

**Stage 2 Geo-Archaeological
Evaluation and Assessment of land at the former Empire Sports Ground,
Knockhall Road, Greenhithe,
Kent, DA9 9EZ**

NGR TQ 593 744

**Project No. 5197
Report Reference No. 2012083
Site Code: KRG11**

Dr Matt Pope and Dr Martin Bates

**With contributions by
John Whittaker, Liz Chambers and Justin Russell**

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Abstract

Archaeology South-East was commissioned by CgMs Consulting Ltd. on behalf of their client Landhold Capital to undertake a geo-archaeological assessment at Knockhall Road, Greenhithe, Kent. The site's archaeological potential comes from its location in Ingress Vale some 300m to the west of Barnfield Pit, a site of international significance due to its rich Palaeolithic archaeology and faunal remains, including the skull of an early Neanderthal female (Swanscombe Man).

The work was undertaken as part of pre-planning submission work to inform the pre-planning process and set out to characterise the sedimentary sequence at the site, ground-truth the results of previous geotechnical work, map the distribution of intact Pleistocene sediments and assess for evidence of human activity and palaeoenvironmental remains. Fourteen geoarchaeological test pits were excavated and assessed for stratigraphy, the presence of artefacts/ecofacts and sampled for palaeoenvironmental evidence.

The investigation has determined that sand and gravel deposits of direct equivalence to those recorded at Barnfield Pit are present on the western and north western parts of the site. These deposits have been equated with the Upper Gravels, Upper Loam and Middle Gravels of the main Barnfield Pit sequence. Humanly struck flint, including hard hammer debitage, soft hammer debitage and a crude bifacial tool were recovered from both the Upper and Middle Gravels. The majority of this material was lightly rolled and indicates human activity relating to the broad site locale.

Middle Pleistocene sediments were observed to have been truncated to the east and south by the emplacement of Head, deposited as part of dry valley formation, probably in the Late Pleistocene. These findings were contra those of the previous geotechnical study which suggested the significant emplacement of recent (19th -20th Century) backfill on the slopes and base of the valley.

Palaeoenvironmental/Science based archaeological evidence was assessed as being locally useful: mollusc communities indicative of open conditions surviving, the determination of a possible buried soil as part of the Late Pleistocene-Early Holocene sequence and in establishing the feasibility for Amino Acid dating (for the Mid-Pleistocene) and OSL dating (for the Late Pleistocene/Holocene) as part of any future mitigation.

This work has concluded that the Knockhall Road site forms a surviving part of a former landscape distribution of well-preserved Pleistocene sediments. These deposits relate to the MIS 11 Boyn Hill Terrace of the Swanscombe-Boyn Hill locale and Late Pleistocene Head Deposits. The site has undergone transformation both through Late Pleistocene valley formation and terracing, possibly as part of both agricultural activities (Orchard planting) and the 1980's football pitch levelled at the base of the slope. However, below superficial made ground, the site preserves intact significant volumes of sediment with demonstrated international archaeological significance.

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1.0 INTRODUCTION

- 1.1** Archaeology South-East was commissioned by CgMs Consulting Ltd. on behalf of their client Landhold Capital to undertake an evaluation of the geo-archaeological potential of land at the former Empire Sports Ground, Knockhall Road, Greenhithe, Kent hereafter referred to as the 'site' (Figure 1).
- 1.2** According to the British Geological Survey (BGS), the site was located on the edge of MIS11 Boyn Hill terrace, occupying flat ground on the western margins which falls away to steeply sloping ground down to level former playing field to the eastern margins of the site. The height range across this slope ranges from approximately 40m in the west to 20m OD at the foot of the slope.
- 1.3** The Boyn Hill Terrace deposits here comprise sands and gravels of fluvial origin relating to the former Middle Pleistocene course of the River Thames. These deposits are of international significance having been demonstrated through a long history of investigation to comprise a depositional sequence exceptionally rich in artefactual remains, containing faunal remains including those of the archaic *Homo sapiens* (Swanscombe Man) as well as palaeoenvironmental evidence.
- 1.4** Examination of geotechnical data (CgMs 2011, Appendix 1) initially indicated that the site had a complex recent history involving both possible quarrying and the emplacement of made ground. The geotechnical investigation was not detailed enough to establish with confidence the extent of this apparent landscaping or definitely establish the interface between intact sediment with archaeological potential and emplaced made ground, much of which appeared from the logs to be comprised of river gravel material. Nor did the geotechnical records provide enough information to determine which facies of the Boyn Hill terrace are present at the site.
- 1.5** The overall objective of the project was to progress the determination of a forthcoming planning application by better defining the nature of deposits on the site. The preceding geotechnical report (CgMs 2011, Appendix 1) indicated that the site had potential to contain archaeologically significant geological deposits but further clarification of their nature was required. A programme of geo-archaeological evaluation to meet this need was therefore developed between ASE Senior Geo-Archaeologist and Project Manager (Dr Matt Pope and Jon Sygrave), the Consultant (Richard Meager, CgMs) and the KCC Heritage team (Liz Dyson and Wendy Rogers, Heritage Conservation Group).

Key aims of the geo-archaeological evaluation were:

- To map accurately the vertical and horizontal distribution across the site of in-situ terrace deposits.
- To assess the sediments in terms of lithology and sedimentary structure in order to establish the overall stratigraphic framework of the sediments and correlation with other local sequences, principally Barnfield Pit.
- To sequence palaeoenvironmental evidence to effect both local

characterisation and more effective inter-site correlation.

- To assess the potential the deposits hold for artefacts and ecofacts through sieving.

The proposed works were described in the preceding Written Scheme of Investigation (WSI) (ASE 2012), the details of which were agreed formally with KCC prior to the commencement of works.

2.0 GEOARCHAEOLOGICAL AND ARCHAEOLOGICAL BACKGROUND

- 2.1** Knockhall Road sits within an area of the Lower Thames of great importance for the British Lower and Middle Palaeolithic. Through the long term study of sites within a few kilometres of Greenhithe, significant parts of the basic chronological and sedimentary sequence for the British Middle Pleistocene and Palaeolithic was developed during the 20th century. Consequently the locality is immensely significant in the development of a depositional framework for SE England and our understanding of human behaviour in the Middle Pleistocene. The deposits of the locality preserve a long terrace sequence of periglacial and interglacial deposits dating from the Anglian glaciation (when the Thames was aligned through glacial advance to its current course) through to the Late Pleistocene/Early Holocene. The locality has a long history of investigation, made possible by an industrial past of cement production and gravel extraction and interest from amateur and academic investigators alike. Wymer described the area as, "From the point of view of Quaternary geology and Palaeolithic archaeology, this is the richest and most well known area of the Thames Valley and, for that matter, Britain." (Wymer 1999, 67).
- 2.2** The present site lies c.325m west of the Barnfield Pit site, one of Northern Europe's richest Lower Palaeolithic sites and of great significance in terms of the history of the Lower Palaeolithic studies. The site is noted particularly for producing the Swanscombe Skull (Marston 1937), identified as being of early Neanderthal affinity, as well as producing substantial quantities of associated finds (including 7613 handaxes, 333 cores and 16300 pieces of debitage) during the twentieth century (Bridgland 1985; Conway et al. 1996; Stringer & Hublin 1999). The Barnfield Pit finds were associated with fluvial sands and gravels, and intervening slits and clays, ascribed to the Boyn Hill Terrace or Orsett Heath Gravels. These consist of sands and gravels divided by layers of sands and silts of fluvial origin relating to the former Middle Pleistocene course of the River Thames (HER TQ57SE219, TQ5977 7423; Wenban-Smith 2007: 50-51; Wessex Archaeology 1993: 96; Wessex Archaeology 2004: 9-12; Wymer 1999: 67).
- 2.3** Study of the geotechnical results from previous investigations at the site (CgMs 2011, Appendix 1) indicates high potential for the preservation of Palaeolithic remains and associated palaeoenvironmental evidence including mammalian fauna. The recorded presence of fluvial sands and gravels at the site, resting on a chalk platform at 22m OD suggests it is situated directly on the edge of MIS11 Boyn Hill terrace, occupying steeply sloping ground from approximately 40m to 20m OD. Potential is indicated by the former Dierdon's Pit site which fronts the north side of Knockhall Road c.375m to the north of the study site. Here, near the Ingress Tavern, Greenhithe, a shell bed was located which produced about 500 Lower Palaeolithic flakes together with animal and molluscan remains during the early twentieth century (Smith and Dewey 1914; HER TQ57SE7; TQ5950 7477). The BGS data (Section 1.2) indicates that Dierdon's Pit, like Knockhall Road, lies within a small area of the Boyn Hill river terrace gravels.
- 2.4** Evidence of further Palaeolithic activity and occupation has been identified at Collyers Pit to the east of the study site (HER TQ57SE242, TQ5968 7449)

while a further location some c.125m to the east produced 37 Palaeolithic handaxes, a core and 6 pieces of debitage (HER TQ57SE1002, TQ595 745). The Kent HER records another find of 37 Lower Palaeolithic handaxes, four retouched flakes and two other flakes, in a valley which cuts through the Boyn Hill Gravels at this point (HER TQ57SE271, TQ5974). These two findspots may be a single site duplicated on the Kent HER.

- 2.5** A single Palaeolithic flint flake has also been identified at Knockhall Road to the southwest of the study site (HER TQ57SE170, TQ59020 74308).
- 2.6** This evidence base indicates strongly that the Knockhall Road site sits within the distribution of a broad suite of deposits that occur intermittently between Dartford and Northfleet that can be dated to Marine Isotope Stages 12-10 (430-350ka B.P.). These deposits consist of sands, silts and gravels deposited in fluvial environments of the Thames and locally the sediments often contain rich associations of faunal material, with preservation aided by the proximity of the chalk in many instances.

Geology Detail (Swanscombe area)

- 2.7** The sequences in the Swanscombe area are particularly well represented by the deposits at Barnfield Pit (Figure 1 (Conway *et al.*, 1996; Wenban-Smith and Bridgland, 2001; McNabb, 2007). The sequence of deposits at the Barnfield Pit consists of:
1. The Lower Gravel and Lower Loam (Phase I), containing a non-handaxe industry often identified as Clactonian, beneath a thick sequence (Phase II) consisting of the Lower and Upper Middle Gravels.
 2. The lower and upper Middle Gravels (Phase II) deposits typically contain a sequence of pointed and sub-cordate handaxes.
 3. The Upper Loam and Upper Gravel (Phase III); it has been suggested (eg. Wymer, 1968) that these may contain a distinct ovate-dominated industry and possible Levallois material, but this remains to be substantiated by well-provenanced material (Wymer 1999).
- 2.8** No evidence for the presence of the Lower Gravel and Lower Loams have been determined at the Knockhall Road site. While it is possible these sediments restricted in distribution to the Barnfield Pit area, their presence elsewhere should always be anticipated; even in un-sampled areas of the Knockhall Road site. These deposits are important, appearing to have been deposited under temperate conditions (Schreve, 2004) and contain secondary context, disturbed, artefacts perhaps spanning a wide chronological range where artefacts were derived from the local banks of the active channel. The exception is an occupation surface within the Lower Loam (Waechter *et al.*, 1970; Ashton and McNabb, 1996) on which refitting artefacts as well as bones were recovered from a short duration phase of activity. This site shows the potential for locally preserved high resolution archaeology and intact Pleistocene land surfaces.
- 2.9** By contrast, the sediments of the Middle Gravels, characterized by rich

quantities of pointed and sub-cordate handaxes, are considerably more extensive in nature and extend across the full Swanscombe region and are therefore much more likely to be present at Knockhall Road. These deposits can be viewed as true terrace deposits and have been equated with the regional Orsett Heath Gravel that has been successfully traced across much of the lower Thames area, and in turn equated with the Boyn Hill gravel of the classic Middle Thames area (e.g. Bridgland, 1994 and 2006). Indeed, even larger palaeogeographical links have been suggested by the presence of a particular association of molluscs, known as the Rhenish fauna, that hint at links with the river Rhine during MIS 11 (White and Schreve, 2000; Bridgland *et al.*, 2004b).

Geology Detail (Knockhall Road)

- 2.10** The site spans a height range from 35m OD. on the western, higher area, falling to as low as 20m at the base of the slope to the east. British Geological Survey mapping indicates that bedrock geology consists of Chalk that is overlain by Thanet Sand at the southern end of Knockhall Road. Pleistocene deposits are therefore mapped as the Boyn Hill Gravel Member. The local topography of the site is dominated by the northward trending valley of Ingress Vale in which Head deposits are mapped along the axis of the valley.
- 2.11** Locally, the site of Dierden's Yard (Smith and Dewey, 1914) previously mentioned is of most direct relevance and importance as this site produced evidence for a calcareous 'Shell bed' rich in molluscs and animal bone. It was first opened around 1900 and did produce handaxes, however Smith and Dewey's excavations of 1913 produced numerous flakes and cores. Attributing this assemblage to the Clactonian, and by possible correlation, to Lower Gravels at Barnfield is unwise as handaxe thinning flakes were found by Kerney (Wymer 1999). However, little is actually known of the stratigraphy at the site and in particular the relationship between the Shell Bed and the location of the artefacts recovered from the site. The site produced mammal fauna of giant beaver (*Tringontherium*) and the shell deposits contained a Rheinisch Fauna which suggest it would post-date the Lower Loam of Barnfield Pit (Wymer 1999)
- 2.12** Gibbard (1994) has suggested that in Dierden's Yard the Chalk surface lay at about 24-25m O.D. The shell sands (up to 2m thick) appear to have been underlain by a red gravel up to 60cm thick. The shelly sands are overlain by current bedded sand and finally a Head deposit. The relationship between these deposits and those at Barnfield Pit remain problematic and Gibbard has provided discussion of the disparate views (1994). The Knockhall Road side may therefore provide an opportunity to attempt a correlation between Dierden's Yard and Barnfield Pit as well as contextualising other find spots within the local area.

Site History

- 2.13** Map regression analysis undertaken as part of the site Desk Based Assessment by CgMs (CgMs 2011) went far in documenting the development of the site. Maps dated to 1870, 1890, 1900, 1910 until the 1920's all clearly show the site as an established orchard within a dry valley (Figure 7), set in a landscape gradually being developed by house building and mineral

extraction.

- 2.14** Between the 1920's and 1930's the intensity of this development steps up with opening of chalk pits to the immediate east and north east of the site, the opening of Barnfield pit and the building of the tramline along the basal axis of the dry valley. By the 1960's chalk quarrying has also extended to the south and south west of the site (the man-made Craylands Gorge) so that mineral extraction had all but encircled the site except along the line of the Knockhall Road which had gone to housing by the turn of the 20th century.
- 2.15** No maps indicate at any point that quarrying had taken place at the site. Indeed it appears to be one of the few land blocks within the valley to have remained substantially free of major extraction. By the 1970's landscape restoration was apparently underway with backfilling of the chalk pits to the immediate north east and east of the site. Backfilling did not completely infill Craylands Gorge and so a deep man-made gorge still exists between the Knockhall Road site and restored quarries to the east.
- 2.16** During this period there is evidence from the maps that the lower part of the Knockhall Road site was levelled to form a playing field, during this phase it is possible that the site was both lowered and levelled, perhaps forming the steep break in slope at the base of the valley side. Our investigation did not reveal any evidence for substantial emplacement of made ground during this process (see below)

Summary

- 2.17** Thus, prior to field investigation and on the basis of historical mapping, previous archaeological investigations and geotechnical work, we could determine that Middle Pleistocene deposits were likely to be preserved at the Knockhall Road Site. It appeared that these deposits had not been subject to any discernable quarrying history and had only been affected by dry valley formation in the late Pleistocene and Holocene and the impact of the sports ground creation. These deposits almost certainly comprised parts of the Boyn Hill – Orsett Heath Terrace of the Thames and would date to MIS12-10 spanning glacial and interglacial cycles between 430-350,000 years BP.
- 2.18** Archaeological potential in the form of artefactual material within these deposits was, on the basis of finds made locally to the site and on the demonstrated richness of the deposits across the wider landscape, considered high.
- 2.19** Determining which part of the sequence was present at the site, rather than whether they were present at all, and their sedimentary/geochemical character was therefore of importance. These factors will determine the potential for the preservation of palaeo-environmental indicators such as pollen, mollusc, large/small vertebrate fauna (including mega fauna). More locally still, these factors would also determine the potential for preservation of in-situ archaeological signatures and butchered/humanly modified fauna.

3.0 ARCHAEOLOGICAL METHODOLOGY (Figure 2)

- 3.1** After initial tree clearance work eleven geo-archaeological test pits (GTP's 1-11) were mechanically excavated across the area of proposed development under geo-archaeological supervision to provide three transects through the sites geological sequence (Figure 2). These were excavated to a maximum depth of 4m across a 2 x 2.5m footprint, where not constrained by ecologically sensitive areas. A hand dug geo-archaeological test pit (GTP 15) was excavated in land adjacent to Knockhall Road, inaccessible to plant machinery, in order to determine the surface height of the underlying gravel deposits and depth of overburden, in relation to those observed in the nearby GTP's 6 and 7. A further 3 mechanically excavated geotechnical soak away pits (GTP's 12-14) were monitored and recorded by a geo-archaeologist on the lower playing field, these were excavated to a maximum depth of 1.5m across a 0.5 x 1.5m footprint.
- 3.2** The location of the trenches was established a survey grade Global Navigation Satellite System (GNSS).
- 3.3** The trial trenches were scanned prior to excavation using a Cable Avoidance Tool (CAT). All of the trenches were excavated under constant archaeological supervision, using an 8 tonne 360° tracked excavator, fitted with a toothless ditching bucket.
- 3.4** Beneath the modern horizons, the mechanically excavated pits were dug down in 0.25m spits to a maximum depth of 4m.
- 3.5** All archaeological features were recorded according to standard ASE practice. All remains were levelled with respect to Ordnance Survey datum. A photographic record was made and key sections in each test pit drawn.
- 3.6** Detailed sediment logs were made (Appendix 1) and all units and unit boundaries were fully described following the methodology of Jones *et al.* (1999), Tucker (1996). When depth precluded entry to the pit further recording was made from the trench side. The arisings were placed in stratigraphical order to enable description and recording. Each unique fluvial and fine-grained deposit was sampled (40 litres) and kept for off site sieving/floatation and subsampled for vertebrate and invertebrate microfauna and palynological analysis. From each unique unit of Pleistocene sediment 100 litres of sediment was also reserved for on-site sieving through a 10mm mesh sieve for the recovery of artefact and ecofacts.
- 3.7** Upon completion of all necessary sampling and recording test pits were backfilled and compacted by the mechanical excavator but no formal re-instatement was undertaken.

4.0 RESULTS

Stratigraphy (Figures 2-5 and 8-10)

- 4.1** Figure 2 shows the location of interventions undertaken on the site and the position of the three transects shown in Figures 3-5. Figures 8-10 show site photographs of the geoarchaeological test pits. The detailed observations made in each test pit are shown in Appendix 1 and the present ground height from which they were excavated in Figure 2. The sediments preserved at the site can be broadly subdivided based on packages of deposits revealed through observations made in the test pits as well as those made previously during the geotechnical site investigation.
- 4.2** At the western margins of the site in GTPs 1, 2, 6 and 7, as well as BH 1, sediments, beneath the made ground/topsoil are dominated by gravel based units varying between thickness' of 1 and 3m. These are replaced downwards by dense clay/silt units (sometimes with blocky structure) that are present in GTPs 1, 2, 6, 7 and 8 and BH1. Beneath this clay/silt a further sequence of gravels was observed in GTP 8 as well as BH 1. Only in GTP 8 and BH 1 was Chalk bedrock reached. On the basis of the evidence from BH 1 and TP8 the surface of the Chalk is broadly horizontal.
- 4.3** In the central parts of the site a series of sands, clay/silts and gravels (in places chalky) occur that in places appear to dip in an easterly direction. These deposits are seen in GTPs 3, 4, 5, 9 and 10. It is also noted that the Chalk surface also appears to dip in a similar direction
- 4.4** In the eastern parts of the site beneath the levelled area examined in GTPs 11-14 as well as the previous geotechnical TPs 3 and 5 and BHs 2 and 4 a similar series of stratified sands, gravels and clay/silts occur. Within this area Chalk was reached in BH 2 and 4 as well as geotechnical test pit 5.
- 4.5** These observations are significant because in many cases the geotechnical records suggest the presence of made ground in places we now know to contain intact Pleistocene or Holocene sediments. For example GTP3 lies adjacent to geotechnical TP2. In the geotechnical log much of the sediments lying above chalk have been classified as made ground or possibly made ground while it is clear from our observations that stratified Pleistocene deposits are present in GTP3.
- 4.6** Consequently a series of new stratigraphic cross sections have been compiled on the basis of our own observation and modified interpretations of the original geotechnical work. The cross sections (Figures 3-5) show clearly the distribution of Pleistocene Fluvial Gravel sequences to the west and north west of the site, truncated by later erosion relating to valley incision and emplacement of Head Deposits of Late Pleistocene and Holocene age.

Sampling Strategy

- 4.7** Two programmes of sampling were undertaken as part of the assessment. On-site up to 100l of sediment per separate stratigraphic unit of interval was screened through a 10mm mesh for the recovery of humanly struck stone

artefacts and ecofacts (eg, mammalian faunal remains)

4.8 In addition up to 40lt of each unit was collected for off-site sieving and floatation for the recovery of palaeoenvironmental material and further artefacts. The following quantities were processed in this way:

Sample	Context	Sample Volume (litres)	Volume floated/subsampled (litres)
1	7/5	40	10 subsampled 30 floated.
2	7/6	40	40
3	7/7	40	40
4	7/8	40	40
5	7/9	40	40
6	6/4	40	40
7	6/5	40	40
8	6/6	40	10 subsampled 30 floated.
9	6/7	40	10 subsampled 30 floated.
10	6/8	40	40
11	1/3	40	40
12	1/4	40	40
13	1/5	40	10 subsampled 30 floated.
14	3/3	40	40
15	3/4	40	40
16	3/5	40	40
17	3/6	40	40
18	8/3	40	40
19	8/4	40	40
20	8/5 (top of unit)	40	40
21	8/5 (base of unit)	40	10 subsampled 30 floated.
22	9/3	40	10 subsampled 30 floated.
23	9/4	40	10 subsampled 30 floated.
24	9/5	40	10 subsampled 30 floated.
25	9/6	40	10 subsampled 30 floated.
26	9/7	40	40
27	2/4	40	10 subsampled 30 floated.
28	5/4	40	40
29	5/6	40	40
30	4/4	40	40
31	4/6	40	10 subsampled 30 floated.
32	11	<1	Subsampled in entirety

Table 1: Palaeoenvironmental Sampling

4.9 Prior to processing, sub-samples consisting of 0.5 litres for palaeontological

assessment and 0.25 litres for pollen analysis were taken from each 10 litre subsample. The palaeontological samples were sent to Dr John Whittaker, (Microfaunal specialist, Natural History Museum) and the pollen samples to Rod Bale (Pollen Specialist, University of Wales, Trinity St Davids).

- 4.10** Samples were processed in a flotation tank, with the flots and residues retained on 250µm and 500µm meshes respectively. Samples that contained a high percentage of large gravel were passed through a 10mm sieve prior to being floated. Residues were dried and passed through geological sieves (8, 4, 2 and a retainer) and the >8, 4-8 and 2-4mm fractions were sorted. The <2mm fraction was retained unsorted for possible further analysis (i.e. recovery of mollusca).
- 4.11** Molluscs recovered from sorting were sent to Martin Bates along with their corresponding <2mm unsorted residues. Slag/clinker recovered from samples was sent to Luke Barber. Two indeterminate fragments of unmineralised bone were recovered from the sample.
- 4.12** A total of 31 flots were assessed for environmental remains such as charcoal, charred macrobotanical remains, bones and shells as well as for the presence of small industrial debris such as flat or spherical hammerscales. The flots were weighed and measured before being scanned under a stereozoom microscope at x7-45 magnification and their contents recorded (Appendix 2). Identifications have been provided for macrobotanical remains present through reference to modern comparative material and reference manuals/texts (Cappers *et al.* 2006, Jacomet 2006, NIAB 2004).
- 4.13** Flots varied in size from very small flots (<2ml) to large flots (240ml). They were all dominated by uncharred material including sediment but uncharred vegetation was the main component of the flots including fine rootlets, larger woody roots, other woody debris and uncharred seeds and fruits.
- 4.14** Overall, the samples produced very small assemblages of charred plant remains. Charred wood fragments were present in 14 samples, though in very small quantities and the fragments were principally small-sized (<4mm) or even limited to very small wood charcoal flecks. Charred crop remains were recorded in very small quantities in only three samples. Sample <6> [6/4] produced a single poorly preserved possible grain of wheat (cf. *Triticum* sp.), sample <18> [8/3] produced a single indeterminate grain (*Cerealia*) and a vetch/bean/pea (*Vicia/Pisum* sp.) was recorded in sample <14> [3/3]. No chaff component were present and only two currently unidentified grass (*Poaceae*) caryopses were noted (samples <22> and <28>). Sample <15> [3/4] produced three poorly preserved charred plant remains and two potential unidentified fruit stone fragments were present in sample <26> [9/7].
- 4.15** No vertebrate remains were evident in the samples although sample <5> [7/9] contained a small uncharred substance. The material was cartilaginous and might represent fish remains. Land mollusca were present in varying quantities in 17 flots. Several flots contained only a few shells but samples <1, 2 and 6> [7/5, 7/6 and 6/4] produced larger assemblages. Very small amount of industrial debris were present in five flots (<2, 6, 7, 8 and 27>). Including both vesicular material and two spherical hammerscales.

