes (e.g. vegetation change, human activity, climate change, hydrological change) thereby increasing our knowledge and understanding of the site and nearby area. In the case of human activity, palaeoenvironmental evidence can include: (1) decreases in tree and shrub pollen suggestive of woodland clearance; (2) the presence of herbs indicative of disturbed ground, pastoral and/or arable agriculture; (3) charcoal/microcharcoal suggestive of anthropogenic or natural burning, and (4) insect taxa indicative of domesticated animals. Such investigations are routinely carried out where required as part of planning conditions across the Lower Thames Valley and its tributaries, instructed by the LPA Archaeological Advisor.

It is therefore recommended that six further boreholes are put down on the site to ground-truth the existing model and collect material for palaeoenvironmental investigation. No further work is recommended in the areas of the existing basement (due to truncation of the deposits) or within known areas of contamination. The boreholes have been selected to: (1) provide a good spatial distribution across the site; (2) investigate the nature of the deposits towards the north of the site; (3) target the sequences with the thickest Peat, and (4) avoid areas of contamination / greatest likely truncation. The proposed locations are displayed in Figure 13. In the interim, the concrete and hardstanding across the site is considered to have no archaeological value and can be broken up/removed. Indeed, this action will aid the recommended geoarchaeological works.

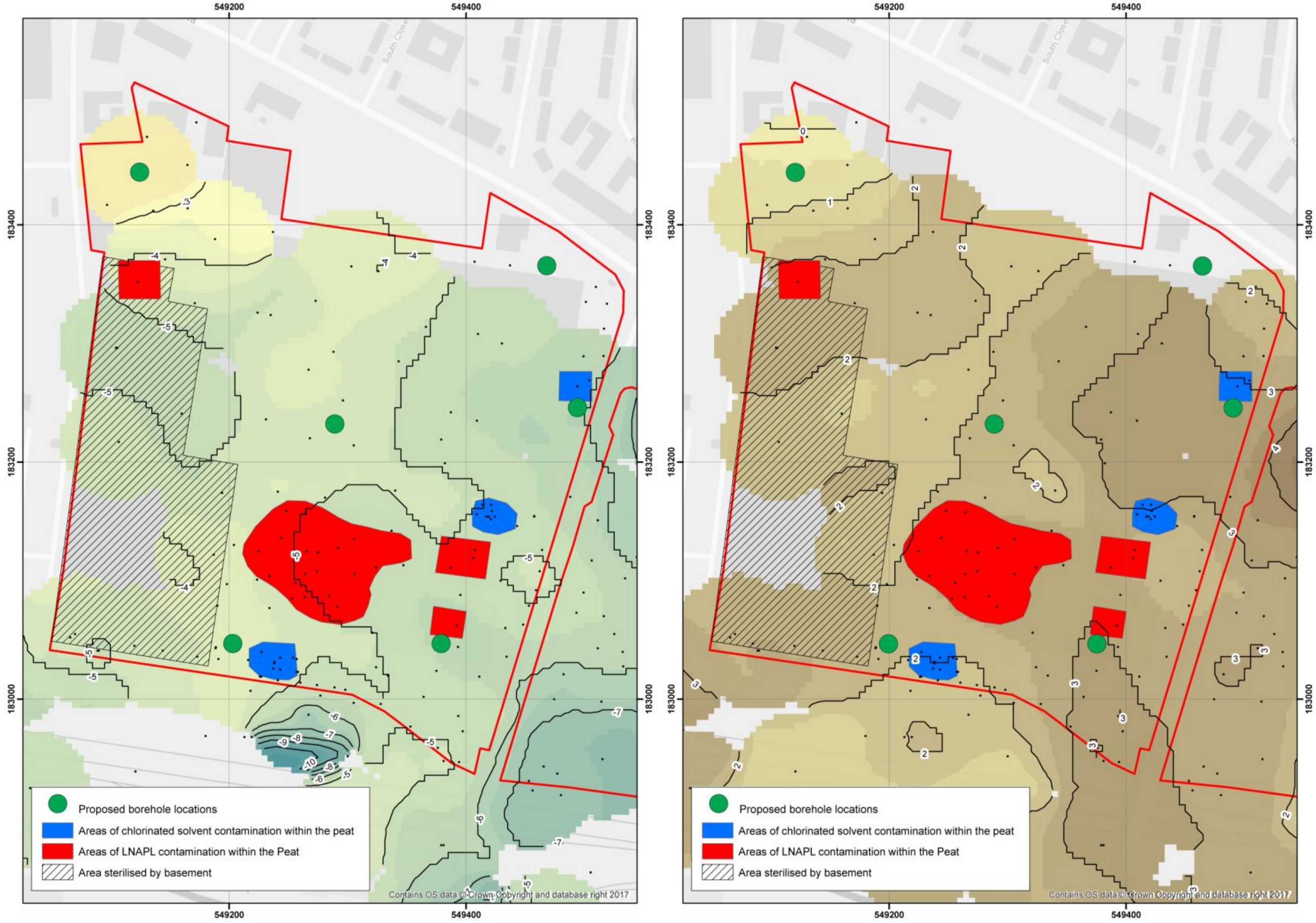

Figure 13: Recommended geoarchaeological borehole locations

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