Microfossil Assessment by Dr John Whittaker

- 4.16** Eleven samples were submitted for assessment. Samples 1/5, 2/4, 6/6, 7/5 and 8/5 are from what is believed to be the Boyn Hill Terrace (an interglacial deposit of MIS 11 age); the remainder, 2/4, 9.3-9.6 and 12/3, are thought to be much younger (Devensian) solifluction deposits.

Microfossil Analysis Materials and Methods

- 4.17** Each sample was placed in a ceramic bowl and dried thoroughly in an oven. A little sodium carbonate was added (to help remove the clay fraction) and then boiling water was poured over the sample. After soaking overnight each sample was then washed through a 75 micron sieve with hand-hot water and the resulting residue decanted back into the bowl for drying in the oven. After final drying the samples were placed in labelled plastic bags. For examination under the binocular microscope, each residue was first dry-sieved into >500, >250, >150 and >75 micron fractions, and a little of each fraction at a time sprinkled onto a picking tray. Notes were made of anything "organic" and about the components of the sediment encountered.

Boyn Hill Terrace (MIS 11)

Sample	Context	Position	Weight processed
1/5	13	Upper	275g
2/4	27	Upper	275g
6/6	8	Upper	225g
7/5	1	Upper	225g
8/5	21	Lower	225g

Devensian Solifluction Deposits

Sample	Context	Weight processed
4/6	31	275g
9/3	25	275g
9/4	23	225g
9/5	24	225g
9/6	25	275g
12/3	32	275g

Table 2: Microfossil Assessment Samples

Microfossil Analysis Results

4.18 *Boyn Hill Terrace*

Four samples (1/5, 2/4, 6/6 and 7/5) are from the upper part of the sequence, whilst 8/5 is from near the base.

Sample 8/5 (Context 21), samples 1/5 (Context 13) and 2/4 (Context 27) were barren, but perhaps surprisingly, the remaining two samples, 6/6 (Context 8) and 7/5 (Context 1) were not. These are pebble horizons with associated fines and in these, in Sample 6/6 there was a mollusc, whereas 7/5 contained not only several molluscs but many earthworm granules and

some small pieces of charcoal.

The samples from this sequence also contained much iron mineral and are probably weathered.

4.19 *Devensian Solifluction Deposits*

Samples 4/6, 9/3, 9/4, 9/5 and 9/6 (from contexts 22-25, respectively) were orange-brown silty sands, with some flint pebbles. All were completely barren of any contemporary calcareous material (either ostracods or molluscs), but they did contain some Chalk debris. There was a great deal of iron mineral and the sediment appeared to be deeply weathered. In spite of this they do indeed look like solifluction deposits. There was some plant debris with rhizolith-like tubes enveloping some of this material, but this was almost certainly modern, from roots growing into the outcrop. Sample 12/3 (Context 32), on the other hand, appeared to be different. Not only was the original sediment different in colour (chocolate brown) but it contained several significant finds. There were still no ostracods, unfortunately, but it did contain earthworm granules, molluscs and charcoal. This appears to indicate a buried soil horizon with a possible anthropogenic component.

Pollen Assessment by Rod Bale

- 4.20** Eleven sub-samples were selected for pollen analysis. Samples for pollen analysis were prepared using standard techniques (Moore *et al.*, 1991), including treatments with HCl to remove carbonates, micro-sieving through a mesh aperture of 10µ, HF digestion to remove silicates (this was repeated twice) and acetolysis to digest organic matter. A known quantity of *Lycopodium* spores were added to each sample to enable the calculation of pollen concentrations within the samples (Stockmarr, 1971). The residues were mounted in safranin-stained glycerine jelly and analysed under a Leica DMR microscope at a magnification of x400, with critical identifications at x630 and, where necessary, under oil at x1000.

A list of the samples is provided below and comments on the results of the preparations

Boyn Hill Terrace

KRG 11 1/5 13- no pollen (except lycopodium)
KRG 11 2/4 27-no pollen (except lycopodium)
KRG 11 6/6 8- occasional other pollen (2 grains)
KRG 11 7/5 1-no pollen (except lycopodium)
KRG 11 8/5 21 - occasional other pollen (1 grain of tree?)

Devensian Solifluction Deposits

KRG 11 4/6 31- no pollen (except lycopodium)
KRG 11 9/3 22 - occasional (2 grains) non lycopodium pollen.
KRG 11 9/4 23 - no pollen (except lycopodium).
KRG 11 9/6 25 - no pollen (except lycopodium)
KRG 11 9/5 24 - no pollen (except lycopodium)
KRG 11 9/6 25 - no pollen (except lycopodium)

- 4.21** Although occasional grains of pollen were recovered from 6/6, 8/5 and 9/3 insufficient pollen was recovered from the prepared slides to make further work possible.

Mollusc Assessment by Dr Martin Bates

- 4.22** Bulk sample residues were examined for contained molluscs and a number of samples were found to contain molluscs. Sample containing molluscs are listed below along with a summary of the material located in the samples.

4.23 Boyn Hill Terrace

Sample 6/4. This sample contained 4 *Vallonia* sp., 3 *T.hispida*, 3 *C.acicula* and fragments of shells.

Sample 7/5. This sample contained 6 *T.hispida*, 2 *Vallonia* sp., 2 *P.muscorum* and fragments including *C.acicula*.

Sample 7/6. This sample contained 4 *Vallonia* sp., 3 *T.hispida*, 1 possible *Cochlicopa* sp., and fragments of *C.acicula*.

4.24 Devensian Solifluction Deposits

Sample 4/4. This sample contained 3 *Trichia hispida* shells, 2 *Vallonia* sp., 1 *Pupilla muscorum* and 3 *Ceciloides acicula* shells.

Sample 9/4. This sample contained 5 *T.hispida* and 1 *Vertigo* sp.

- 4.25** There is no apparent difference in the assemblages from either suit of deposit. In all cases the molluscs preserved are indicative of grassland conditions. The presence of *C.acicula* has to be ignored as this is a burrowing mollusc and unlikely to be contemporary with the sediments in which the remains were found. Of the remainder these are likely to be contemporary with the sediments in which they were recovered. No trace of aquatic molluscs were recovered and a slope with grassland cover may be envisaged as a living habitat for these molluscs.

- 4.26** While there are no climatic inference that can be drawn from the presence of these molluscs as all species can live in cool environments as well as fully temperate ones, the presence of molluscs preserved within this sequence is significant. It indicates there is the potential for palaeoenvironmental reconstruction work based on mollusc indicators and opens the possibility that molluscs may be locally abundant, as was noted at the Dierdon's Pit site to the north of Knockhall Road.

Palaeoenvironmental Summary

- 4.27** The palaeoenvironmental material from the site is poor and preservation of contained material is minimal. However molluscs have been documented and do provide a plausible environment of deposition (grassland situations) for both the Upper Loams and the Devensian slope deposits.
- 4.28** No inference of climate can be derived from these molluscs and all species are well recorded in late Pleistocene as well as mid Holocene contexts in southern England.
- 4.29** Further sampling of sediments for contained palaeoenvironmental remains

(at least molluscs and possibly small mammals) must however be considered as part of any future post determination mitigations works. There is no doubt that a palaeoenvironmental reconstruction of both the Middle Pleistocene loams and the Upper Pleistocene slope deposits can be made from the molluscan remains. There is also a possibility that Amino Acid Geochronology can be applied to the remains of *P.muscorum* for which data from the Ebbsfleet Valley exists for comparison (Wenban-Smith *et al.*, in prep.).

5.0 Finds

Humanly Struck Flint by Dr Matt Pope

- 5.1** Humanly struck flint comprising both hard and soft hammer flakes (n=24) was recovered from the site through direct collection, on-site sieving and off-site processing of sediment samples (Table 3). Struck material was found present in the Upper Gravels, Middle Gravels and within Head Deposits. Only a single bifacial tool (from the Upper Gravels) and two simple, single platform cores (one each from the Upper and Middle Gravels) were identified as non-debitage elements and these exhibited technology consistent with having been part of a Lower Palaeolithic industry. The presence of these artefacts within the gravels at the site comprises archaeological signature consistent with core and biface technology recorded for the wider Boyn Hill Terrace (eg. Wymer 1968).
- 5.2** Assemblages from the Upper and Middle Gravels both contained lightly rolled and fresh material. The degree to which material is rolled is an important attribute to consider as it gives an indication of fluvial velocity and the degree to which material has travelled in a sediment stream. 'Fresh material' refers to artefacts which have travelled little or no distance, which therefore raises the likelihood of in-situ preservation conditions existing at the site.
- 5.3** 10 artefacts (55%) of recovered artefacts from the Upper and Middle Gravels showed no indications of fluvial rolling, this indicates a significant percentage of material may relate to primary context preservation at the site. Material from the Head Gravels, while lightly patinated was not rolled and so can be assumed to relate to human occupation with the locale, reworking of these pieces from the older fluvial gravels cannot however be ruled out.

Context	Unit	# Flint Artefacts	Wt (g)	Notes
5/5	Head	3	10	Patinated
4/5	Head	3	98	Patinated
6/4	Upper Gravels	2	100	Includes bifacial tool
1/4	Upper Gravels	1	12	
7/6	Upper Loam	5	216	
6/6	Upper Loam	1	122	
8/5 (top of unit)	Middle Gravels	2	208	Includes core
8/5 (base of unit)	Middle Gravels	1	82	Soft hammer Flake
8/6	Middle Gravels	6	120	
Total		24	968	

Table 3: Quantification of Humanly Struck Flint

The Slag by Luke Barber

- 5.4** All of the material is black aerated clinker aerated fuel ash slag, often with glassy surfaces and solidified bubbles recovered from samples taken from units: 1/3, 1/4, 2/4, 3/3, 6/4, 6/5, 6/6, 6/8, 7/5 and 7/6. The majority is from 6/5

and 6/6 but the material is spread across all the samples in low numbers. Although most of them are just granules there are a couple of pieces up to 30mm across. There are two pieces, one from 6/8 the other from 7/5 which appear to have amalgamated a small chip of Kentish ragstone and there is a tiny flake of iron sheeting / rust from 8/5. Overall, the slag is not diagnostic of process but the general feel of the material is later post-medieval (Later 18th - 19th century). One piece has a possible fragment of coal shale adhering suggesting the fuel to be coal. Any number of industries could have produced this slag.

- 5.5** Slag was prevalent throughout the upper part of the sequence, including some assessed samples of Pleistocene gravel. Slag formed a component of the capping made ground in this part of the site and was loose and unconsolidated, it was therefore impossible to prevent partial trench collapse of material from the trench side. Given the consolidated and unequivocal nature of Pleistocene deposits when encountered through machine excavation, the presence of slag particles in recovered samples can be best explained as contamination through partial collapse of the trench edges.

6.0 DISCUSSION

6.1 The sedimentary sequence recorded below ground on the western part of the site correlates well in terms of height and anticipated sedimentary succession with the type sequence at Barnfield Pit.

- Elevations for the height range for the Lower Loams/Lower Gravels, Middle Gravels and Upper Loams/Gravels are presented adjacent to the transect BH 1 – TP5 (Figure 4) and a good match between the lowermost gravels in BH 1 and TP8 with the Middle Gravels in Barnfield Pit can be extrapolated.
- The fact that the surface of the chalk between BH 1 and TP8 seems relatively horizontal also supports the notion that this is part of a fluvially incised erosion surface forming the base of the Boyn Hill terrace at the correct anticipated altitude.
- The most extensive sequences of Pleistocene gravel were observed in TP8 and BH 1 (CgMs 2011, Appendix 1).
- Our observations for GTP's 1, 2, 6, 7 and 8 confirm these records and suggest two major gravel bodies separated by finer grained clays with sand.
- We have correlated the lower most gravels with the Middle Gravels at Barnfield Pit, the intervening clays with the Upper Loam and the higher gravel body with the Upper Gravels.

6.2 Within the central part of the site (GTP's 3, 4, 5, 9 and 10) a series of slope (Head) deposits are inferred, probably largely laid down under cold climate conditions. These will have incised through the older deposits to the west and may be of late Pleistocene age. This interpretation accords well with that made by Burchell to the south (Wymer, 1968) and similar sets of deposits (with relationships with older, higher Pleistocene sequences) have recently been described in the Ebbsfleet Valley (Wenban-Smith *et al*, forthcoming) as well as around Dartford (Wenban-Smith *et al.*, 2010; Simmonds *et al.*, 2011).

6.3 Finally, in the eastern part of the site (across the levelled area of the former valley bottom) intact Head deposits of probable late Pleistocene age are now known to exist. This contradicts the interpretation of the previous geotechnical ground investigation and consequently modifies our understanding of the site and its archaeological significance. The steep slope on the northern part of the site may not necessarily represent a real quarry edge, but possibly made ground related to the restoration of pits to the north. Investigation of this section as part of any proposed mitigation would be useful.

6.4 The excavation methodology has been effective in determining the range of deposits present at the site but of only qualified success in recovering palaeoenvironmental signatures. If further works are required the following could be considered: clearance of made ground deposits around the top of test pits to prevent contamination, AAR dating of molluscs to check their antiquity and OSL dating of the potential younger Devensian slope deposits.

7.0 CONCLUSIONS (Figure 6)

- 7.1** The investigation has determined that sand and gravel deposits of direct equivalence to those recorded at Barnfield Pit are present on the western and north western parts of the site comprising the entire plateau area bounding Knockhall Road and across the northern parts of the slope (Figure 6: Zone 1). These deposits have been correlated with the Upper Gravels, Upper Loam and Middle Gravels of the main Barnfield Pit sequence. If this correlation is upheld it is of some significance as much of the previous work has focused on the Lower Loam, Lower Gravels and Middle Gravels but little in the Upper Loam. The evidence presented in this report for a palaeoenvironmental signature from the Upper Loams makes this unit of great interest. No formal clast lithological analysis has yet been undertaken, analysis of this aspect would be useful in taking the study of the location further, if necessary, as part of mitigation of any permitted development impact. While confident we have identified an extensive sequence of intact Middle Pleistocene gravels relating to the Boyn Hill terrace of the Thames fluvial system, only further multi-disciplinary study can confirm further our correlation of the Knockhall Road sequence to that of Barnfield Pit.
- 7.2** Humanly struck flint, including hard hammer debitage, soft hammer debitage, cores and a crude bifacial tool were recovered from both the Upper and Middle gravels as well as the Upper Loam and Devensian Head Deposits. Some material from the Upper and Middle gravels was unrolled and indicates human activity directly relating to the site locale.
- 7.3** Across the eastward falling slope no evidence for the emplacement of made ground could be determined beyond superficial surface cover. No evidence for significant backfilling or quarrying operations could be determined within the areas of the excavated pits and so it has been concluded that this slope represents the natural valley slope of Ingress Vale modified at both its top and bottom by terracing, the latter most likely relating to the formation of a sports ground at the base of the slope.
- 7.4** Across the slope, Head Deposits of Late Pleistocene age and overlying colluvium, of presumed Holocene age, have been traced and represent sequences incised through the older intact gravels and the underlying bedrock (Figure 6: Zone 2). We suggest this would have resulted from successive processes of dry valley incision into intact Middle Pleistocene fluvial gravels forming a valley deposit sequence typical of the Cretaceous landscape of north Kent. Useful comparison with the complexity of similar processes occurring in the Ebbsfleet Valley (Wenban-Smith *et al.* in prep.) would be instructive in devising more detailed mitigation of these deposits should development impact upon them.
- 7.5** Within the dry valley a sequence of Late Pleistocene and early Holocene Head deposits formed (Figure 6: Zone 3). The area of flat ground comprising the former playing field (Figure 6: Zone 4) does not appear to have been made level by the significant emplacement of made ground, but rather is more likely to have formed through the truncation of such *in situ* Head deposits. In all observed cases, superficial made ground gave way within 0.5m to Head Deposits of presumed Late Pleistocene and early Holocene

date. The fine grained nature of these deposits does present a potential context for Palaeolithic and Holocene archaeology although no features or finds were encountered in the course of the field investigations.

Statements of Significance

- 7.6** The site comprises a block of largely undisturbed Pleistocene sediment in a landscape which has been extensively quarried and developed. These sediments are correlated with the lateral equivalent of the internationally, important sequence of deposits at the nearby Barnfield Pit. These deposits comprise Middle Pleistocene fluvial gravels spanning MIS 13-11-10 and Late Pleistocene (Devensian) head deposits.
- 7.7** The fluvial gravels and loams contain humanly struck flint consistent with the Lower Palaeolithic material recovered from Barnfield Pit and other sites in the Greenhithe/Swanscombe locale. The fluvial sequence appears to span the Middle Gravels (known to contain an abundance of artefacts and the less well known Upper Gravels, which have a distinct archaeological signature and may relate to a distinct chronological period (eg early MIS10).
- 7.8** Palaeoenvironmental evidence was sparse in the assessed samples but mollusc, charcoal, earth worm granules and weathered vertebrate fauna indicate the presence of useful indicators and the potential for localised preservation.
- 7.9** The instability of the overlying made ground deposits limits the degree to which assessment from test pitting can recover uncontaminated samples (as evidenced by the presence of slag within many sub-surface samples). This problem should be considered during any further assessment of the site.
- 7.10** The study has shown there is potential to date the sequence through OSL (Late Pleistocene Sediments), Amino Acid Racemization (Molluscs from Mid-Pleistocene Sediments) and AMS (Charcoal within Late Pleistocene Head Deposits and Holocene Colluvium) techniques.
- 7.10** Due to constraints of access a significant proportion of the slope and plateau along the northern margins of the site was not assessed. While the basic sedimentary character is highly likely to follow the pattern of fluvial gravel overlain by Late Pleistocene head, the nature of palaeoenvironmental preservation and artefact counts cannot be assumed for this zone.

Considerations for Site Development

- 7.11** At present detailed development plans showing levels of impact are not available. However, should development be approved further mitigation measures should be designed and implemented. Any proposed impact to Pleistocene Head and Fluvial deposits would require further geo-archaeological mitigation measures given their regional significance to identify concentrations of lithic material and recover detailed palaeoenvironmental and dating samples. Test pitting should comprise of larger evaluation trenches to base of impact depth allowing stepped access to facilitate sample excavation of sediment contacts and accurate recording and sampling of sections. This would be an effective sampling and recording

method if backed up by contingencies for recovery should *in-situ* archaeology be found. Linear developments, e.g. road access, would potentially afford long sections through deposits after a suitably monitored ground reduction.

- 7.12** Data gathered through any subsequent fieldwork should be subject to appropriate scientific assessment and the results presented in a Post-Excavation Assessment which could consider what further analysis and publication would be suitable. Such further work should also include archival research to locate the site in relation to other nearby sites of Palaeolithic interest, notably Dierden's Pit, the accurate location of which is not currently known.
- 7.13** Through these approaches the impact of permitted development could be mitigated.

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OASIS ID: archaeol6-122160	
Project name	Knockhall Road, Greenhithe
Short description of the project	Pre-determination assessment of land at the former Empire Sports Ground, Knockhall Road, Greenhithe, Kent. geoarchaeological test pits identified an extensive sequence of Boyn Hill terrace sediments with flint artefacts and palaeoenvironmental indicators.
Project dates	Start: 09-01-2012 End: 15-01-2012
Reference codes	5197 - Contracting Unit No.
Reference codes	KRG11 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Other 13 - Waste ground
Monument type	FLUVIAL TERRACE Lower Palaeolithic
Significant Finds	STRUCK FLINT Lower Palaeolithic
Methods	'Test Pits'
Development type	Not recorded
Prompt	Voluntary/self-interest
Position in the planning process	Between deposition of an application and determination
Country	England
Site location	KENT DARTFORD SWANSCOMBE AND GREENHITHE Knockhall Road, Greenhithe
Postcode	DA9 9EZ
Study area	5.00 Hectares
Site coordinates	TQ 593 744 51.4456300593 0.292599994576 51 26 44 N 000 17 33 E Point
Height OD / Depth	Min: 15.00m Max: 35.00m
Name of Organisation	Archaeology South East
Project brief originator	Kent County Council
Project design originator	CgMs Consulting
Project director/manager	Jon Sygrave
Project supervisor	Matt Pope
sponsor/funding body	Client
Entered by	Matt Pope (m.pope@ucl.ac.uk)
Entered on	29 March 2012

APPENDICIES

Appendix 1: Test Pit records

GTP 1

Depth below ground surface (m)	Lithology	Inferred environment of deposition	Unit
0.00 – 0.20	Topsoil		1
	---diffuse contact---		
0.3	Subsoil/made ground		2
	---sharp contact---		
0.6	7.5YR 6/8 reddish yellow sorted flint gravels. 60% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	High energy fluvial conditions in cold climate braided channel environment	3
	----diffuse contact---		
1.6	7.5YR 6/8 reddish yellow sorted flint gravels. 20% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	Medium energy fluvial conditions in cold climate braided channel environment	4
	---sharp contact---		
2.1	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm and blocky structure with iron mineralised plant psuedomorphs.	Low energy fluvial conditions in cold climate braided channel environment	5
	----diffuse contact---		
2.4	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm and impenetrable below 4m	Low energy fluvial conditions in cold climate braided channel environment	6
	---Base of GTP 4.0m---		

GTP 2

Depth below ground surface (m)		Lithology	Inferred environment of deposition	Unit
0.00 – 0.20		Topsoil		1
		---sharp contact---		
0.20 – 0.50		Made ground		2
		---sharp contact---		
0.50 – 1.50		7.5YR 6/8 reddish yellow poorly sorted flint gravels. Clasts <1cm to >6cm, rounded to sub-angular. Sandy silty matrix – almost clast supported in places. Structureless and loose.	High energy fluvial conditions in cold climate braided channel environment	3
		---sharp/dipping contact---		
0.50 – 2.70		2.5Y 6/4 light yellowish brown sandy clay with 7.5YR 6/8 reddish yellow patches. Cohesive and structureless.	Low energy fluvial floodplain	4
		---base of GTP 2.70m---		

GTP 3

Depth (m)		Lithology	Inferred environment of deposition	Unit
0.00 – 0.25		Topsoil		1
		---diffuse contact---		
0.25 – 0.40		2.5Y 5/4 light olive brown clayey silt with common rounded to sub-angular clasts (<5cm) and occasional CBM	Made ground	2
		---diffuse contact---		
0.40 – 0.80		10YR 5/4 yellowish brown sandy silty gravel with clasts <5cm. Clasts are rounded to subangular. Matrix supported and no structure.	Periglacial head gravel	3
		---diffuse contact---		
0.80 – 1.00		10YR 5/4 yellowish brown silt with gravel clasts varying laterally to silty gravel. Very patchy. Clasts as above but less common. The larger clasts are typically subangular. Some chalk clasts present and these are angular. Relatively loose and unconsolidated. Slightly blocky structure. Appears to be bedded in places with units dipping downslope.	Periglacial head gravel	4
		---abrupt contact---		
1.00 – 1.40		10YR 5/4 yellowish brown medium to fine sand with silt. Common gravel clasts that are poorly sorted (1-10cm) and rounded to subangular.	Periglacial head gravel	5
		---diffuse contact---		
1.40 – 1.60		7.5YR 4/6 strong brown gravel with Tertiary flint and occasional subangular flint clasts <10cm.	Periglacial head gravel	6
		---diffuse contact---		
1.60 – 1.70		5Y 6/3 pale olive sand with occasional green stained flint clasts	Tertiary remnant	7
		---sharp contact---		
1.70 -		Chalk	Bedrock	8
		---base of test pit 1.80m---		

GTP 4

Depth below	Lithology	Inferred environment of	Unit
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ground surface (m)			deposition	
0.00 – 0.30	Topsoil			1
	---diffuse contact---			
0.30 – 0.55	Made ground			2
	---sharp contact---			
0.55 – 0.65	10YR 4/6 dark yellowish brown flint gravel. Clasts 2-6cm, subangular to rounded and rolled. Very loose and unconsolidated	Periglacial deposits?	head	3
	---abrupt contact---			
0.65 – 1.40	5YR 5/6 yellowish brown fine silty sand. Soft and unconsolidated. Occasional patches of gravel – very poorly sorted (1->7cm) and sub-angular in shape. Becomes more gravelly with depth	Periglacial deposits?	head	4
	---abrupt contact---			
1.40 – 1.80	7.5YR 6/8 reddish yellow flint gravel. Medium to coarse sand with some silt in matrix. Moderately dense and compact. Clasts are <1cm to >6cm, rounded to subangular and rolled.	Periglacial deposits?	head	5
	---abrupt contact---			
1.80 – 2.40	5YR 5/6 yellowish red dense clay silt with white chalky patches in places. Very compact and firm	Periglacial deposits?	head	6
	---sharp contact---			
2.40 – 2.50	5YR yellowish red flint gravel – poorly sorted.	Periglacial deposits?	head	7
	---sharp contact---			
2.50 -	Chalk	Bedrock		8
	---base of test pit 2.60m---			

GTP 5

Depth below ground surface (m)		Lithology	Inferred environment of deposition	Unit
0.00 – 0.30		Topsoil		1
		---diffuse contact---		
0.30 – 1.00		10YR 3/3 dark brown slightly silty sandy gravel. Clasts 1-5cm, rounded to sub angular. Loose and unconsolidated.	Periglacial head deposits?	2
		---abrupt contact---		
1.00 – 1.60		7.5YR 5/6 strong brown silt with some angular flint clasts (<5cm). Dense and compact.	Periglacial head deposits?	3
		---abrupt contact---		
1.60 – 1.90		10YR 5/6 yellowish brown fine sand with common flint clasts (<5cm, subangular to rounded and rolled). Loose and unconsolidated.	Periglacial head deposits?	4
		---sharp contact---		
1.90 – 2.30		7.5YR 4/6 strong brown flint gravel. Relatively loose and poorly sorted (1->10cm) subangular to rounded and rolled clasts.	Periglacial head deposits?	5
		---sharp contact---		
2.30 – 2.65		7.5YR 4/6 strong brown sandy-silt with gravel clasts	Periglacial head deposits?	6
		---sharp contact---		
2.65 – 2.75		5 YR 5/6 yellowish red very coarse sand with some silt. Occasional gravel clasts.	Periglacial head deposits?	7
		---sharp contact---		
2.75 – 2.80		Green sand	Thanet Sand (?reworked)	8
2.80 -		Chalk bedrock	Bedrock	9
		---base of test pit 2.85m---		

GTP 6

Depth below ground surface (m)	Lithology	Inferred environment of deposition	Unit
0.00	Topsoil		1
	---diffuse contact---		
0.35	Subsoil/made ground		2
	---sharp contact---		
1.1	7.5YR 6/8 reddish yellow sorted flint gravels. 80% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	High energy fluvial conditions in cold climate braided channel environment	3
	----diffuse contact---		
1.5	7.5YR 6/8 reddish yellow sorted flint gravels. 60% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	High energy fluvial conditions in cold climate braided channel environment	4
	----diffuse contact---		
1.8	7.5YR 6/8 reddish yellow sorted flint gravels. 60% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	High energy fluvial conditions in cold climate braided channel environment	5
	----diffuse contact---		
3.1	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm	Low energy fluvial conditions in cold climate braided channel environment	6
	----diffuse contact---		
3.8	Pale yellow sand with clay	Low energy fluvial conditions in cold climate braided channel environment	7
	----diffuse contact---		
4.2	pale yellow grey with reddish brown rooting pseudomorphs	Low energy fluvial conditions in cold climate braided channel environment	8
	---Base of GTP 4.5m---		

GTP 7

Depth below ground surface (m)	Lithology	Inferred environment of deposition	Unit
0.00 – 0.20	Topsoil		1
	---diffuse contact---		
0.3	Subsoil/made ground		2
	---sharp contact---		
0.6	7.5YR 6/8 reddish yellow sorted flint gravels. 80% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	High energy fluvial conditions in cold climate braided channel environment	3
1.1	----diffuse contact---		
	7.5YR 6/8 reddish yellow sorted flint gravels. 60% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	High energy fluvial conditions in cold climate braided channel environment	4
	---sharp contact---		
1.6	10YR 5/4 yellowish brown sand with occasional sub- rounded flint gravel 10-80mm	Low energy fluvial conditions in cold climate braided channel environment	5
	----diffuse contact---		
2.4	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm	Low energy fluvial conditions in cold climate braided channel environment	6
	----diffuse contact---		
3.3	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm	Low energy fluvial conditions in cold climate braided channel environment	7
	---Base of GTP 4.0m---		

GTP 8

Depth below ground surface (m)		Lithology	Inferred environment of deposition	Unit
0.00 – 0.30		Topsoil		1
		---diffuse contact---		
0.30 – 0.90		Made ground		2
		---abrupt contact---		
0.90 – 1.60		7.5YR 5/8 strong brown mixed with 5Y 6/2 light olive grey clay silt. Very dense and compact. Structureless and with very rare flint clasts (<10cm).	Low energy floodplain possibly some colluvial input	3
		---abrupt contact---		
1.60 – 1.90		7.5YR 6/8 reddish yellow flint gravel. Matrix slightly silty very coarse sand. Subangular nodules of flint (<8cm) rolled.	High energy fluvial channel	4
		---abrupt contact---		
1.90 – 3.80		2.5Y 5/6 light olive brown very coarse sandy gravel. Very loose and unconsolidated. Clasts are typically <6cm, subangular and with relatively few Tertiary flints.	High energy fluvial channel	5
		---sharp contact---		
3.80 – 3.90		Very large cobbles of flint (>30cm) lying in a 2.5Y 5/3 light olive brown clay with occasional brown patches (?organic). Cohesive and plastic.	Gravel lag in low energy floodplain	6
		---sharp contact---		
3.90 -		Chalk	Bedrock	7
		---base of test pit 3.90m---		

GTP 9

Depth below ground surface (m)	Lithology	Inferred environment deposition	of	Unit
0.00 – 0.30	Topsoil			1
	---diffuse contact---			
0.30 – 0.40	Made ground			2
	---abrupt contact---			
0.40 – 0.70	7.5YR 5/6 strong brown clay silt. Very dense and compact. Structureless.	Periglacial deposits?	head	3
	---abrupt contact---			
0.70 – 1.40	10YR 6/6 brownish yellow silt to very fine sand. Blocky structure.	Periglacial deposits?	head	4
	---abrupt contact---			
1.40 – 2.20	10YR 7/6 yellow soft unconsolidated medium to fine sand with occasional chalky lenses. Occasional small flint clasts (<2cm) that are subangular to rounded.	Periglacial deposits?	head	5
	---abrupt contact---			
2.20 – 2.60	7.5YR 6/6 reddish yellow medium sand with some silt. Occasional flint clasts. Chalky patches and occasional larger flint clasts. Slightly blocky structure.	Periglacial deposits?	head	6
	---sharp contact---			
2.60 -	Chalk	Bedrock		7
	---base of test pit 2.70m---			

GTP 10

Depth below ground surface (m)		Lithology	Inferred environment deposition	of	Unit
0.00 – 0.30		Topsoil			1
		---diffuse contact---			
0.30 – 0.90		Made ground			2
		---abrupt contact---			
0.90 – 1.40		10YR 5/6 yellowish brown silty very fine sand with common flint clasts. Clasts are 1-6cm, subangular and rounded. Occasional chalk clasts also present.	Periglacial deposits?	head	3
		---abrupt contact---			
1.40 – 1.70		10 YR 5/8 yellowish brown sandy gravel. Very loose and poorly sorted (1-6cm, subangular to rounded).	Periglacial deposits?	head	4
		---diffuse contact---			
1.70 – 2.00		10 YR 5/8 yellowish brown sandy gravel. Very loose and poorly sorted (1-6cm, subangular to rounded). Occasional carbonate patches and zones	Periglacial deposits?	head	5
		---abrupt contact---			
2.00 – 2.30		10YR 5/8 yellowish brown clay silt with rare gravel clasts. Very dense and compact.	Periglacial deposits?	head	6
2.30 -		Chalk	Bedrock		7
		---base of test pit 2.30m---			

GTP 11

Depth below ground surface (m)	Lithology	Inferred environment of deposition	Unit
0	Topsoil		1
	---diffuse contact---		
0.2	Made Ground		2
	---sharp contact---		
0.6	Pale Yellow Brown clay silt with 40% rounded to sub-rounded flint gravels 10-40mm	Slope Wash, Colluvium with solution structure.	3
	---diffuse contact---		
1.6	Pale Yellow Brown clay silts. Stone free.	Head Deposits	4
	Base of GTP 4.0m		

GTP 12

Depth below ground surface (m)	Lithology	Inferred environment of deposition	Unit
0	Topsoil		1
	---diffuse contact---		
0.2	Made Ground		2
	---sharp contact---		
0.69	Light Yellow Brown clay silt with chalk flecks	Truncated Head Deposits (Presumably Late Pleistocene). Charcoal and earthworm granules suggest possible buried soil and human activity?	3
	Base of GTP 1.6m		

GTP 13

Depth below ground surface (m)	Lithology	Inferred environment of deposition	Unit
0	Topsoil		1
	---diffuse contact---		
0.2	Made Ground		2
	---sharp contact---		
0.4	Light Yellow Brown clay silt with chalk flecks	Truncated Deposits (Presumably Late Pleistocene)	3
	---sharp contact---		
1.1	Solid Chalk		4
	Base of GTP 1.6m		

GTP 14

Depth below ground surface (m)	Lithology	Inferred environment of deposition	Unit
0	Topsoil		1
	---diffuse contact---		
0.2	Light Yellow Brown clay silt with chalk flecks Made Ground	Truncated Deposits (Presumably Late Pleistocene)	2
	---sharp contact---		
0.5	Solid Chalk		3
	Base of GTP 1.6m		

GTP15

Depth below ground surface (m)	Lithology	Inferred environment deposition	Unit
0.00 – 0.20	Topsoil		1
	---diffuse contact---		
0.3	Subsoil/made ground		2
	---sharp contact---		
0.6	7.5YR 6/8 reddish yellow sorted flint gravels. 80% clasts 20-60mm, rounded to sub-rounded, Tertiary and Fluvial flint. Medium sand with clay matrix	High energy fluvial conditions in cold climate braided channel environment	3
	Base of TP: 0.8m		

Appendix 2: Flots quantification (* = 0-10, ** = 11-50, *** = 51 – 250, **** = >250) and preservation (+ = poor, ++ = moderate, +++ = good)

Sample Number	Context	Weight g	Flot volume ml	Uncharred %	Sediment %	Seeds and fruits uncharred	Charcoal >4mm	Charcoal <4mm	Charcoal <2mm	Crop seeds charred	Identifications	Preservation	Weed seeds charred	Identifications	Preservation	Other botanical charred	Identifications	Preservation	Land Snail Shells	Industrial debris hammerscale
1	7/5	<2	8	45	2	* <i>Sambucus nigra</i> (1)		* (1)	*										*** 53% 3 types	
2	7/6	<2	2	45	2				*										*** 53% 2 types	*
3	7/7	<2	<2	80	20	*													*	
4	7/8	<2	<2	10	90															
5	7/9	<2	<2	-	-															
6	6/4	<2	8	89	1	* Chenopodiaceae				*	cf. <i>Triticum</i> sp. (1)	+							*** 10% 3types	*
7	6/5	<2	8	94	5	* Chenopodiaceae													*	*
8	6/6	<2	<2	40	60														* (1)	*
9	6/7	<2	<2	20	80															

Sample Number	Context	Weight g	Flot volume ml	Uncharred %	Sediment %	Seeds and fruits uncharred	Charcoal >4mm	Charcoal <4mm	Charcoal <2mm	Crop seeds charred	Identifications	Preservation	Weed seeds charred	Identifications	Preservation	Other botanical charred	Identifications	Preservation	Land Snail Shells	Industrial debris hammerscale
10	6/8	<2	<2	95	5															
11	1/3	22	150	99	1	** <i>Rubus fruticosus</i> agg./ <i>idaeus</i> , <i>Chenopodiaceae</i>		*												
12	1/4	<2	10	97	2	* <i>Rubus fruticosus</i> agg./ <i>idaeus</i>		* (1)	*											
13	1/5	2	35	98	2	* <i>Rubus fruticosus</i> agg./ <i>idaeus</i>			*											
14	3/3	6	35	97	3	* <i>Rubus fruticosus</i> agg./ <i>idaeus</i> (1)	* (2)	*	*	*	<i>Vicia/Pisum</i> sp. (1)	++							* (1)	
15	3/4	6	50	96	2	* <i>Sambucus nigra</i> (1), unid. fruit stone (1)	* (6)	*	*							*	CPR (3 small pcs)	+	** 2 types	
16	3/5	20	100	94	5	** <i>Rubus fruticosus</i> agg./ <i>idaeus</i> , unid. seeds	* (4)	**	*										*	
17	3/6	4	45	98	2		* (1)	*	*											
18	8/3	6	65	98	2	* unid. fruit stones		*	*	*	cf. <i>Cerealia</i> (1)	+							*	

Sample Number	Context	Weight g	Flot volume ml	Uncharred %	Sediment %	Seeds and fruits uncharred	Charcoal >4mm	Charcoal <4mm	Charcoal <2mm	Crop seeds charred	Identifications	Preservation	Weed seeds charred	Identifications	Preservation	Other botanical charred	Identifications	Preservation	Land Snail Shells	Industrial debris hammerscale
19	8/4	2	8	80	20															
20	8/5	<2	<2	90	10	** <i>Rubus fruticosus</i> agg./ <i>idaeus</i> , unid. Seeds, <i>Euphorbia helioscopia</i> , unid. thorn														
21	8/5	<2	<2	98	2	* cf. <i>Crataegus monogyna</i>														
22	9/3	20	170	95	1	* cf. <i>Crataegus monogyna</i> , Chenopodiaceae, unid. Seeds	* (9)	**	**				*	Poaceae (1 frag.)	++				* 2 types	
23	9/4	24	240	97	1	* cf. <i>Crataegus monogyna</i> , Chenopodiaceae	* (2)	*	*										* (2)	
24	9/5	16	125	98	1			*												
25	9/6	32	115	85	15		* (1 twig frg.)													
26	9/7	14	120	98	2	* unid.thorn (1)	* (1)									*	cf. fruit stones (2) (unid.)	++	* (1)	

Sample Number	Context	Weight g	Flot volume ml	Uncharred %	Sediment %	Seeds and fruits uncharred	Charcoal >4mm	Charcoal <4mm	Charcoal <2mm	Crop seeds charred	Identifications	Preservation	Weed seeds charred	Identifications	Preservation	Other botanical charred	Identifications	Preservation	Land Snail Shells	Industrial debris hammerscale
27	2/4	2	<2	98	2	* (1)														* (1)
28	5/4	14	90	98	1	*	* (1)	*					*	cf. Poaceae (1)	+				* (1)	
29	5/6	10	70	99	1	* (1)													* (1)	
30	4/4	16	75	98	2	** Lamiaceae, <i>Euphorbia helioscopia</i> , <i>Rubus fruticosus</i> agg./ <i>idaeus</i>													** 2 types	
31	4/6	4	40	99	1	unid. fruit stone (1)													* (3)	

Appendix 3: Desk Based Assessment (CgMs 2011)



**ARCHAEOLOGICAL
DESK BASED
ASSESSMENT**

**LAND AT
KNOCKHALL ROAD
GREENHITHE
KENT**

AUGUST 2011

Planning • Heritage

Specialist & Independent Advisors to the Property Industry

**Planning Authority:
Dartford Borough Council**

**Site centred at:
TQ593 744**

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RICHARD MEAGER BA MA PG Cert MIfA**

**Approved by:
DUNCAN HAWKINS BA MIfA**

**Report Status:
DRAFT FOR CLIENT REVIEW**

**Issue Date:
AUGUST 2011**

**CgMs Ref:
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EXECUTIVE SUMMARY

- Land at Knockhall Road Greenhithe Kent has been reviewed for its below ground archaeological potential.
- The site is considered to have a potential for the early prehistoric periods.
- Past post-depositional impacts within the study site are considered severe and widespread as a result of twentieth century landforming.
- A suite of further mitigation measures will be required prior to development, initially in the form of archaeological monitoring of site investigation works, with further work dependant upon the results of initial monitoring.

1.0 INTRODUCTION AND SCOPE OF STUDY

- 1.1 This archaeological desk-based assessment has been researched by Caroline Butler and prepared by Richard Meager of CgMs Consulting, on behalf of Bartonwillmore.
- 1.2 The assessment considers the site of the former Empire Sports Ground, Knockhall Road Greenhithe Kent. The site is c.3.6 hectares in extent and from northwest to southeast comprises a plateau to the northwest behind the buildings fronting Knockhall Road, occupied by a bowling green and parking; there is then a wooded downward slope to an open plateau occupied by a former sports field. The site is centred at National Grid Reference TQ593 744 (Fig 1).
- 1.3 In accordance with government guidance on archaeology and planning (PPS5) this assessment draws together the available archaeological, topographic and land-use information in order to clarify the archaeological potential of the site.
- 1.4 The assessment comprises an examination of evidence in the Kent Historic Environment Record (HER), considers the results of nearby archaeological investigations, incorporates published and unpublished material and charts historic land-use through a map regression exercise and includes the results of a site visit.
- 1.5 As a result, the assessment enables relevant parties to assess the archaeological potential of the site and to consider the need for design, civil engineering, and/or archaeological solutions to the potential identified.

2.0 PLANNING BACKGROUND AND DEVELOPMENT PLAN FRAMEWORK

- 2.1 In March 2010, the government published *Planning Policy Statement 5: Planning for the Historic Environment*, providing guidance for planning authorities, property owners, developers and others on the conservation and investigation of heritage assets.
- 2.2 PPS5 is supported by guidance in a document called '*Historic Environment Planning Practice Guide*' (HEPPG), issued simultaneously in March 2010.
- 2.3 PPS5 sets out the Government's objectives in paragraph 7 as being (in summary) to:
- Deliver sustainable development
 - Conserve England's heritage assets in a manner appropriate to their significance
 - Contribute to our knowledge and understanding of our past.
- 2.4 Paragraph 7 of PPS5 recognises that intelligently managed change may sometimes be necessary if heritage assets are to be maintained for the long term. The same paragraph also ensures that decisions are based on the significance of the heritage asset - significance now being a key factor in the assessment of impacts on the historic environment.
- 2.5 Development management is addressed in Policies HE6 to HE12 of PPS5, beginning with the information requirements for applications for consent affecting heritage assets in Policy HE6. Paragraph HE6.1 indicates that in describing the significance of a heritage asset, the level of detail supplied by an applicant should be subject to two considerations:
- 2.6 Heritage Assets are defined in Annexe 2 of PPS5 as: a building, monument, site, place, area or landscape positively identified as having a degree of significance meriting consideration in planning decisions. They include designated heritage assets (as defined in the PPS) and assets identified by the local planning authority during the process of decision-making or through the plan-making process.

Annex 2 defines Archaeological Interest as: an interest in carrying out an expert investigation at some point in the future into the evidence a heritage asset may hold of past human activity. Heritage assets with archaeological interest are the primary source of evidence about the substance and evolution of places, and of the people and cultures that made them. These heritage assets are part of a record of the past that begins with traces of early human and continues to be created and destroyed.

A Designated Heritage Asset comprises a: World Heritage Site, Scheduled Monument, Listed Building, Protected Wreck Site, Registered Park and Garden, Registered Battlefield or Conservation Area.

Significance is defined as: The value of a heritage asset to this and future generations because of its heritage interest. This interest may be archaeological, architectural, artistic or historic.

2.7 In short, government policy provides a framework which:

- Protects nationally important designated Heritage Assets (which include World Heritage Sites, Scheduled Ancient Monuments, Listed Buildings, Protected Wreck Sites, Registered Parks and Gardens, Registered Battlefields or Conservation Areas)
- Protects Heritage Assets (as defined above)
- Protects the settings of such designations
- In appropriate circumstances seeks adequate information (from field evaluation) to enable informed decisions
- Provides for the excavation and investigation of sites not significant enough to merit in-situ preservation.

2.8 In considering any planning application for development, the planning authority will be mindful of the framework set by government policy, in this instance PPS5, by current Development Plan Policy and by other material considerations.

2.9 The South East Plan and other Regional Spatial Strategies (RSS) were revoked in July 2010. The decision by government to withdraw the RSS was legally challenged by Cala Homes on 10 November 2010. A High Court decision concluded that the Secretary of State did not have the power to withdraw RSS's. This means the South East Plan has now been restored and once again forms part of the planning policy framework. Policy relevant to the study site comprises:

POLICY BE6: MANAGEMENT OF THE HISTORIC ENVIRONMENT

WHEN DEVELOPING AND IMPLEMENTING PLANS AND STRATEGIES, LOCAL AUTHORITIES AND OTHER BODIES WILL ADOPT POLICIES AND SUPPORT PROPOSALS WHICH PROTECT, CONSERVE AND, WHERE APPROPRIATE, ENHANCE THE HISTORIC ENVIRONMENT AND THE CONTRIBUTION IT MAKES TO LOCAL AND REGIONAL DISTINCTIVENESS AND SENSE OF PLACE. THE REGION'S INTERNATIONALLY AND NATIONALLY DESIGNATED HISTORIC ASSETS SHOULD RECEIVE THE HIGHEST LEVEL OF PROTECTION. PROPOSALS THAT MAKE SENSITIVE USE OF HISTORIC ASSETS THROUGH REGENERATION,

PARTICULARLY WHERE THESE BRING REDUNDANT OR UNDER-USED BUILDINGS AND AREAS INTO APPROPRIATE USE SHOULD BE ENCOURAGED.

- 2.10 The relevant Local Plan framework is provided by the Dartford Borough Council Local Plan Review Second Deposit Draft, dated September 2002. Since September 2007 a number of saved policies remain valid until the adoption of the Local Development Plan Framework (LDF). Saved policies relating to archaeology include:

BE10 SCHEDULED ANCIENT MONUMENTS

DEVELOPMENT ON OR NEAR THE SITE OF A SCHEDULED ANCIENT MONUMENT WHICH WOULD HAVE AN ADVERSE IMPACT ON THE ARCHAEOLOGICAL INTEREST OR ITS SETTING WILL NOT BE PERMITTED.

BE11 PROTECTION OF SITES OF LOCAL ARCHAEOLOGICAL VALUE

PLANNING PERMISSION WILL ONLY BE GRANTED FOR DEVELOPMENT WHICH WOULD HAVE A DETRIMENTAL EFFECT UPON THE REMAINS OF LOCAL ARCHAEOLOGICAL VALUE IF THE IMPORTANCE OF THE DEVELOPMENT OUTWEIGHS THE LOCAL VALUE OF THE REMAINS. IF PLANNING PERMISSION IS GRANTED, CONDITIONS WILL BE IMPOSED TO ENSURE THAT THE REMAINS ARE PROPERLY RECORDED, EVALUATED AND, WHERE PRACTICABLE, PRESERVED.

- 2.11 This desk based assessment therefore aims to meet the national, regional and local government guidance as set out above, in clarifying the archaeological potential of the study site and the need or otherwise for further mitigation measures.
- 2.12 In terms of designated heritage assets, no Scheduled Ancient Monuments, Historic Battlefield or Historic Wreck designations lie within the study site or its immediate vicinity (see Figure 2). The site does not lie within an area of archaeological priority.

3.0 GEOLOGY AND TOPOGRAPHY

3.1 Geology

- 3.1.1 British Geological Survey Sheet 271 Dartford (1998) shows the site to have originally been underlain by Upper Chalk deposits. However the site and its wider area has been identified as 'Worked Ground and Made Ground' defined as 'wholly or partially backfilled pits'. Geological information held at the Kent HER identifies Head deposits on the southern site boundary, Thanet Sand on the southwestern boundary and Boyn Hill Gravels on the western boundary.
- 3.1.2 Geotechnical investigations carried out at the study site in October 2010 revealed the following geological sequence. Made Ground is present across the entire site, dropping from the northwestern plateau across the downward northwest-southeast slope, where it lies at its thinnest. The centre of the sports field (see TP04) revealed over 4m of made ground deposits, while TP5 in the eastern corner revealed 2.3m of made ground over chalk. Boyn Hill Gravels are present across the western part of the site from the northwestern boundary to part of the way down the slope (see Figure 4 Section A-A), but were not identified anywhere else on site. Chalk deposits were identified beneath the made ground and the gravels across the whole site.
- 3.1.3 Figures 3 and 4 provide vertical and horizontal profiles of the site, derived from site investigation work. Figure 4 in particular shows the identified level of impact at the site and the conjectured original ground surface. It would appear that deposits of sand and gravel have been removed from the bulk of the study site, save for the western and northern parts of the site.
- 3.1.4 The borehole logs and location plan are reproduced at Appendix 1.

3.2 Topography

- 3.2.1 The existing site topography is believed to have been created by the re-profiling of the site during the mid twentieth century. It has been conjectured that this has been achieved by removing overlying sands and gravels (Boyn Hill Gravels and Thanet Sands) from the centre of the site, altering the topography from a gradual southeastern downward slope into a steeper step with an upper plateau to the northwest, and an extensive lower plateau to the southeast. At the same time, the chalk pit shown on Ordnance Surveys within the southeastern part of the site was

filled in with the material taken from the site, and the surplus spread across the lower plateau, now represented as made ground (Hydrock 2010: 7).

- 3.2.2 Figure 3 provides a summary in plan of the site's topography, while Figure 4 provides a cross section through the site using the results of the geotechnical investigations and the conjectured line of the previous land surface.
- 3.2.3 No watercourses or naturally occurring bodies of water are known within the vicinity of the study site.

4.0 **ARCHAEOLOGICAL AND HISTORICAL BACKGROUND**

(Including Map Regression Exercise)

Timescales used in this report:

Prehistoric

Palaeolithic	450,000 - 12,000 BC
Mesolithic	12,000 - 4,000 BC
Neolithic	4,000 - 1,800 BC
Bronze Age	1,800 - 600 BC
Iron Age	600 - AD 43

Historic

Roman	AD 43 - 410
Anglo Saxon/Early Medieval	AD 410 - 1066
Medieval	AD 1066 - 1485
Post Medieval	AD 1486 - 1749
Modern	AD 1750 - Present

4.1 **Introduction**

- 4.1.1 What follows is a review of archaeological finds and features within a 500m radius of the study site, also referred to as the study area, held on the Kent Historic Environment Record (HER), together with a map regression exercise from the eighteenth century until the present day.
- 4.1.2 Figure 2 reproduces the summary of cultural heritage assets obtained from the Kent HER. In terms of cultural heritage designations the study site does not lie within the vicinity of a Scheduled Ancient Monument, Historic Battlefield or Historic Wreck site.
- 4.1.3 The HER findspots include substantial quantities of Palaeolithic material within the vicinity of the site which are regarded as being of national importance (see section 4.2 below).
- 4.1.4 The map regression exercise indicates that the study site remained largely undeveloped land until it was significantly remodelled in the middle of the twentieth century, to create the site topography as it exists today.

4.2 **Prehistoric – Palaeolithic and Mesolithic**

- 4.2.1 Kent has produced some of the richest Palaeolithic evidence in the country. The study site lies c.325m west of the Barnfield Pit site, where the Swanscombe Skull (the oldest human remains found in Britain) together with substantial quantities of associated finds (including 7613 handaxes, 333 cores and 16300 pieces of debitage) were identified at various points during the twentieth century. The geology of this site has been classified as a series of fluvial sand and gravel deposits divided by layers of sands and silts (HER TQ57SE219, TQ5977 7423; Wenban-Smith 2007: 50-51; Wessex Archaeology 1993: 96; Wessex Archaeology 2004: 9-12; Wymer 1999: 67).
- 4.2.2 The former Dierdon's Pit site fronts the north side of Knockhall Road c.375m to the north of the study site. A Chellean shell bed was found near the Ingress Tavern, Greenhithe, which revealed about 500 flakes of probable Acheulian date together with animal and molluscan remains, during the early twentieth century (HER TQ57SE7; TQ5950 7477). The BGS data (section 3.1 above) indicates that this site lies within a small area of river terrace gravels.
- 4.2.3 Evidence of further Palaeolithic activity and occupation has been identified at Collyers Pit to the east of the study site (HER TQ57SE242, TQ5968 7449).
- 4.2.4 A site c.125m to the east of the study site has revealed 37 Palaeolithic handaxes, a core and 6 pieces of debitage (HER TQ57SE1002, TQ595 745). The Kent HER records another find of 37 Lower Palaeolithic handaxes, four retouched flakes and two other flakes, in a valley cut through the Boyn Hill Gravels (HER TQ57SE271, TQ5974). These two findspots may be a single site duplicated on the Kent HER.
- 4.2.5 A single Palaeolithic flint flake has been identified at Knockhall Road to the southwest of the study site (HER TQ57SE170, TQ59020 74308).
- 4.2.6 The potential of the study site for the Palaeolithic can be categorised as high, although the impact of twentieth century development is likely to have had a significant impact upon such potential. The available geotechnical information (see Section 3 above and Figures 3-4) indicate a potential for Palaeolithic material within intact gravels present across the western and northern parts of the site. Across the remainder of the site, which appears to have been significantly truncated, the potential for Palaeolithic material can be identified as low.

4.3 **Mesolithic**

- 4.3.1 No finds of Mesolithic date have been identified within a 500m radius of the study site. The Mesolithic in Kent appears to be typically represented by artefactual discoveries (Champion 2007: 73).
- 4.3.2 The potential of the study site for the Mesolithic can be identified as generally low. Small quantities of residual flintwork could conceivably be present.

4.4 **Neolithic, Bronze Age and Iron Age**

- 4.4.1 From around 4000 BC the mobile hunter-gathering economy of the Mesolithic gradually gave way to a more settled agriculture-based subsistence. The pace of woodland clearance to create arable and pasture-based agricultural land varied regionally and locally, depending on a wide variety of climatic, topographic, social and other factors. The trend was one of a slow, but gradually increasing pace of forest clearance.
- 4.4.2 By the 1st millennium, i.e. 1000 BC, the landscape was probably a mix of extensive tracts of open farmland, punctuated by earthwork burial and ceremonial monuments from distant generations, with settlements, ritual areas and defended locations reflecting an increasingly hierarchical society.
- 4.4.3 Finds of Neolithic flintwork and pottery are known from Ingress Vale within the study area (HER TQ57SE83, TQ5974), and small sherds of Bronze Age pottery have been identified at the Collyers Pit site to the east of the study site (HER TQ57SE242, TQ5968 7449). No finds or features of Iron Age date have been identified within a 500m radius of the study site.
- 4.4.4 Taken together the above finds are not indicative of extensive later prehistoric activity or settlement within the study area. The potential of the study site itself for the Neolithic, Bronze Age and Iron Age can therefore be categorised as generally low.

4.5 **Roman**

- 4.5.1 Roman features in the form of a ritual pit, 35 feet (c.10m) deep, filled with sand and containing animal bones, ox-horn, potsherds, nails, and three inhumations side by side at the bottom, have been identified in the general study area (HER TQ57SE88

TQ5974). Roman pottery in the form of a poppy-headed beaker has been identified in the general study area (HER TQ57SE86, TQ5974). Without an exact location of identification the usefulness of these findspots in identifying areas of activity is limited.

4.5.2 A Roman vase and urn containing ashes were found during the construction of some detached houses in the later nineteenth century, at Greenhithe c.400m north of the study site (HER TQ57SE11, TQ5929 7485).

4.5.3 Taken together the above finds are not indicative of extensive Roman activity or settlement within the study area. The potential of the study site itself for the Roman period can therefore be categorised as generally low.

4.6 **Anglo Saxon & Medieval**

4.6.1 No finds of Anglo-Saxon or Medieval date have been identified within a 500m radius of the study site.

4.6.2 During these periods the study site probably lay in open land, south of areas of known settlement.

4.6.3 The potential of the study site for the Anglo-Saxon and Medieval periods can be identified as generally low. Evidence of agricultural activity and land division could conceivably have been present.

4.7 **Post Medieval and Modern (including map regression exercise)**

4.7.1 In the late eighteenth century the study site lay in undeveloped land south of the village of Knockhall (Fig 5: 1769 Andrews Drury & Herbert Map of Kent; Fig 6: 1799 Ordnance Survey).

4.7.2 The 1844 Swanscombe Tithe Map (Fig 7) and the accompanying Award show the study site lying within an orchard, with a 'chalk hole' to the southeast now lying within woodland. A range of agricultural buildings associated with Knockhall Farm lie in the western corner.

4.7.3 The First Edition Ordnance Survey (Fig 8: 1864) shows the study site as on the Tithe Map occupied by orchard with the chalk pit to the southeast and the farm buildings to the west, with open space along the northwestern boundary. On the Second Edition Ordnance Survey (Fig 9: 1895) the quarry to the southeast is labelled 'Old Chalk Pit'

perhaps indicating disuse, and the western farm buildings are now not shown. The Third Edition (Fig 10: 1907) shows no changes from the previous edition.

- 4.7.4 The Revised Ordnance Survey (Fig 11: 1938) shows the proximity of the massive gravel workings which dominated the area of the study site. The bulk of the study site remains unchanged save for buildings present in the northern corner and to the northwest. The 1940s aerial photograph (Plate 1) shows the site covered in woodland.
- 4.7.5 The 1954 Ordnance Survey (Fig 12) shows little change at the site save that the land within the southern boundary has reverted from orchard to brushwood and rough pasture.
- 4.7.6 The 1961 aerial photograph (Plate 2) shows no change within the study site, but the 1967 aerial photograph (Plate 3) shows the presence of the bowling green and tennis courts to the northwest, a bank of woodland to the west and open ground to the east.
- 4.7.7 The 1969 Ordnance Survey (Fig 13) shows that the western and northern parts of the study site now drop steeply downwards from a narrow plateau running along the northwestern boundary, towards a sports field in the southeast. A bowling green, pavilion, tennis courts and community hall (the *Coronation Hall*) occupy the northwestern plateau. The slope itself appears to be occupied with scrub, and the former old chalk quarry on the southeastern boundary is now not shown, indicating it has been filled in. The 1985 aerial photograph (Plate 4) shows no significant changes within the study site.
- 4.7.8 The 1992 Ordnance Survey (Fig 14) shows the absence of the Coronation Hall in the northwestern corner of the site, and the 2011 Ordnance Survey (Fig 15) shows the absence of the tennis courts on the northwestern boundary.
- 4.7.9 The potential of the study site for the Post Medieval and Modern periods can be identified as low.

5.0 SITE CONDITIONS AND THE PROPOSED DEVELOPMENT

(Impact on the Buried Archaeological Deposits)

5.1 Site Conditions

- 5.1.1 The study site currently comprises (from northwest to southeast) a plateau to the northwest behind the buildings fronting Knockhall Road is occupied a bowling green and parking; there is then a wooded downward slope to an open plateau occupied by a former sports field. Pedestrian access leads onto the site from Knockhall Road to the north and Jubilee Close to the west, and a public footpath runs along the southern boundary (Fig 15 and Plates 5-10).
- 5.1.2 The landforming which led to the creation of the site as it is today, during the middle of the twentieth century, can be considered likely to have had a widespread and significant negative impact on below ground archaeological deposits.
- 5.1.3 The presence of the gravel quarry within the southeastern part of the site, from the nineteenth century until the mid twentieth century, is considered likely to have had a severe negative archaeological impact, concentrated within its footprint.
- 5.1.4 The use of the site as an orchard from the nineteenth century until the middle of the twentieth century is considered likely to have had a widespread negative impact through the planting and grubbing out of trees. The late reprofiling, however, may have removed much of the remains of such activity.

5.2 The Proposed Development

- 5.2.1 Detailed development proposals are currently unavailable but it is understood that the lower plateau of the site will be developed for residential purposes, with the provision across other parts of the site for attendant infrastructure (roads, services etc.).
- 5.2.2 While the study site undoubtedly has a potential for the early prehistoric periods, with remains of national significance being identified within the study area, the impact of twentieth century landforming can be considered likely to have had a significant negative impact on geological horizons typically containing such deposits.
- 5.2.3 It is therefore anticipated that further archaeological mitigation measures build on the existing information regarding ground conditions. Initially such measures should

concentrate upon further defining the archaeological potential in order to inform a strategy for dealing with the potential, within the context of future development.

6.0 SUMMARY AND CONCLUSIONS

- 6.1 The site of the Empire Sports Ground Knockhall Road Greenhithe Kent has been reviewed for its below ground archaeological potential.
- 6.2 In accordance with central and local government policy, as set out in PPS5 *Planning for the Historic Environment* a desk based assessment has been undertaken to clarify the archaeological potential of the study area.
- 6.3 The site can be shown to have a potential for the early prehistoric periods.
- 6.4 Past post-depositional impacts within the study site are considered severe and cumulative as a result of twentieth century landforming.
- 6.5 Detailed development proposals are currently unavailable, but are likely to comprise residential development.
- 6.6 On the basis of the available information we would suggest further mitigation measures in the form of archaeological monitoring of all future site investigation works. This in turn will inform the scope and nature of further mitigation measures, informed by the likely impact of redevelopment proposals. Due to the site's perceived archaeological importance, the preservation *in situ* of the archaeological resource will be carefully considered.

SOURCES CONSULTED

1. **General**

British Library
Centre for Kentish Studies
Kent Historic Environment Record

2. **Bibliographic**

Champion Prehistoric Kent in Williams (ed.) *The Archaeology of Kent to AD800* 2007

English Heritage *Identifying and Protecting Palaeolithic remains Archaeological Guidance for planning authorities and developers* 1998 unpublished document

Gibbard *Pleistocene History of the Lower Thames Valley* 1994

Harley *Ordnance Survey Maps a descriptive manual* 1975

Hasted *A History & Topographical Survey of Kent* Vol. 2 1797

Hydrock *Desk Study and Ground Investigation at Knockhall Road Greenhithe Kent* October 2010 unpublished document

Newman *Buildings of England West Kent & the Weald* 2nd Edition 1976

Wenban Smith The Palaeolithic archaeology of Kent in Williams (ed.) *The Archaeology of Kent to AD800* 2007

Wessex Archaeology *Swanscombe Heritage Park and Craylands Gorge Swanscombe Kent Archaeological and Geological Desk-Based Assessment* 2004 unpublished report

Wessex Archaeology *The Southern Rivers Palaeolithic Project Report No 2 1992-3: The South West and South of the Thames* 1993

Wymer *The Lower Palaeolithic Occupation of Britain* 2 Volumes 1999

3. **Cartographic**

1769 Andrews, Drury & Herbert's Map of Kent

1844 Swanscombe Tithe Map

1864 Ordnance Survey

1895 Ordnance Survey

1907 Ordnance Survey

1938 Ordnance Survey

1954 Ordnance Survey

1969 Ordnance Survey

1992 Ordnance Survey

1998 British Geological Survey Sheet Dartford

4. **Aerial Photographs**

1940s x 2 (no references)

13 May 1961 Run 4 2216

13 May 1961 Run 5

22 August 1967 Run 34 1317

13 July 1972 Run 2 6367

6 November 1985

24 July 1995 Run 5 8841



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 Site Location	 Cgms CONSULTING Planning & Development Archaeology & Historic Buildings www.cgms.co.uk	Project title: Empire Sports Ground, Knockhall Road, Greenhithe, Kent	
		Not to Scale: Illustrative Only	
		Date printed: 10.08.11	Drawn by: LW Checked by: RM

Figure 1: Site Location

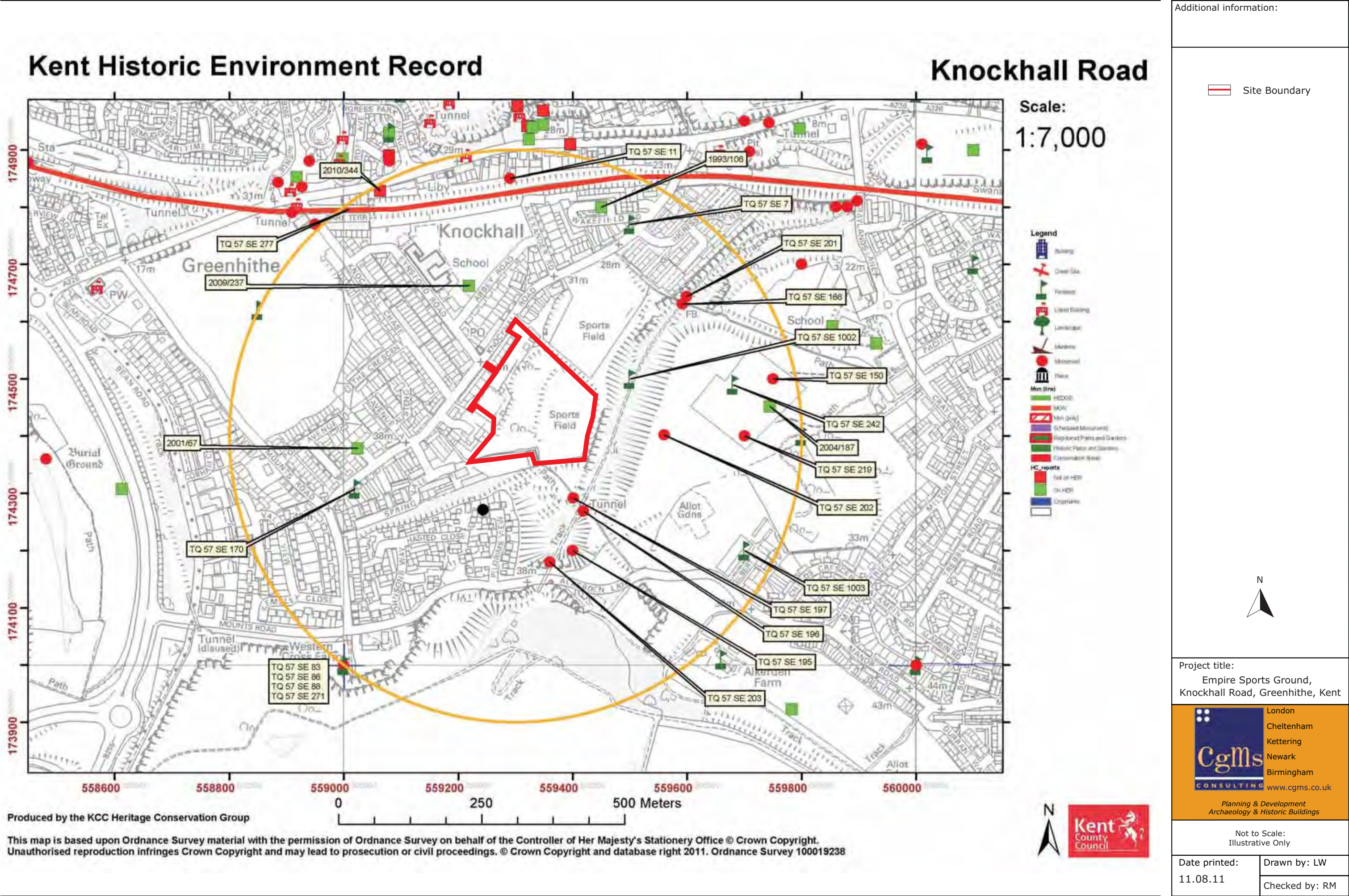
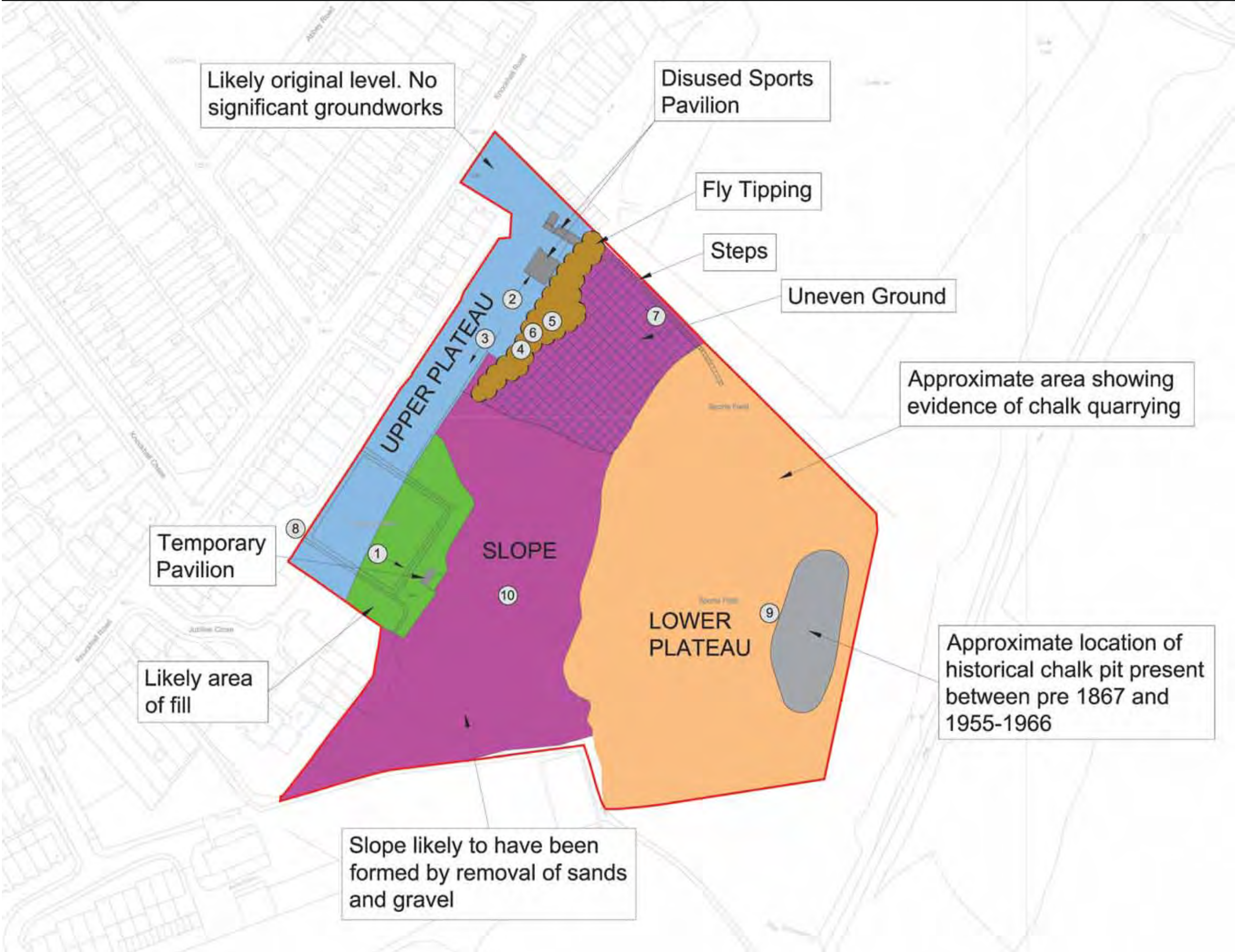


Figure 2: Summary of Cultural Heritage Designations (data from Kent HER)



Additional information:

Site Boundary

N

Project title:
Empire Sports Ground,
Knockhall Road, Greenhithe, Kent


 London
 Cheltenham
 Kettering
 Newark
 Birmingham
www.cgms.co.uk

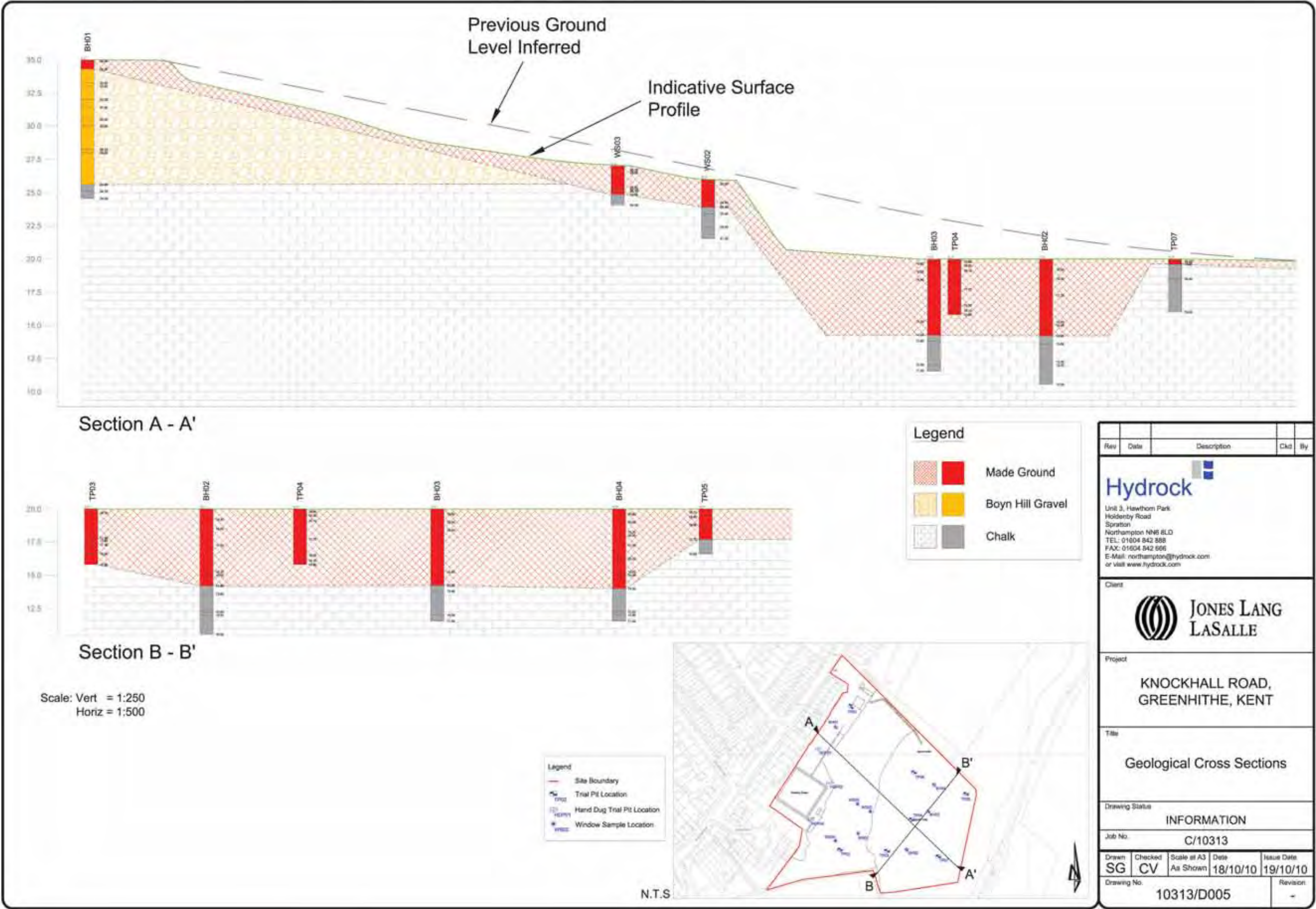
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Figure 3: Identified geological zones across the study site (data from Hydrock 2010)

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Figure 4: Geological profile through study site (data from Hydrock 2010)



○ Site Location



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Figure 5: 1769 Andrews, Drury & Herbert Map of Kent

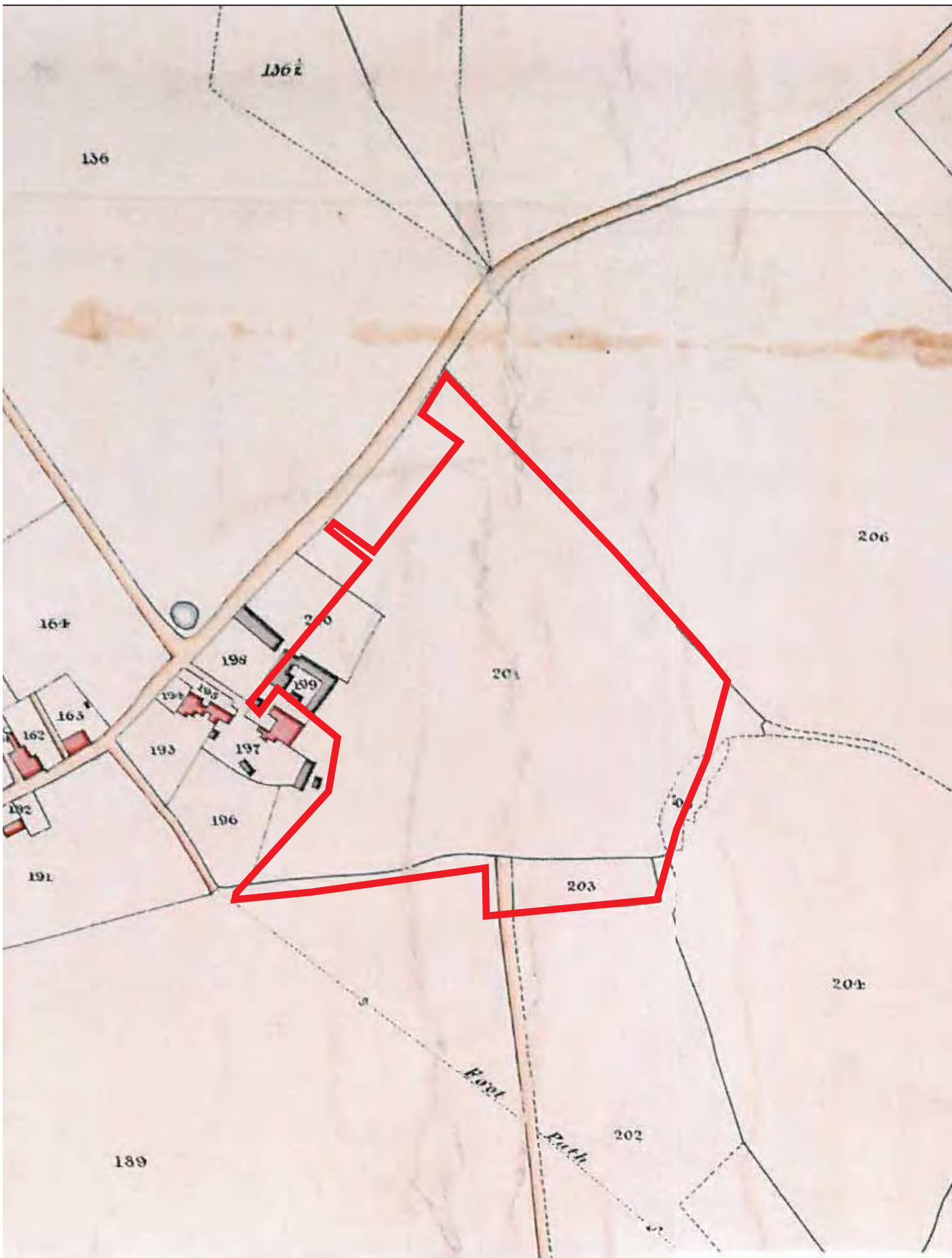


 Site Boundary



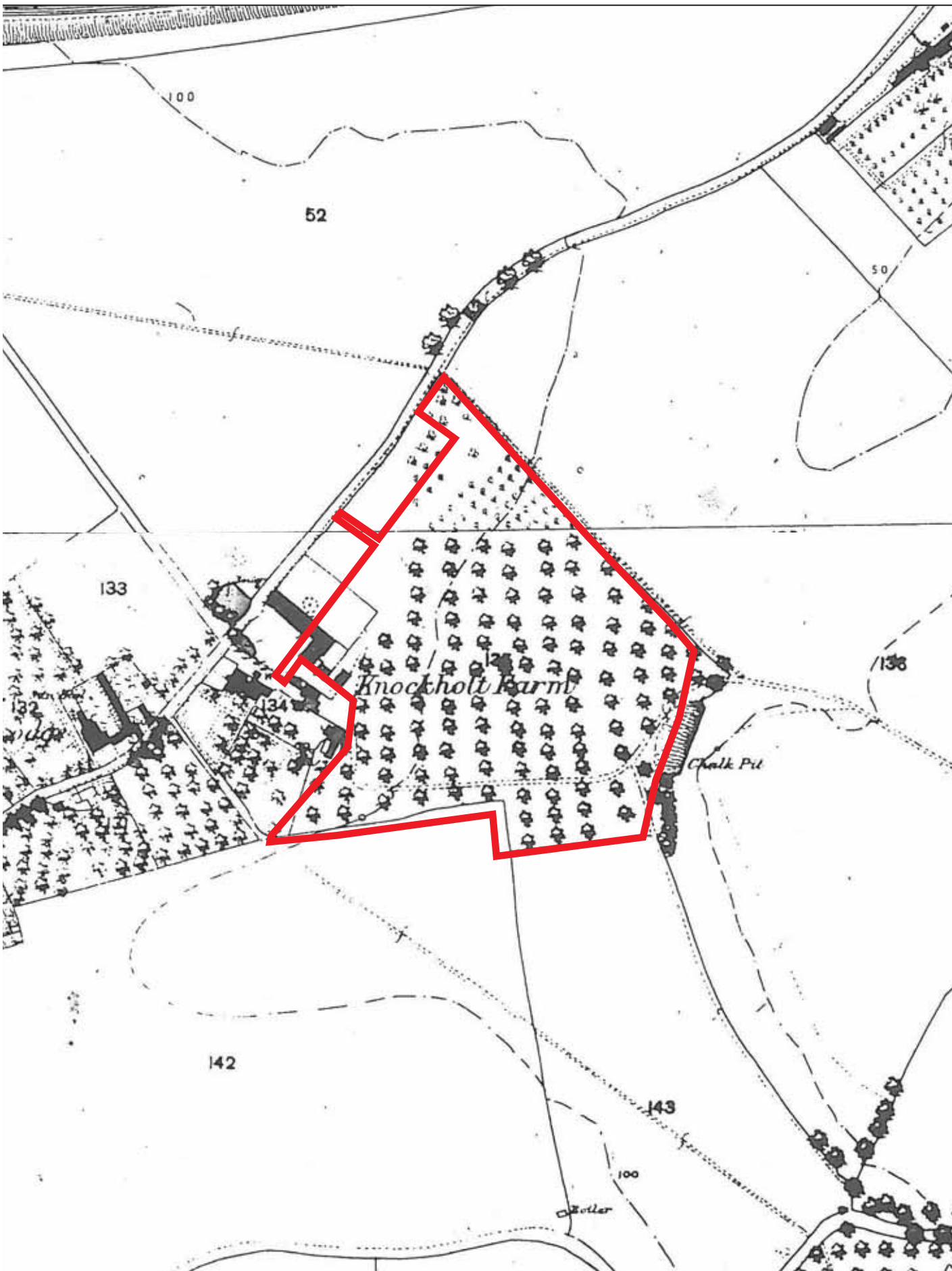
Project title: Empire Sports Ground, Knockhall Road, Greenhithe, Kent		 London Cheltenham Kettering Newark Birmingham CONSULTING www.cgms.co.uk Planning & Development Archaeology & Historic Buildings
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Figure 6: 1799 Ordnance Survey



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Figure 7: 1844 Swanscombe Tithe Map



Site Boundary



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Knockhall Road, Greenhithe, Kent

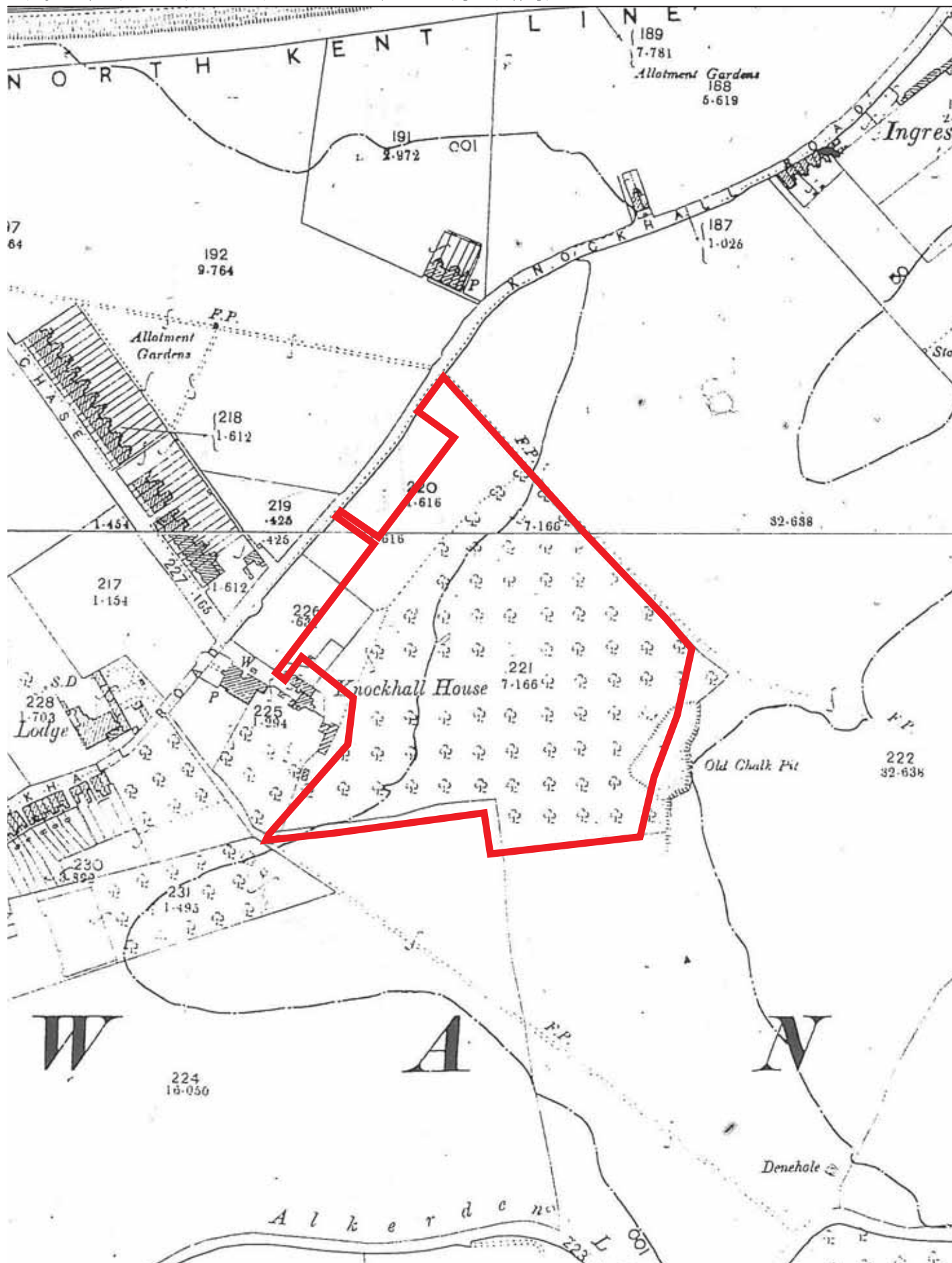
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Figure 8: 1864 Ordnance Survey



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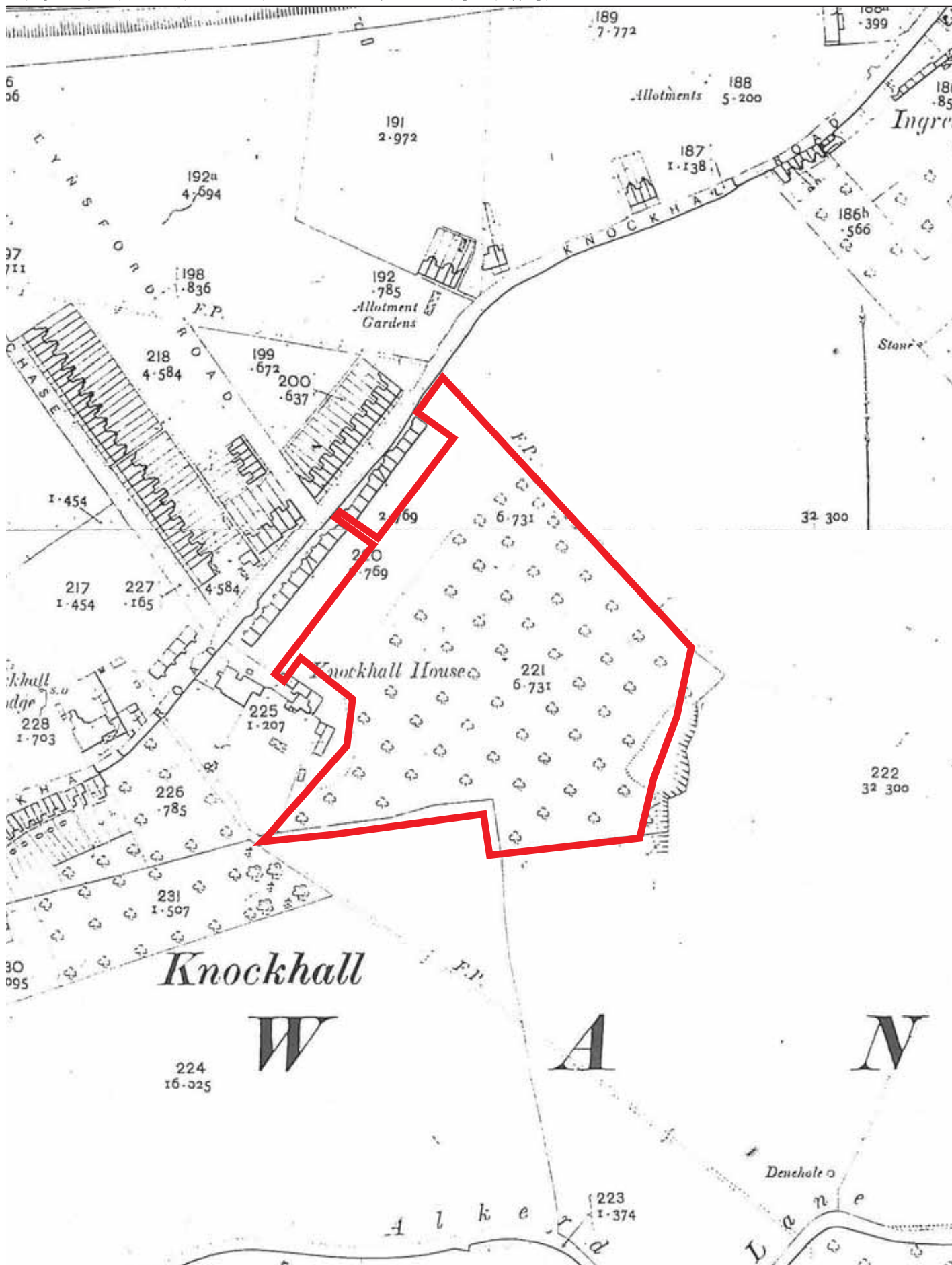
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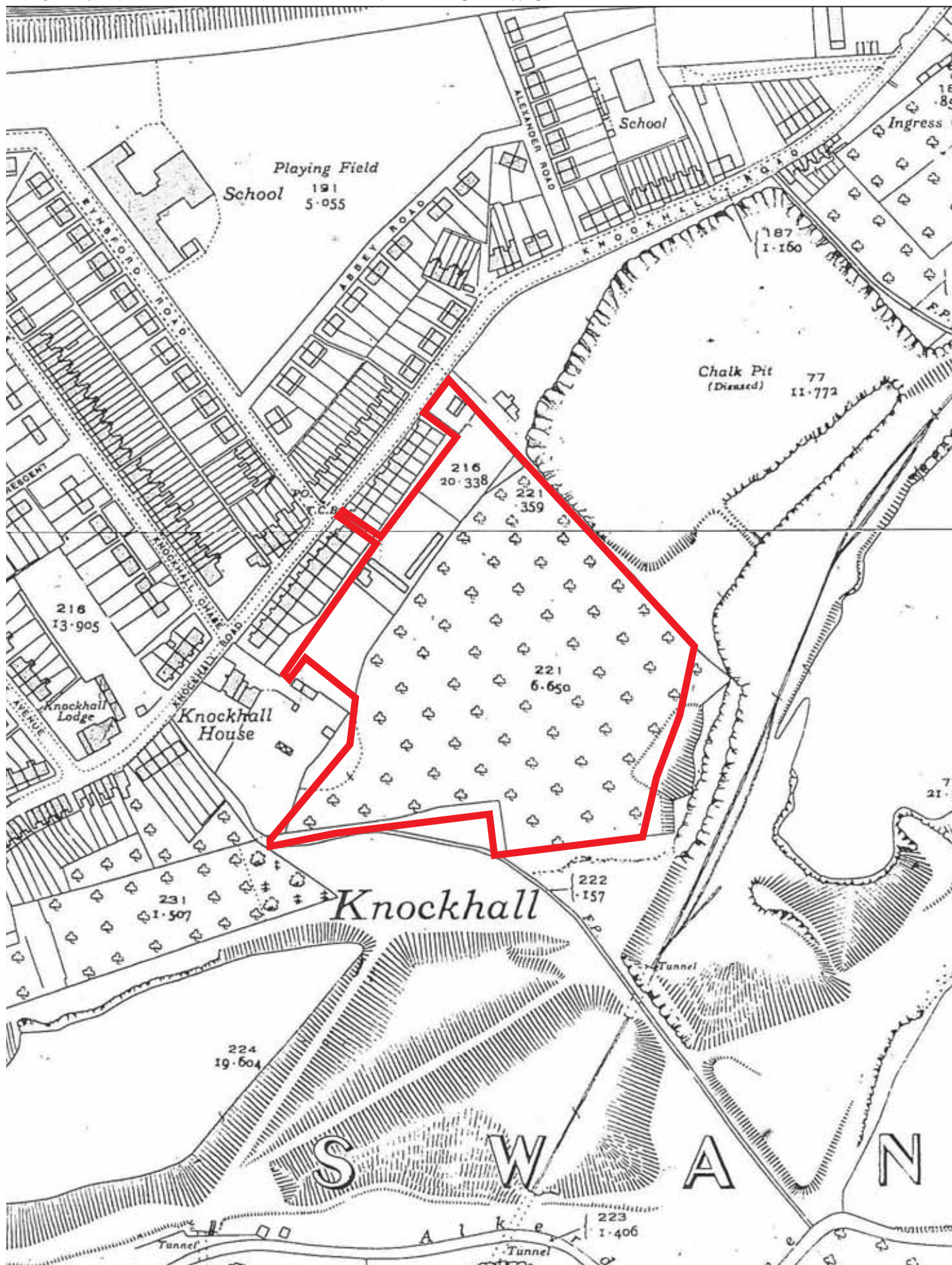
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Figure 9: 1895 Ordnance Survey



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Figure 10: 1907 Ordnance Survey



 Site Boundary



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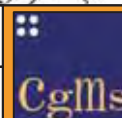
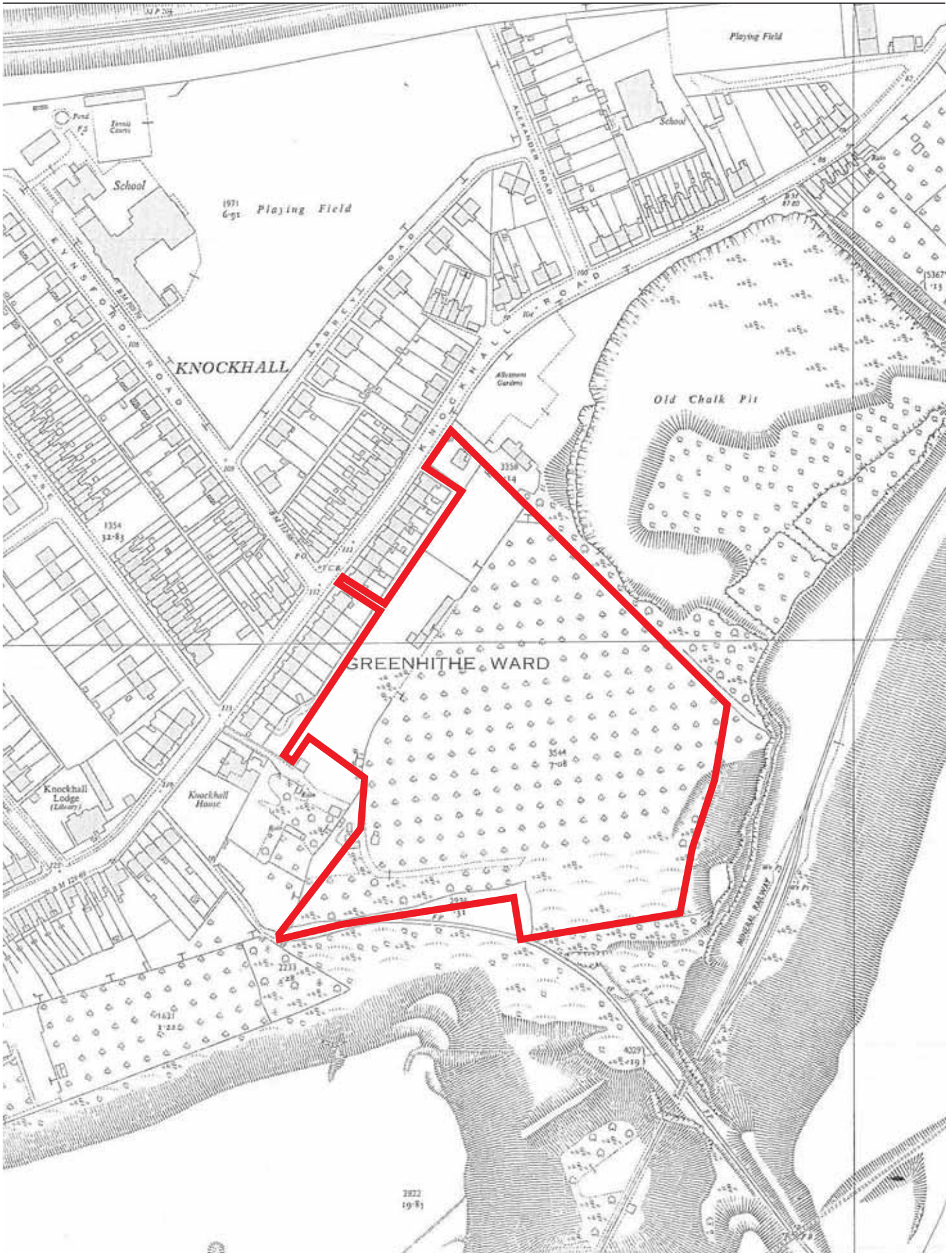
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	Birmingham
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Figure 11: 1938 Ordnance Survey



 Site Boundary



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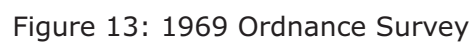
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Figure 12: 1954 Ordnance Survey





 Site Boundary



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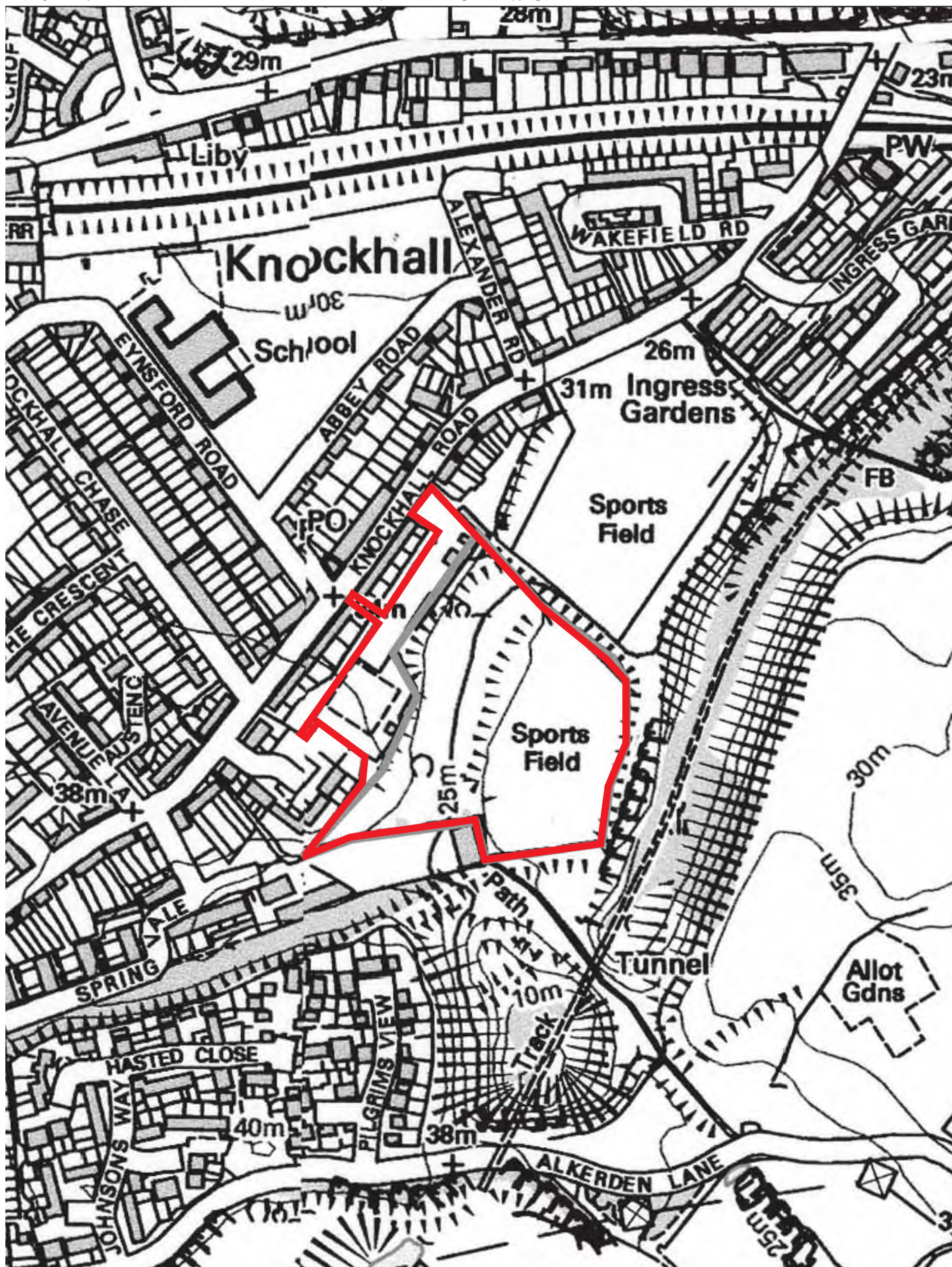
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Figure 14: 1992 Ordnance Survey



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Figure 15: 2011 Ordnance Survey



Plate 1: 1940's aerial photograph



Plate 2: 1961 aerial photograph

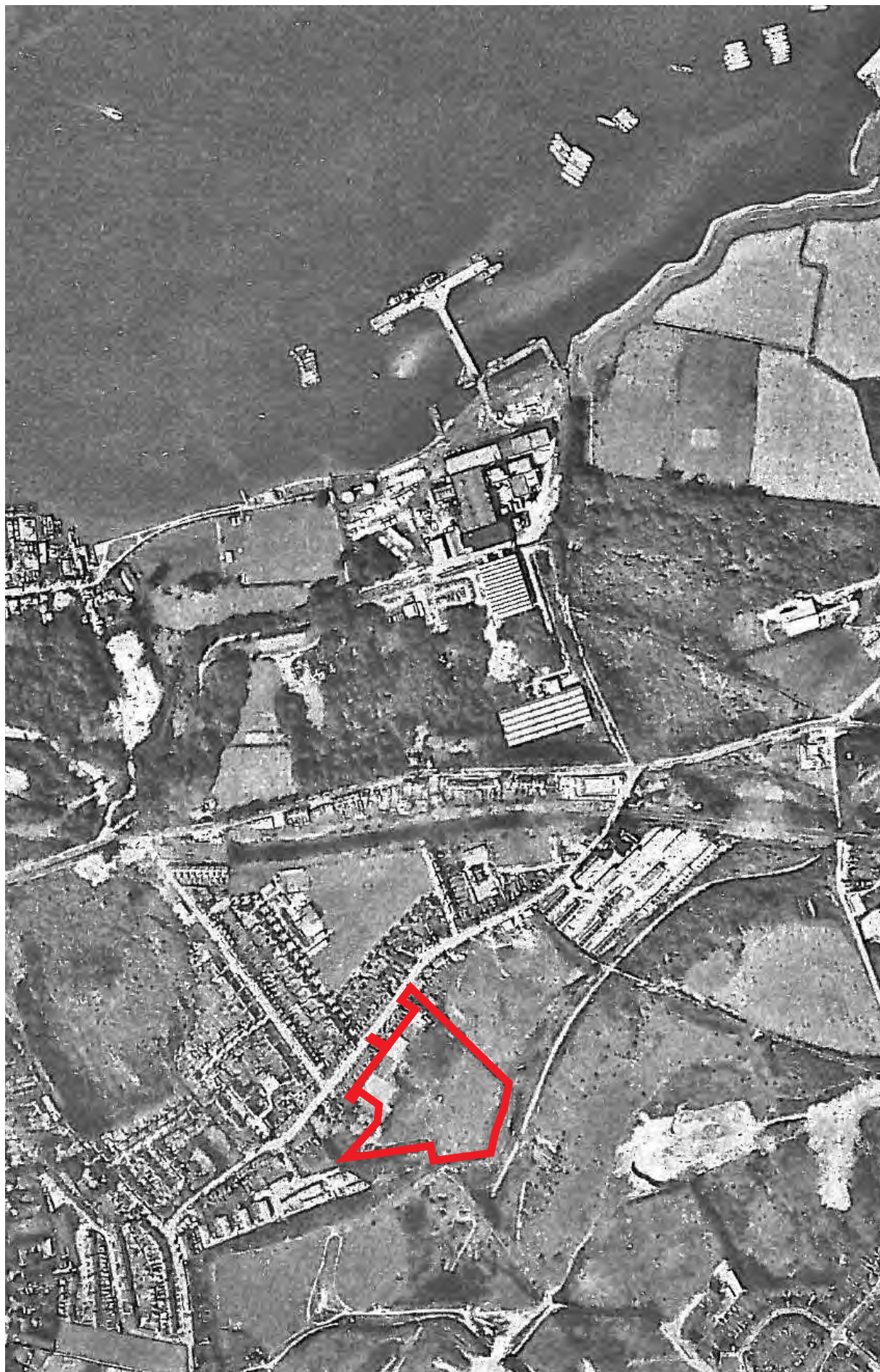


Plate 3: 1967 aerial photograph

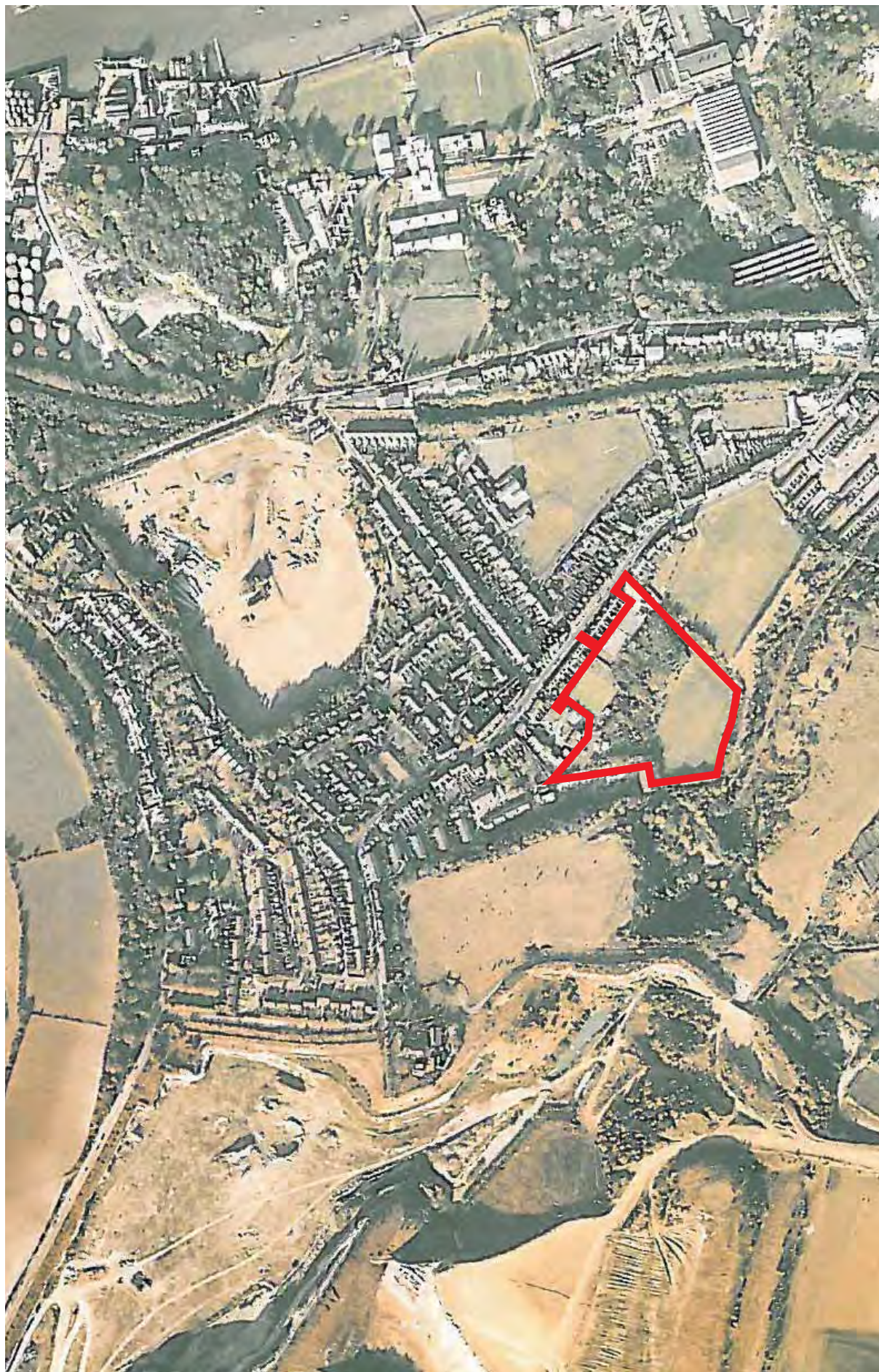


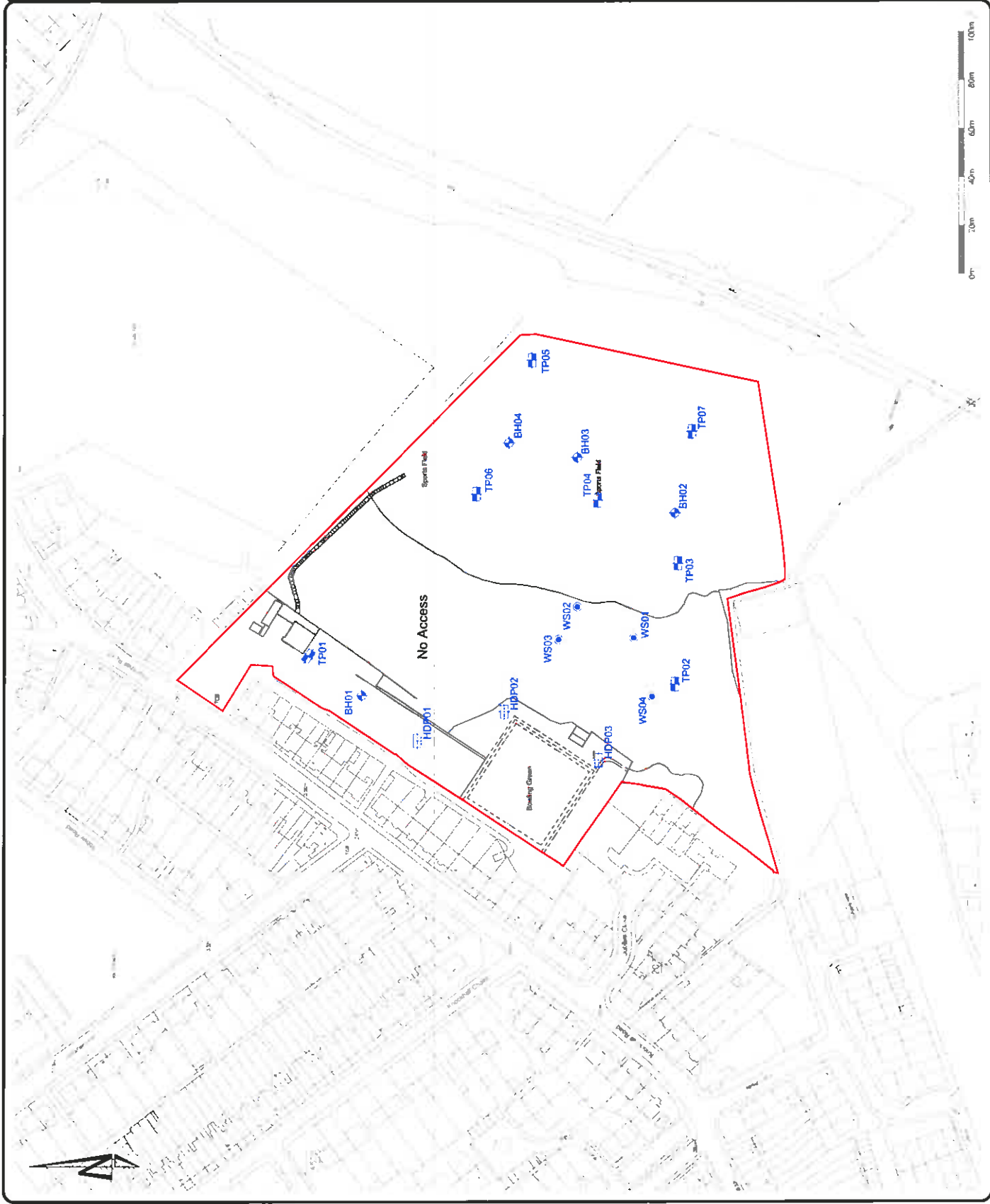
Plate 4: 1985 aerial photograph



Plate 5: 2006 aerial photograph

APPENDIX 1

Geotechnical information September 2010
(taken from Hydrock 2010)



Legend

- Site Boundary
- Trial Pit Location
- Hand Dug Trial Pit Location
- Window Sample Location

Date	Description	By



Unit 3, Hewdon Park,
Hewdon Road,
Spalding
Northampton NN8 6LD
TEL: 01604 842 888
Fax: 01604 842 886
Email: enquiries@hydrock.com
or Mail: www.hydrock.com

Client



JONES LANG
LASALLE

Project

KNOCKHALL ROAD,
GREENHITHE, KENT

Drawn

Exploratory Hole Location Plan

Drawing Status

INFORMATION

Job No. C/10313

Date	Checked	Scale	Drawn	Issue Date
SG	CV	1:1500	11/10/10	19/10/10

Drawing No.

10313/D004

Revision

-



Likely original level. No significant groundworks

Disused Sports Pavilion

Fly Tipping

Steps

Uneven Ground

Approximate area showing evidence of chalk quarrying

Temporary Pavilion

Likely area of fill

SLOPE

LOWER PLATEAU

Approximate location of historical chalk pit present between pre 1867 and 1955-1966

Slope likely to have been formed by removal of sands and gravel

Legend

- Site Boundary
- Photograph Location and Orientation

Rev	Date	Description	Drawn By



Unit 3, Meadows Farm,
Kilnsey Road,
Spalden
Northampton NN6 8LD
Tel: 01604 454 888
Fax: 01604 454 844
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

Client



JONES LANG
LASALLE

Project

KNOCKHALL ROAD,
GREENHITHE, KENT

Title

Site Features/Zonation Plan

Drawing Status

INFORMATION

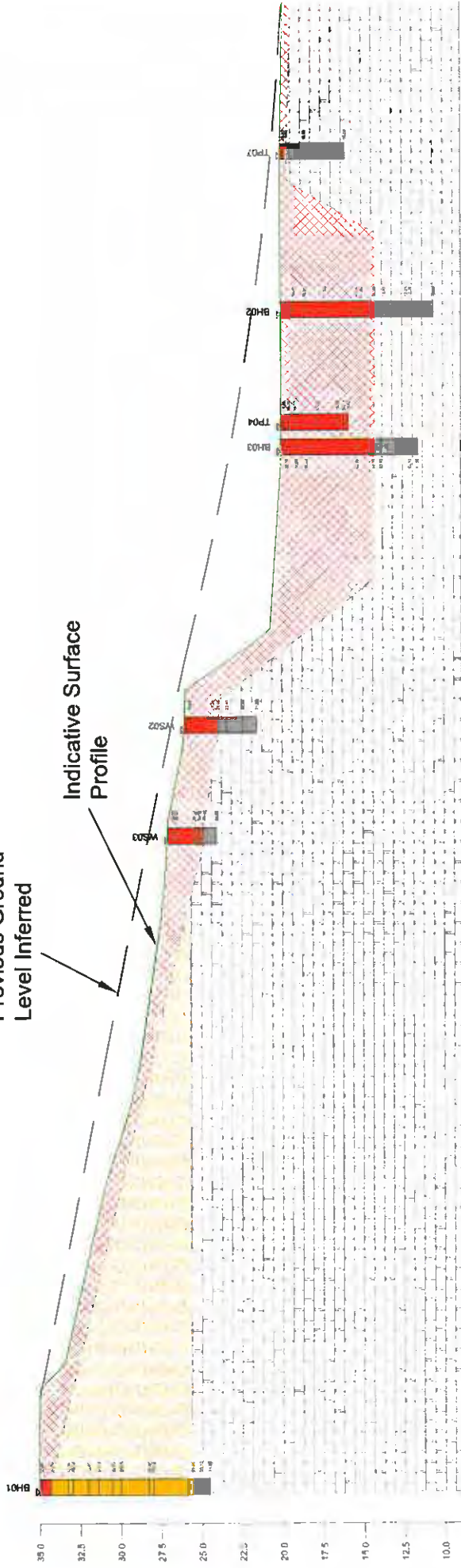
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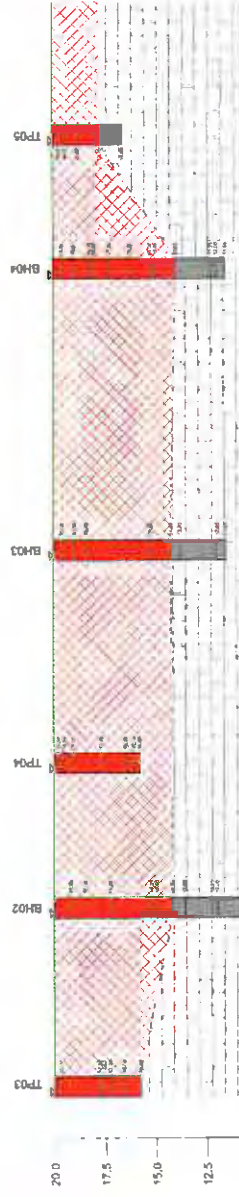
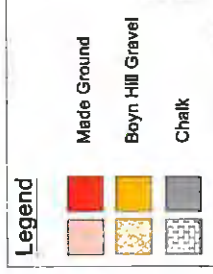
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10313/D003	

Previous Ground
Level Inferred

Indicative Surface
Profile

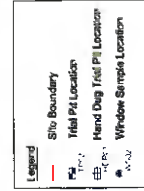


Section A - A'



Section B - B'

Scale: Vert = 1:250
Honz = 1:500



N.T.S

Pay	Date	Description	Qty	By

Unit 13 - Haverford Park
1000000 Road
Sutton
Northampton NN8 4LD
TEL: 01604 842 818
FAX: 01604 842 819
E: info@hydrock.com
or visit www.hydrock.com

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LASALLE

Project

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GREENHITHE, KENT

Title

Geological Cross Sections

Drawing Status

INFORMATION

Job No.

C/10313

Drawn

Checked

Scale

Date

Job No.

18/10/10

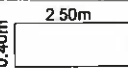
19/10/10

Drawing No.

10313/D005

Revision

1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559308E - 174556N Level: 35.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
				0.05	Bituminous Material (Hard Standing). (MADE GROUND)	34.95
				0.10	Black ash fine to coarse SAND. (MADE GROUND)	34.90
0.30	ES				Brown slightly silty sandy sub-rounded to rounded fine to coarse flint GRAVEL with some sub-angular to sub-rounded flint cobbles. (BOYN HILL GRAVEL)	
0.50	B					
				1.10	Orange brown clayey sandy sub-rounded to rounded flint and black flint GRAVEL with occasional sub-rounded flint cobbles and pockets (<100mm dia.) of orange brown very sandy clay. (BOYN HILL GRAVEL)	33.90
1.20	ES					
1.40	LB					
				1.60	Firm low to medium strength orange brown occasionally light grey very sandy SILT. (BOYN HILL GRAVEL)	33.40
1.80	HSV	35				
2.00	B					
						
2.50	HSV	72				
						
3.00	HSV	53				
				3.20	Trial pit complete at 3.20 m	31.80

Remarks:

HSV = Hand Shear Vane reading (KPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
AJ = Ambient Jet
PT = Plastic Tub
V = Vial

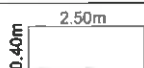
Groundwater: No groundwater encountered during excavation.

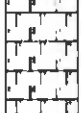
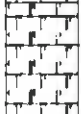
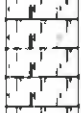
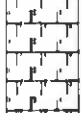
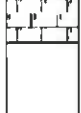
Logged By :

SC

Checked By :

CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559304E - 174404N Level: 31.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
0.40	ES			0.30	Vegetation over dark brown sandy CLAY with many roots and rare angular brick gravel. (MADE GROUND)	30.70
1.00	ES				Stiff friable orange brown sandy slightly gravelly CLAY with some roots and occasional angular to rounded quartzite, flint, chert and chalk cobbles. Gravel is angular to rounded fine to coarse quartzite, flint, chert, black flint and chalk. (POSSIBLE MADE GROUND)	
1.00	LB					
1.80	B			1.55	Orange brown very sandy sub-angular to rounded quartzite and flint GRAVEL and COBBLES. (POSSIBLE MADE GROUND)	29.45
1.90	B			1.70		29.30
				1.85	Orange brown mottled dark orange brown occasionally light grey SAND. (POSSIBLE MADE GROUND)	29.15
				2.00	Structureless CHALK composed of slightly sandy silty, subangular, GRAVEL with occasional subangular cobble. Gravel is extremely weak, low density, white. Cobbles are extremely weak, low density, white. Matrix is uncompact, white occasionally brown. Occasional flint gravel. (Grade Dc) (WHITE CHALK)	29.00
					Very weak to weak, low density, white, unstained CHALK. Fractures closely spaced, clean and tight, some specks and orange brown staining. Some flint boulders. (Medium density, Grade A3) (WHITE CHALK)	
3.00	B			2.70	Very weak to weak, low density, white, occasional pink staining CHALK. Fractures closely spaced, open, some orange brown and iron staining. Some flint boulders. (Medium density, Grade B3) (WHITE CHALK)	28.30
						
				4.00	Trial pit complete at 4.00 m	27.00

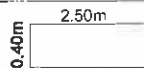
Remarks:

HSV - Hard Shear Vane reading (kPa)
D - Disturbed Sample
B - Bulk Sample
LB - Large Bulk Sample
AJ - Ambient Jar
PT - Plastic Tub
V - Vial

Groundwater: No groundwater encountered during excavation.

Logged By: SC

Checked By: CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559355E - 174402N Level: 20.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

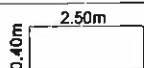
Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
0.40	ES			0.30	Grass over brown sandy CLAY. (MADE GROUND)	19.70
					Orange brown slightly silty gravelly SAND with occasional sub-rounded flint cobbles. Gravel is angular to rounded fine to coarse flint, quartzite and chalk. (PROBABLE MADE GROUND)	
1.00	ES					
1.50	LB					
2.30	B			2.20	Orange brown very clayey slightly gravelly SAND. Gravel is sub-angular to rounded fine to coarse quartzite and flint. (PROBABLE MADE GROUND)	17.80
				2.40		17.60
2.60	B			2.70	Stiff dark orange brown mottled orange brown very sandy CLAY with occasional pockets (<20mm dia.) of grey and yellow clayey sand. Some subrounded flint and quartzite gravel and cobbles. (PROBABLE MADE GROUND)	17.30
					Friable cream mottled brown sandy gravelly CLAY. Gravel is subrounded fine to coarse chalk. (PROBABLE MADE GROUND)	
3.00	B			3.40	Firm to stiff cream mottled brown sandy gravelly CLAY with occasional irregular flint cobble. Gravel is subrounded fine to coarse chalk. (PROBABLE MADE GROUND)	16.60
			4.20	Trial pit complete at 4.20 m		15.80

Remarks:

HSV = Hand Shovel vane reading (KPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
AJ = Amber Jar
PT = Plastic Tub
V = Vial

Groundwater: No groundwater encountered during excavation.

Logged By: SC Checked By: CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559373E - 174428N Level: 20.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
				0.20	Grass over dark brown sandy CLAY. (MADE GROUND)	19.80
0.40	ES			0.50	Brown very gravelly SAND with some pockets (150mm dia.) of sandy chalk gravel. Gravel is subangular to rounded flint, quartzite, chalk and brick. (MADE GROUND)	19.50
0.70	B			0.90	Friable orange brown very sandy CLAY with occasional subrounded to rounded flint and chalk gravel and cobbles. (PROBABLE MADE GROUND)	19.10
1.00	ES				Orange brown clayey SAND with occasional subangular to rounded flint and quartzite. (PROBABLE MADE GROUND)	
1.50	B			2.30	Soft to firm low to medium strength dark orange brown very sandy SILT with occasional angular to rounded flint, quartzite and chalk gravel. (PROBABLE MADE GROUND)	17.70
2.50	HSV	40				
2.50	B					
3.00	HSV	38				
3.50	HSV	29		3.50	Soft to firm low strength dark orange brown very sandy SILT with some rounded black flint gravel. Occasional angular to rounded flint and quartzite occasionally chalk gravel. (PROBABLE MADE GROUND)	16.50
4.00	B			3.90	Brown sandy subrounded to rounded black flint GRAVEL. (PROBABLE MADE GROUND)	16.10
				4.20	Trial pit complete at 4.20 m	15.80

Remarks:

HSV = Hand Shear Vane reading (kPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
AJ = Amber Jar
PT = Plastic Tub
V = Vial

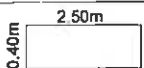
Groundwater: No groundwater encountered during excavation.

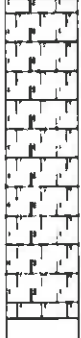
Logged By :

SC

Checked By :

CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559408E - 174458N Level: 20.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

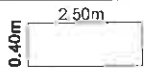
Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
0.40	ES			0.25	Grass over brown sandy CLAY. (MADE GROUND)	19.75
					Friable brown and orange brown slightly clayey very gravelly SAND with some brick, slate, metal and plastic cable. Gravel is angular to rounded fine to coarse quartzite and flint. Some rootlets. (MADE GROUND)	19.40
				0.60	Firm to stiff medium strength light brown slightly gravelly sandy CLAY. Gravel is subangular to rounded fine to coarse chalk. (PROBABLE MADE GROUND)	
1.00 1.00 1.00	HSV ES LB	62		1.20	Firm medium strength orange brown very sandy CLAY with occasional pockets (<10mm dia.) of black silty carbonaceous material and subangular fine to coarse chalk gravel. (PROBABLE MADE GROUND)	18.80
1.50	HSV	58			1.3m mbgl - x2 150mm dia. metal pipes (north east / south west direction)	
2.00 2.00	ES B			2.30	Very weak to weak, low density, white with some yellow banded staining CHALK. Fractures very closely spaced, generally infilled with uncompact, white sandy silt-size comminuted chalk. (Medium-density, Grade C4) (WHITE CHALK)	17.70
3.00	B			3.40	Trial pit complete at 3.40 m	16.60

Remarks:

HSV = Hand Shown Vane reading (kPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
A_u = Amber Jar
PT = Plastic Tub
V = Vial

Groundwater: No groundwater encountered during excavation.

Logged By: SC Checked By: CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559379E - 174474N Level: 20.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

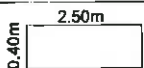
Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
0.40	ES			0.30	Grass over dark brown sandy CLAY. (MADE GROUND)	19.70
				0.60	Brown very gravelly SAND with occasional pockets (<200mm dia.) of chalk gravelly chalk sandy sill. (MADE GROUND)	19.40
1.00	ES				Orange brown slightly silty very gravelly SAND with brick. Gravel is quartzite, flint and occasionally chalk. (MADE GROUND)	
1.00	B			1.30	Firm medium strength orange brown mottled dark orange brown occasionally grey sandy CLAY with occasional subrounded to rounded black flint and quartzite gravel. Rare pockets (<50mm dia.) of black silty carbonaceous material. (PROBABLE MADE GROUND)	18.70
1.50	HSV	45				
1.50	ES					
1.50	B					
2.00	HSV	70				
2.50	HSV	50				
3.00	HSV	61				
3.50	HSV	58		3.60	Soft to firm low strength dark orange brown very sandy SILT with some subangular to rounded fine to coarse flint and black flint gravel. (PROBABLE MADE GROUND)	16.40
4.00	HSV	39				
4.00	B			4.20	Trial pit complete at 4.20 m	15.80

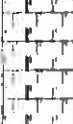
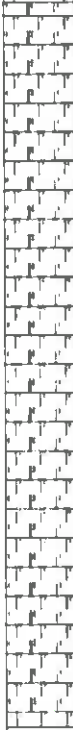
Remarks:

HSV = Hand Shear Vane reading (kPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
AJ = Amber Jar
PT = Plastic Tub
V = Vial

Groundwater: No groundwater encountered during excavation.

Logged By: SC Checked By: CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559399E - 174407N Level: 20.00 m AOD	Date 07/09/2010
Location: Greenhill, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

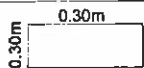
Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
0.30	ES			0.20	Grass over brown sandy CLAY. (PROBABLE MADE GROUND)	19.80
				0.40	Firm orange brown slightly gravelly very sandy CLAY. Gravel is subangular to subrounded fine to medium chalk. (PROBABLE MADE GROUND)	19.60
1.00	B			1.50	Very weak to weak, low density, white, unstained CHALK. Fractures closely spaced, generally infilled with friable uncompact, white sandy silt-size comminuted chalk. Fractures with some orange brown and iron staining and many specks. Some flint cobbles. (Medium density, Grade C4) (WHITE CHALK)	18.50
2.50	B			4.00	Very weak to weak, low density, white, unstained CHALK. Fractures medium spaced, generally infilled with uncompact, white sandy silt-size comminuted chalk. Fractures with rare orange brown staining, some specks. (Medium density, Grade C2) (WHITE CHALK)	16.00
Trial pit complete at 4.00 m						

Remarks:

HSV = Hand Shovel Vane reading (kPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
A₁ = Amber Jar
PT = Plastic Tub
V = Void

Groundwater: No groundwater encountered during excavation.

Logged By: SC Checked By: CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559276E - 174507N Level: 35.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent	Dimensions: 	Scale 1:25	
Client: Jones Lang LaSalle	Trial Pit Stability : Stable	Plant Used: JCB	

Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
				0.25	Grass over dark brown slightly gravelly sandy CLAY. (MADE GROUND)	34.75
0.50	ES				Orange brown slightly clayey sandy subangular to rounded fine to coarse quartz and flint GRAVEL with some subangular to subrounded flint cobbles. (MADE GROUND)	
0.70	B					
1.00	ES			1.00	Trial pit complete at 1.00 m	34.00

Remarks:

HSV = Hand Shear Vane reading (kPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
AJ = Amber Jar
PT = Plastic Tub
V = Vial

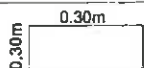
Groundwater: No groundwater encountered during excavation.

Logged By :

SC

Checked By :

CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559288E - 174471N Level: 35.00 m AOD	Date 07/09/2010
Location: Greenhilthe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
0.50 0.50	ES B			0.10	Grass over dark brown sandy CLAY. (MADE GROUND) Brown slightly cobbly very sandy subangular to subrounded fine to coarse flint and quartz GRAVEL with rare metal and brick. Cobbles are irregular flint. (MADE GROUND)	34.90
1.00	ES			1.00	Trial pit complete at 1.00 m	34.00

Remarks:

HSV = Hand Shear vane reading (kPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
AJ = Auger Jar
PT = Plastic Tub
V = Vial

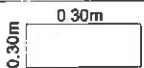
Groundwater: No groundwater encountered during excavation.

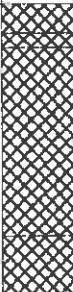
Logged By :

SC

Checked By :

CV

Project Name Knockhall Road	Project No. C10313	Co-ords: 559268E - 174432N Level: 35.00 m AOD	Date 07/09/2010
Location: Greenhithe, Kent		Dimensions: 	Scale 1:25
Client: Jones Lang LaSalle		Trial Pit Stability : Stable	Plant Used: JCB

Samples & In Situ Testing			Legend	Depth (m)	Stratum Description	Level (m AOD)
Depth (m)	Type	Results				
0.10				0.10	Grass over dark brown sandy CLAY. (MADE GROUND)	34.90
0.15				0.15	Concrete. (MADE GROUND)	34.85
0.50	ES				Brown very sandy subangular to rounded fine to coarse quartz and flint GRAVEL with brick. Occasional irregular flint cobbles. (MADE GROUND)	
0.50	B					
0.80				0.80	Orange brown slightly silty sandy subangular to rounded quartz and flint GRAVEL and COBBLES. (MADE GROUND)	34.20
0.90	ES					
1.00	B			1.00	Trial pit complete at 1.00 m	34.00

Remarks:

HSV = Hand Shovel vane reading (kPa)
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
AJ = Amber Jar
PT = Plastic Tub
V = Vial

Groundwater: No groundwater encountered during excavation

Logged By: SC Checked By: CV

Project Name:
Knockhall Road

Project No. :
C10313

Co-ords: 559298E - 174539N

Hole Type
Cable

Location: Greenhithe, Kent

Level: 35.00 m AOD

Scale
1:50

Client: Jones Lang LaSalle

Dates: 13/10/2010

Logged By
SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.10	34.90		Bituminous Material - Hard Standing. (MADE GROUND)	
		0.50	B					Dark brown very gravelly SAND with occasional angular to subangular flint cobbles and rare brick fragments. Gravel is angular to rounded flint and chalk. (MADE GROUND)	
		1.00	CPT	N=17 (4,6,5,4,4,4)	0.70	34.30		Stiff orange brown mottled dark orange brown and grey slightly gravelly sandy CLAY. Gravel is angular to rounded flint. (BOYN HILL GRAVEL)	1
		1.00-1.45	B						
		1.75	D		1.75	33.25		Orange brown mottled brown clayey gravelly SAND. Gravel is subangular to rounded flint. (BOYN HILL GRAVEL)	2
		2.00	CPT	N=39 (4,7,10,10,9,10)	2.00	33.00		Dense orange brown slightly silty very sandy subangular to rounded flint GRAVEL. (BOYN HILL GRAVEL)	
		2.00-2.45	B						
		2.75	D						
		3.00	CPT	N=25 (3,5,6,6,6,7)	3.00	32.00		Stiff orange brown occasionally grey very sandy CLAY with some subangular to rounded flint gravel. (BOYN HILL GRAVEL)	3
		3.00-3.45	B						
		3.75	D		3.60	31.40		Firm orange brown occasionally grey very sandy CLAY with occasional subangular to rounded flint gravel. (BOYN HILL GRAVEL)	4
		4.00-4.45	U						
		4.50	D		4.50	30.50		Firm orange brown very sandy CLAY with occasional pockets (3mm dia.) of black silty carbonaceous material. (BOYN HILL GRAVEL)	5
		4.75	D						
		5.00	SPT	N=29 (3,5,5,7,7,10)	5.00	30.00		Stiff orange brown mottled grey sandy CLAY with some to many pockets (3mm dia.) of black silty carbonaceous material and rounded fine gravel size ferruginous nodules. Occasional to some subrounded to rounded flint gravel and iron staining. (BOYN HILL GRAVEL)	6
		5.00-5.45	D						
		5.75	D						
		6.00-6.45	U						
		6.75	D		6.75	28.25		Firm orange brown mottled dark orange brown sandy gravelly CLAY with occasional black silty carbonaceous material. Gravel is subrounded to rounded flint and black flint. (BOYN HILL GRAVEL)	7
		7.00	SPT	N=13 (3,3,3,3,4,3)	7.00	28.00			
		7.00-7.45	D					Medium dense dark orange brown very gravelly SAND with some pockets (<60mm dia.) of firm orange brown sandy clay and subangular to subrounded flint cobbles. Gravel is subrounded to rounded flint. (BOYN HILL GRAVEL)	8
		7.75	D						
		8.00	SPT	N=11 (3,4,2,2,4,3)					
		8.00-8.45	D						
		8.75	D						
		9.00	SPT	N=17 (5,6,4,3,4,6)					
		9.00-9.45	D		9.40	25.60		Structureless CHALK composed of yellow occasionally white sandy SILT with many black specks. (Grade Dm) (WHITE CHALK)	
		9.55	SPT	N=14 (2,3,3,3,3,5)					
		9.55-10.00	D		9.90	25.10			

Continued next sheet

Remarks: 1) No groundwater encountered during drilling;
2) No installation

In-situ Testing	Sample Types
SPT - Standard Penetration Test (Split Barrel)	D - Disturbed Sample
CPT - Standard Penetration Test (Cone)	LB - Large Bulk Sample
HSV - Hand Shovel Value	B - Bulk Sample
U - Undisturbed Sample and number of blows	AJ - Another Jar Sample
Borehole Types	W - Water Sample
DP - Dynamic Sampling	V - Vial
Cable - Cable Percussion	SPTL - SPT Sample
Roller - Roller Core	
RO - Rotary Corehole	

Project Name: Knockhall Road	Project No. : C10313	Co-ords: 559298E - 174539N	Hole Type Cable
Location: Greenhithe, Kent		Level: 35.00 m AOD	Scale 1:50
Client: Jones Lang LaSalle		Dates: 13/10/2010	Logged By SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.00	SPT	N=17 (3,3,4,4,5,4)	10.45	24.55		Structureless CHALK composed of white slightly gravelly sandy SILT. Gravel is extremely weak, low-density, white with occasional black specks and subangular to subrounded. (Grade Dm) (WHITE CHALK)	
		10.00-10.45	D					End of Borehole at 10.45 m	
									11
									12
									13
									14
									15
									16
									17
									18
									19

Remarks: 1) No groundwater encountered during drilling.
2) No installation.

In-situ Testing SP-1 Standard Penetration Test (Split Spoon) CP-1 Standard Penetration Test (Solid Cone) HSV Hand Shear Vane U Undisturbed Sample and number of blows Borehole Types DP Dynamic Sampling Cable Cable Percussion Rotary Rotary Core RC Rotary Core/Tube	Sample Types D Disturbed Sample LB Large Bulk Sample B Bulk Sample AJ Amber Jar Sample W Water Sample V Vial SPT/S SPT Sample
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Project Name:
Knockhall Road

Project No. :
C10313

Co-ords: 559374E - 174409N

Hole Type
Cable

Location: Greenhithe, Kent

Level: 20.00 m AOD

Scale
1:50

Client: Jones Lang LaSalle

Dates: 11/10/2010

Logged By
SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES					Grass over dark brown SAND. (MADE GROUND)	
		0.50	B						
					0.80	19.20		Dark brown slightly silty SAND with occasional roots. (MADE GROUND)	1
		1.00-1.45	U						
					1.50	18.50		Orange brown silty SAND with some subangular to rounded flint gravel. (MADE GROUND)	2
		1.50-2.00	B						
		2.00-2.45	U						
					2.75	17.25		Brown very silty SAND with rare subrounded flint gravel. (MADE GROUND)	3
		2.75	D						
		3.00-3.45	U						
					3.75				4
		3.75	D						
		4.00-4.45	U						
					4.75	15.25		Soft to firm dark brown slightly gravelly very sandy SILT. Gravel is subangular to rounded flint. (PROBABLE MADE GROUND)	5
		4.75	D						
		5.00	CPT	N=19 (2,3,5,4,5,5)	5.00	15.00		Stiff dark brown slightly gravelly very sandy SILT with some pockets (<40mm dia.) of soft white slightly gravelly sandy silt size communited chalk. Gravel is subrounded to rounded flint and chalk. (PROBABLE MADE GROUND)	6
		5.00-5.45	B						
					5.80	14.20		Structureless CHALK composed of light brown slightly gravelly sandy SILT. Gravel is extremely weak, low-density, white and subangular to subrounded. Some flint.(Grade Dm) (WHITE CHALK)	7
		5.75	D						
		6.00	SPT	N=6 (1,1,1,1,1,3)				Structureless CHALK composed of slightly sandy very silty, subrounded to rounded GRAVEL. Clasts are extremely weak, low density, white with some black specks. Matrix is light brown.(Grade Dc) (WHITE CHALK)	8
		6.00-6.45	D		6.40	13.60			
					7.75	12.25		Structureless CHALK composed of light brown slightly gravelly sandy SILT. Gravel is extremely weak, low-density, white and subangular to subrounded. Rare flint.(Grade Dm) (WHITE CHALK)	9
		6.75	D						
		7.00-7.45	U						
					8.00	12.00		Structureless CHALK composed of slightly sandy very silty, subrounded to rounded GRAVEL. Clasts are extremely weak, low density, white with some pink staining and black specks. Matrix is light brown.(Grade Dc) (WHITE CHALK)	
		7.75	D						
		8.00	SPT	N=6 (1,1,2,2,1,1)	8.00	12.00			
		8.00-8.45	D						
					9.45	10.55		End of Borehole at 9.45 m	
		9.00	SPT	N=6 (1,1,2,2,1,1)					
		9.00-9.45	D						

Remarks 1) No groundwater encountered during drilling.
2) Installation details - plain pipe between G.L. and 6.0mbgl. slotted pipe with filter sock between 6.0mbgl and 9.0mbgl Bentonite seal between G.L. and 6.0mbgl.

In-situ Testing
SPT - Standard Penetration Test (Split Sectors)
CPT - Standard Penetration Test (Solid Cone)
HSV - Hard Shove Vane
U - Undisturbed Sample and number of blows
Borehole Types
DP - Dynamic Sampling
Cable - Cable Percussion
Rotary - Rotary Core
R/C - Rotary Openhole

Sample Types
O - (Disturbed) Sample
LB - Large Bulk Sample
B - Bulk Sample
AJ - Amber Jar Sample
W - Water Sample
V - Vial
SPT/S - SPT Sample

Project Name:
Knockhall Road

Project No. :
C10313

Co-ords: 559385E - 174445N

Location: Greenhithe, Kent

Level: 20.00 m AOD

Scale
1:50

Client: Jones Lang LaSalle

Dates: 11/10/2010-12/10/2010

Logged By
SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES	N=28 (4,5,5,7,8,8)	0.40	19.60		Grass over dark brown SAND. (MADE GROUND)	1
		0.50	B					Friable brown slightly silty slightly gravelly SAND with some pockets (<60mm dia.) of orange brown very sandy clay. Gravel is subangular to rounded flint and chalk. (MADE GROUND)	
		1.00	CPT		1.00	19.00		Stiff slightly friable dark orange brown very sandy CLAY with some subangular to rounded flint gravel. (PROBABLE MADE GROUND)	
		1.00-1.45	B	N=10 (2,2,1,2,4,3)	1.60	18.40		Firm dark orange brown very sandy CLAY with occasional subangular to rounded flint gravel. (PROBABLE MADE GROUND)	2
		1.75	D						
		2.00-2.45	U						
		2.75	D						
		3.00	CPT						
		3.00-3.45	D	N=12 (2,2,2,3,3,4)				Very soft to soft dark orange brown very sandy CLAY with many pockets (<100mm dia.) of soft white slightly gravelly sandy silt size comminuted chalk. Some subangular to rounded flint gravel. (PROBABLE MADE GROUND)	5
		3.75	D		4.75	15.25			
		4.00-4.45	U						
		4.75	D						
		5.00-5.45	U						
		5.75	D	N=17 (3,4,4,4,5,4)	5.75	14.25		Structureless CHALK composed of cream slightly gravelly sandy SILT. Gravel is extremely weak, low density, white with some black specks and occasional yellow staining and subangular to subrounded. Some flint gravel.(Grade Dm) (WHITE CHALK)	6
		6.00	SPT		6.20	13.80			
		6.00-6.45	D						
		6.75	D						
		7.00-7.45	U						
		7.75	D	N=17 (3,4,4,4,5,4)	8.00	12.00		Structureless CHALK composed of sandy silty subangular to subrounded GRAVEL. Clasts are extremely weak, low density, white with some cream staining and black specks. Matrix is white.(Grade Dc) (WHITE CHALK)	8
		8.00	SPT		8.45	11.55			
		8.00-8.45	D						
								End of Borehole at 8.45 m	9

Remarks 1) No groundwater encountered during drilling;
2) No installation

In-situ Testing
SPT Standard Penetration Test (Split Spoon)
CPT Standard Penetration Test (Solid Cone)
HSV Hand Shovel Value
U Undisturbed Sample and number of blows
Borehole Types
DP Dynamic Sampling
Cable Cable Percussion
Rotary Rotary Core
RC Rotary Core

Sample Types
D Disturbed Sample
LB Large Bulk Sample
B Bulk Sample
AJ Anchor Jar Sample
W Water Sample
V Vial
SPT SPT Sample

Project Name:

Knockhall Road

Project No. :

C10313

Co-ords: 559399E - 174469N

Hole Type

Cable

Location: Greenhithe, Kent

Level: 20.00 m AOD

Scale

1:50

Client: Jones Lang LaSalle

Dates: 12/10/2010

Logged By

SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES					Grass over dark brown slightly silty SAND. (MADE GROUND)	
		0.50	B		0.40	19.60		Soft to firm orange brown slightly gravelly sandy CLAY. Gravel is subrounded to rounded flint. (PROBABLE MADE GROUND)	
		1.00	CPT	N=22 (6,6,7,5,6,4)	1.00	19.00		Medium dense orange brown mottled brown slightly silty gravelly SAND. Gravel is angular to rounded flint. (PROBABLE MADE GROUND)	1
		1.00-1.45	B						
		1.75	D		1.75	18.25		Firm dark orange brown occasionally brown sandy CLAY with some angular to rounded flint gravel and brick fragments. (PROBABLE MADE GROUND)	2
		2.00	CPT	N=14 (5,4,4,3,4,3)	2.00	18.00		Firm orange brown very sandy CLAY with occasional subangular to rounded flint gravel. (PROBABLE MADE GROUND)	
		2.00-2.45	B						
		2.75	D		2.75	17.25		Very soft to soft orange brown very sandy CLAY with much iron staining. (PROBABLE MADE GROUND)	3
		3.00-3.45	U						
		3.75	D		3.75	16.25		Very soft dark orange brown very sandy CLAY. (PROBABLE MADE GROUND)	4
		4.00-4.45	U						
		4.75	D		4.75	15.25		Firm orange brown slightly gravelly sandy CLAY. Gravel is subangular to rounded flint. (PROBABLE MADE GROUND)	5
		5.00	CPT	N=10 (3,2,3,2,2,3)	5.00	15.00		Firm orange brown slightly gravelly sandy CLAY with abundant pockets (<90mm dia.) of soft white slightly gravelly sandy silt size comminuted chalk. Gravel is subangular to rounded flint and chalk. (PROBABLE MADE GROUND)	
		5.00-5.45	B						
		5.75	D		6.00	14.00		Structureless CHALK composed of cream mottled light brown slightly gravelly sandy SILT. Gravel is extremely weak, low density, white with some cream and yellow staining and black specks, subangular to subrounded. (Grade Dm) (WHITE CHALK)	6
		6.00	SPT	N=11 (2,2,3,2,3,3)	6.00	14.00			
		6.00-6.45	D						
		6.75	D		7.00	12.25		Structureless CHALK composed of white slightly gravelly sandy SILT. Gravel is extremely weak, low density, white and clean, subrounded. Some rounded flints. (Grade Dm) (WHITE CHALK)	8
		7.00-7.45	U						
		7.75	D		7.75	12.25			
		8.00	SPT	N=16 (2,3,3,4,4,5)	8.00	12.00			
		8.00-8.45	D		8.45	11.55		Structureless CHALK composed of silty sandy subangular to subrounded GRAVEL. Clasts are extremely weak, low density, white with some cream and yellow staining and black specks. Matrix is white with some iron staining and occasionally light brown. (Grade Dc) (WHITE CHALK)	9
								End of Borehole at 8.45 m	

Remarks: 1) No groundwater encountered during drilling.
2) Installation details:- plain pipe between G.L. and 1.0mbgl, slotted pipe with filter sock between 1.0mbgl and 5.0mbgl Bentonite Seal between G.L. and 1.0mbgl, 5.0mbgl and 8.45mbgl

In-Situ Testing

SPT Standard Penetration Test (Split Spoon)
CPT Standard Penetration Test (Split Cone)
HSV Hand Shear Vane
U Undisturbed Sample and number of blows

Borehole Types

OP Open Sampling
Cable Cable Permeation
Rdery Rdery Code
RD Rdery Code

Sample Types

D Disturbed Sample
LB Large Bulk Sample
B Bulk Sample
AJ Amber Jar Sample
W Water Sample
V Vial
SPTLS SPT Sample

[illegible]

Sample Types	
D	Disturbed Sample
LB	Large Bulk Sample
B	Bulk Sample
AJ	Amber Jar Sample
W	Water Sample
V	Vial
SPTLS	SPT Sample

Project Name:

Knockhall Road

Project No. :

C10313

Co-ords: 559333E - 174440N

Location: Greenhithe, Kent

Level: 26.00 m AOD

Client: Jones Lang LaSalle

Dates: 11/10/2010

Logged By

SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratium Description	
		Depth (m)	Type	Results					
		0.20	ES		0.35	25.65		Dark brown gravelly SAND with many roots. Gravel is angular to subrounded flint. (POSSIBLE MADE GROUND)	
		0.40-1.00	D					Medium dense friable orange brown slightly silty gravelly SAND with occasional roots. Gravel is subangular to rounded black flint and flint. (POSSIBLE MADE GROUND)	1
		1.00	SPT	N=20 (6,5,4,4,6,6)					
		1.00-1.45	SPT						
		1.00-1.70	D						
		1.70-2.00	D		1.75	24.25		Very stiff slightly friable orange brown very sandy CLAY with some subrounded to rounded black flint and flint gravel. (POSSIBLE MADE GROUND)	2
		2.00	SPT	N=34 (6,8,9,10,9,6)	2.10	23.90			
		2.00-2.45	SPT						
		2.10-2.50	D						
		3.00	SPT	N=14 (3,2,2,2,2,8)	2.60	23.40		Structureless CHALK composed of light brown, slightly gravelly sandy SILT. Gravel is extremely weak, low density, white, clean and subrounded. (Grade Dm) (WHITE CHALK)	3
		2.50-3.50	D						
		3.00-3.45	SPT						
		3.60-4.00	D		3.60	22.40		Structureless CHALK composed of slightly sandy silty, subangular to subrounded GRAVEL. Clasts are extremely weak to very weak, low density, white with some black specks and subrounded. Rare flint cobbles. Matrix is white. (Grade Dc) (WHITE CHALK)	4
		4.00	SPT	N=9 (2,2,2,2,2,3)					
		4.00-4.45	SPT		4.45	21.55		Very weak, low density, white with some cream bands and black specks CHALK. Fractures are very closely spaced, infilled with white comminuted chalk, with some rinded flint gravel and cobbles. (Grade C4) (WHITE CHALK)	5
End of Borehole at 4.45 m									6
									7
									8
									9

Remarks: 1) No groundwater encountered during excavation.
2) Installation details:- Plain pipe between G.L. and 1.0mbgl, slotted pipe with filter sock between 1.0mbgl and 4.0mbgl Bentonite seal between G.L. and 1.0mbgl.

In-situ Testing

SPT - Standard Penetration Test (Split Spoon)
CPT - Standard Penetration Test (Solid Cone)
HSV - Hand Shear Vane
U - Undisturbed Sample and number of blows

Borehole Types

DP - Dynamic Sampling
Cable - Cable Percussion
Rotary - Rotary Core
RM - Rotary Core

Sample Types

D - Undisturbed Sample
LB - Large Bulk Sample
B - Bulk Sample
AJ - Air Jet Sample
W - Water Sample
V - Vial
SPTLS - SPT Sample

Project Name:

Knockhall Road

Project No. :

C10313

Co-ords: 559318E - 174444N

Hole Type

WS

Location: Greenhithe, Kent

Level: 27.00 m AOD

Scale

1:50

Client: Jones Lang LaSalle

Dates: 11/10/2010

Logged By

SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description					
		Depth (m)	Type	Results									
		0.20	ES	N=19 (4,5,5,4,5,5)	0.30	26.70		Dark brown gravelly SAND. Gravel is subrounded to rounded flint. (POSSIBLE MADE GROUND)	1				
		0.30-0.50	D		0.50	26.50		Friable dark orange brown very sandy subangular to rounded flint GRAVEL. (POSSIBLE MADE GROUND)					
		0.50-1.00	D					Medium dense orange brown slightly silty gravelly SAND. Gravel is subrounded flint. (POSSIBLE MADE GROUND)					
		1.00	SPT					Orange brown slightly silty slightly sandy subrounded flint GRAVEL. (POSSIBLE MADE GROUND)					
		1.00-1.45	SPT					Friable orange brown slightly silty SAND. (POSSIBLE MADE GROUND)					
		1.00-1.50	D	N=45 (3,4,5,7,18,15)	1.60	25.40				Very stiff friable orange brown very sandy CLAY with occasional subrounded to rounded flint gravel. (POSSIBLE MADE GROUND)	3		
		2.00	SPT		1.80	25.20				Structureless CHALK composed of light brown, slightly gravelly sandy SILT. Gravel is extremely weak, low density, white, clean and subangular to subrounded. Some rounded flint gravel and cobbles.(Grade Dm) (WHITE CHALK)			
		1.90-2.10	D		1.90	25.10				End of Borehole at 2.95 m			
		2.00-2.45	SPT		2.15	24.85							
		2.20-2.40	D										
		2.50	SPT	52/150mm - Abandoned	2.95	24.05							
												4	
									5				
									6				
									7				
									8				
									9				

Remarks: 1) No groundwater encountered during excavation;
2) No installation

In-situ Testing

SPT: Standard Penetration Test (Split Cone)
CPT: Standard Penetration Test (Solid Cone)
HSV: Hand Shear Vane
U: Undisturbed Sample and number of blows

Borehole Types

DP: Dynamic Sampling
Cable: Cable Percussion
Rotary: Rotary Core
RO: Rotary Drilling

Sample Types

D: Disturbed Sample
LB: Large Bulk Sample
B: Bulk Sample
AJ: Ambient Jet Sample
W: Water Sample
V: Vial
SPTLS: SPT Sample

Project Name:

Knockhall Road

Project No. :

C10313

Co-ords: 559300E - 174410N

Hole Type

WS

Location: Greenhithe, Kent

Level: 34.00 m AOD

Scale

1:50

Client: Jones Lang LaSalle

Dates: 11/10/2010

Logged By

SC

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.25	33.75		Dark brown slightly silty SAND with many roots. (POSSIBLE MADE GROUND)	
		0.25-0.40	D		0.40	33.60			
		0.40-0.80	D		0.80	33.20		Very stiff friable orange brown mottled brown very gravelly CLAY with some roots and occasional subangular flint cobbles. Gravel is subangular to rounded. (POSSIBLE MADE GROUND)	1
		0.80-1.10	D		1.10	32.90		Orange brown slightly clayey slightly sandy subangular to rounded flint and sandstone GRAVEL. (POSSIBLE MADE GROUND)	
		1.00	SPT	N=29 (9,8,9,7,6,7)	1.10	32.90			
		1.00-1.45	SPT		1.40	32.60			
		1.10-1.40	D		1.40	32.60			
		1.40-1.80	D		1.80	32.20		Very stiff friable orange brown very sandy CLAY with some thin laminations of light orange brown medium to coarse sand. (POSSIBLE MADE GROUND)	2
		1.80-1.95	D		1.95	32.05			
		2.00	SPT	N=19 (4,5,5,4,5,5)	1.95	32.05			
		2.00-2.45	SPT		2.60	31.40		Medium dense orange brown slightly clayey sandy subrounded to rounded flint GRAVEL. (POSSIBLE MADE GROUND)	
		2.00-2.60	D		2.60	31.40			
		2.60-2.90	D		2.90	31.10		Friable orange brown very clayey SAND with some subangular to rounded flint gravel. (POSSIBLE MADE GROUND)	3
		2.90-3.20	D		2.90	31.10			
		3.00-3.45	SPT		3.50			Orange brown very sandy subrounded to rounded flint GRAVEL with occasional pockets (<80mm dia.) of light orange brown slightly sandy gravelly clay. (POSSIBLE MADE GROUND)	
		3.50	SPT	N=15 (4,3,3,4,4,4)	3.50				
					3.95	30.05		Stiff friable green grey mottled green brown very sandy SILT. (POSSIBLE MADE GROUND)	4
								Very stiff friable green slightly gravelly sandy SILT. Gravel is subrounded flint. (POSSIBLE MADE GROUND)	
								Stiff to very stiff orange brown very sandy CLAY with many pockets (<80mm dia.) of firm to stiff brown clay containing abundant pockets (<3mm dia.) of black silty carbonaceous material. (POSSIBLE MADE GROUND)	5
								End of Borehole at 3.95 m	

Remarks: 1) No groundwater encountered during excavation;
2) Installation details:- Plain pipe between G.L. and 1.0mbgl, slotted pipe with filter sock between 1.0mbgl and 3.0mbgl. Bentonite seal between G.L. and 1.0mbgl

In-situ Testing

SPT Standard Penetration Test (SPT) Splice
CPT Standard Penetration Test (CPT) Cone
HSV Hand Shear Vane
U Undisturbed Sample and number of blows

Borehole Types

DT Dynamic Sampling
Cable Cable Percussion
Rotary Rotary Core
RD Rotary Drilling

Sample Types

U Undisturbed Sample
LB Large Bulk Sample
R Bulk Sample
AU Another Jar Sample
W Water Sample
V Vial
SPTLS SPT Sample



Figure 11: TP01 Excavation



Figure 12: TP01 Spoil



Figure 13: TP02 Excavation



Figure 14: TP02 Spoil



Figure 15: TP06 Excavation



Figure 16: TP06 Spoil



Figure 17: TP07 Excavation



Figure 18: TP07 Spoil

Appendix F

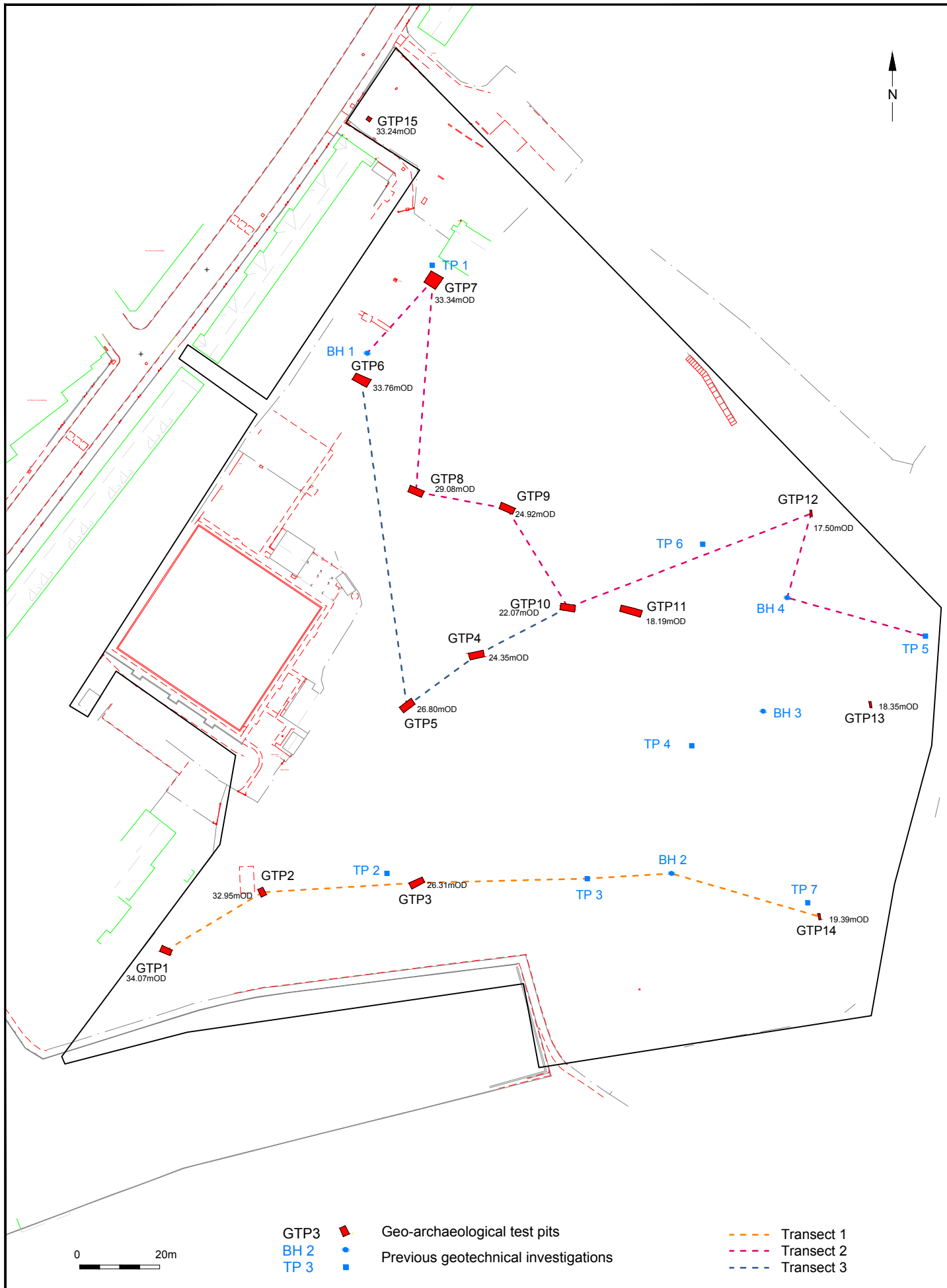
GEOTECHNICAL TEST RESULTS & ASSESSMENTS

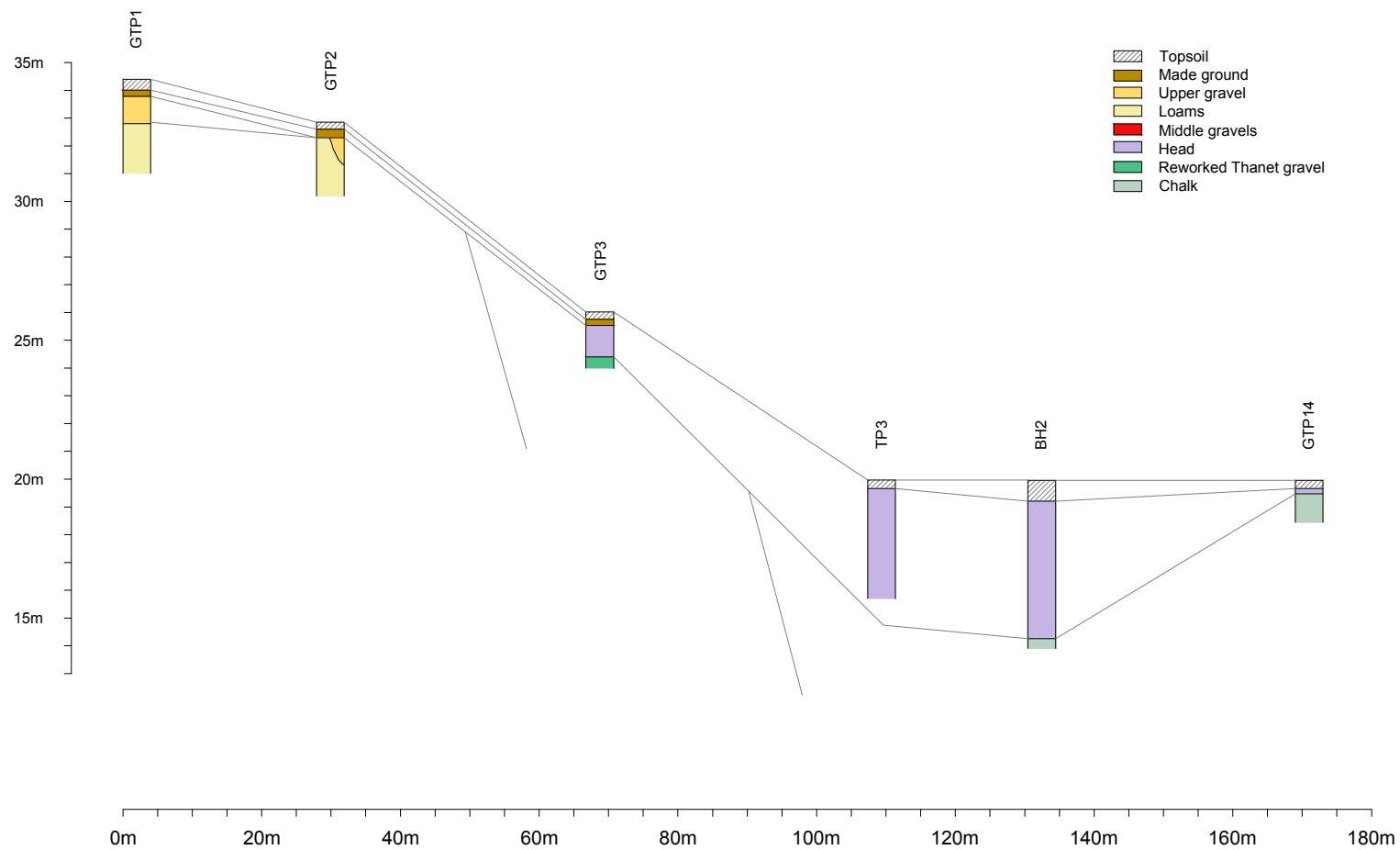
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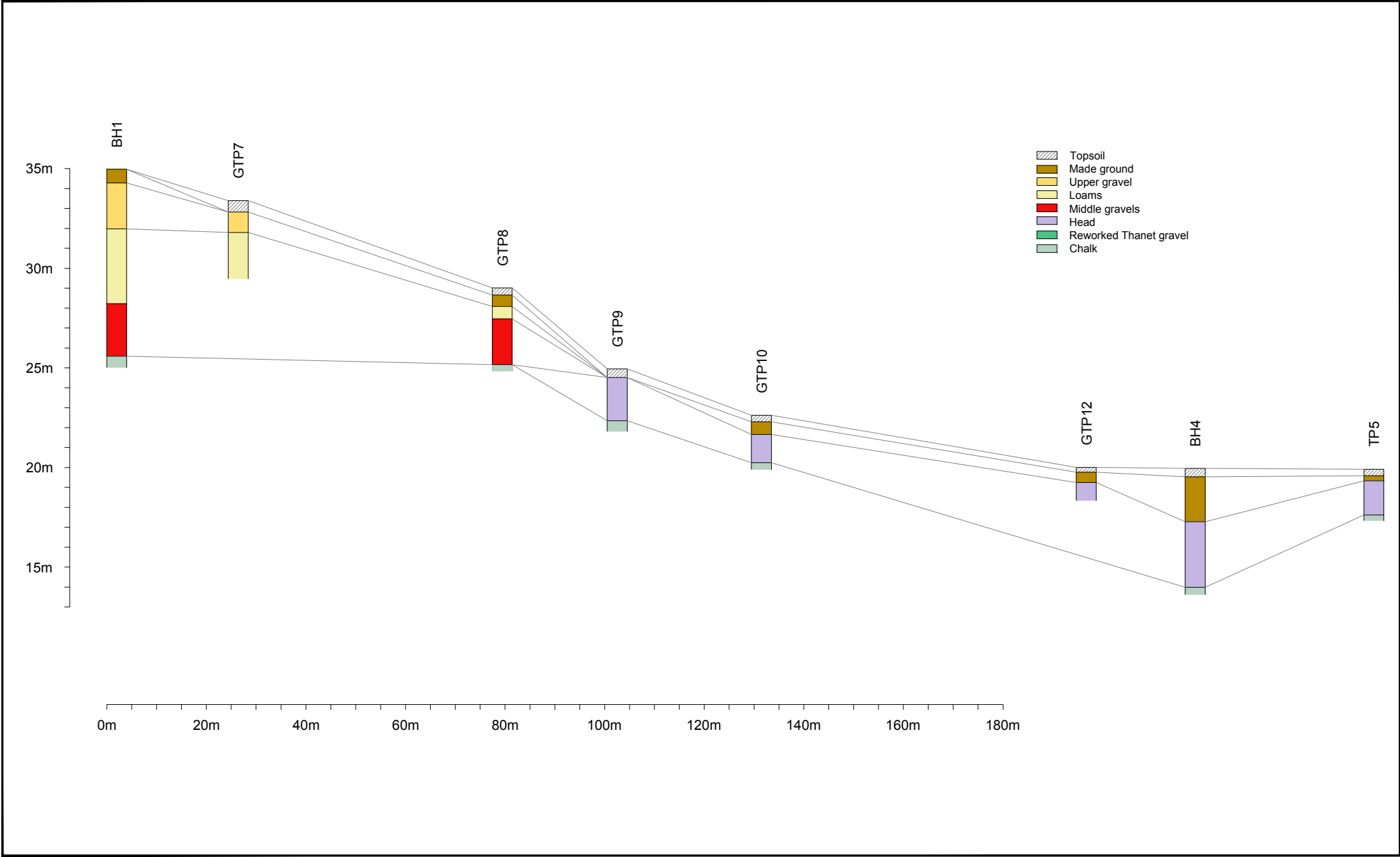
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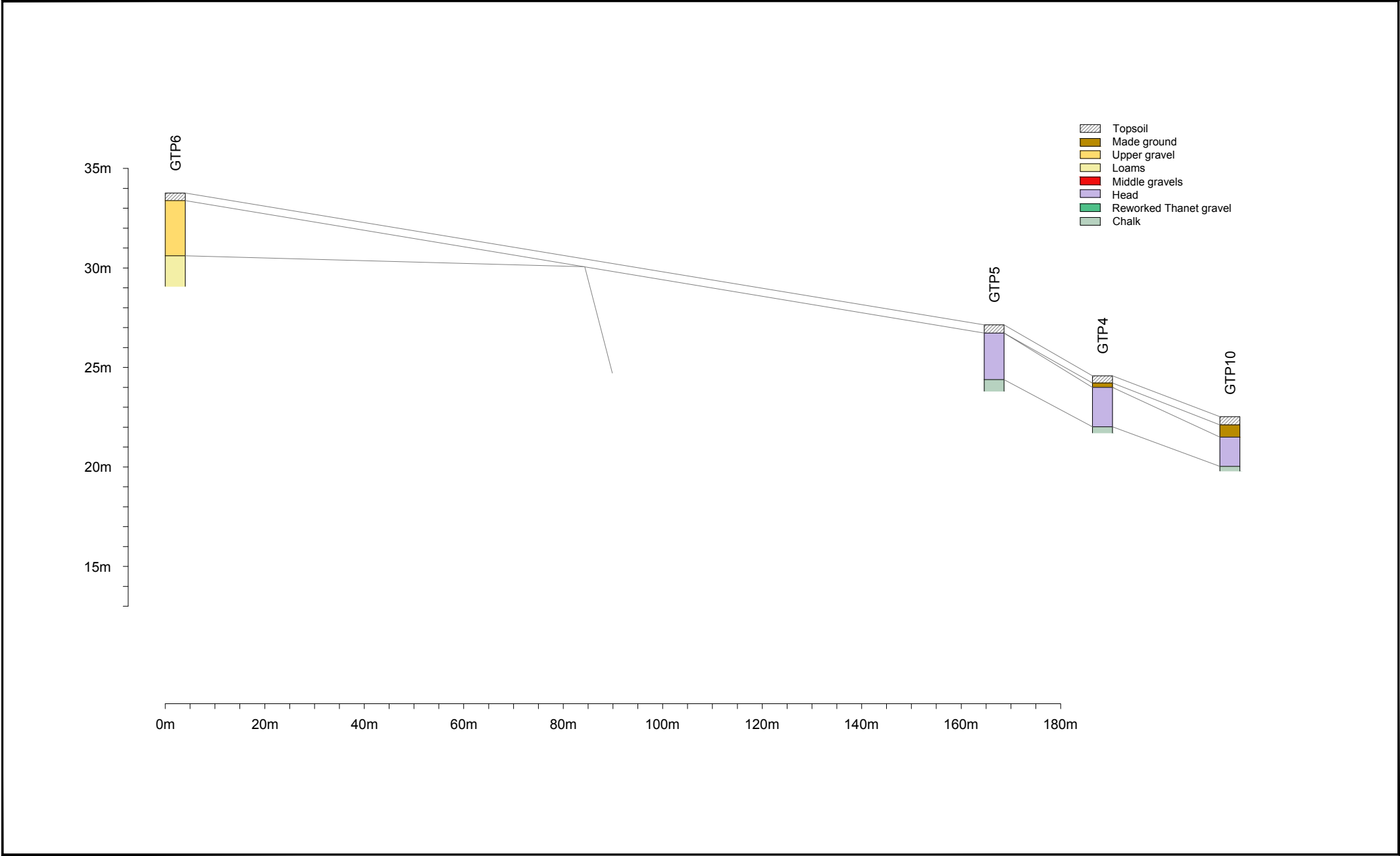


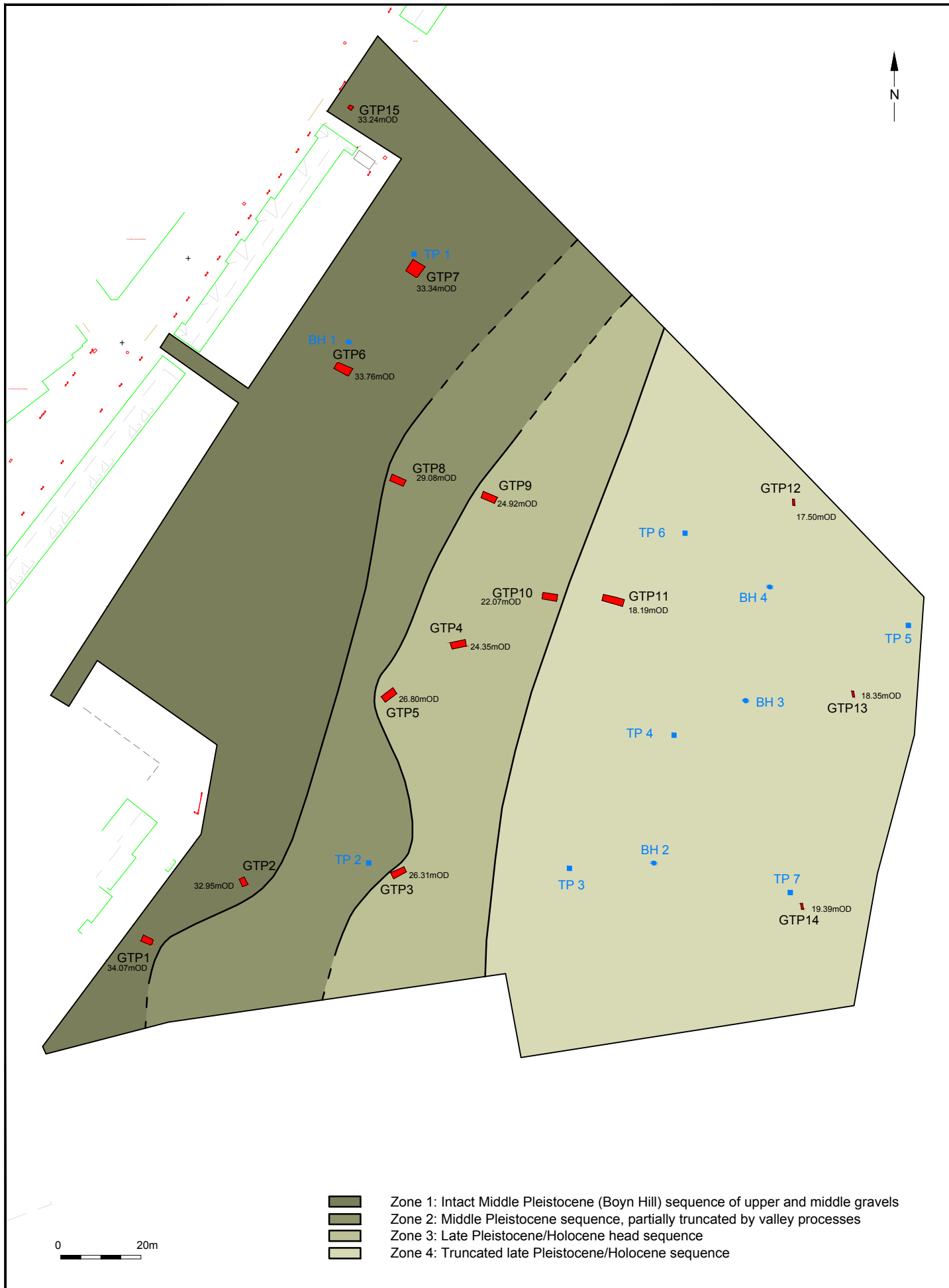
© Archaeology South-East		Former Empire Sports Ground, Greenhithe	Fig. 1
Project Ref: 5197	Jan 2012	Site location	
Report Ref: 2012083	Drawn by: JLR		



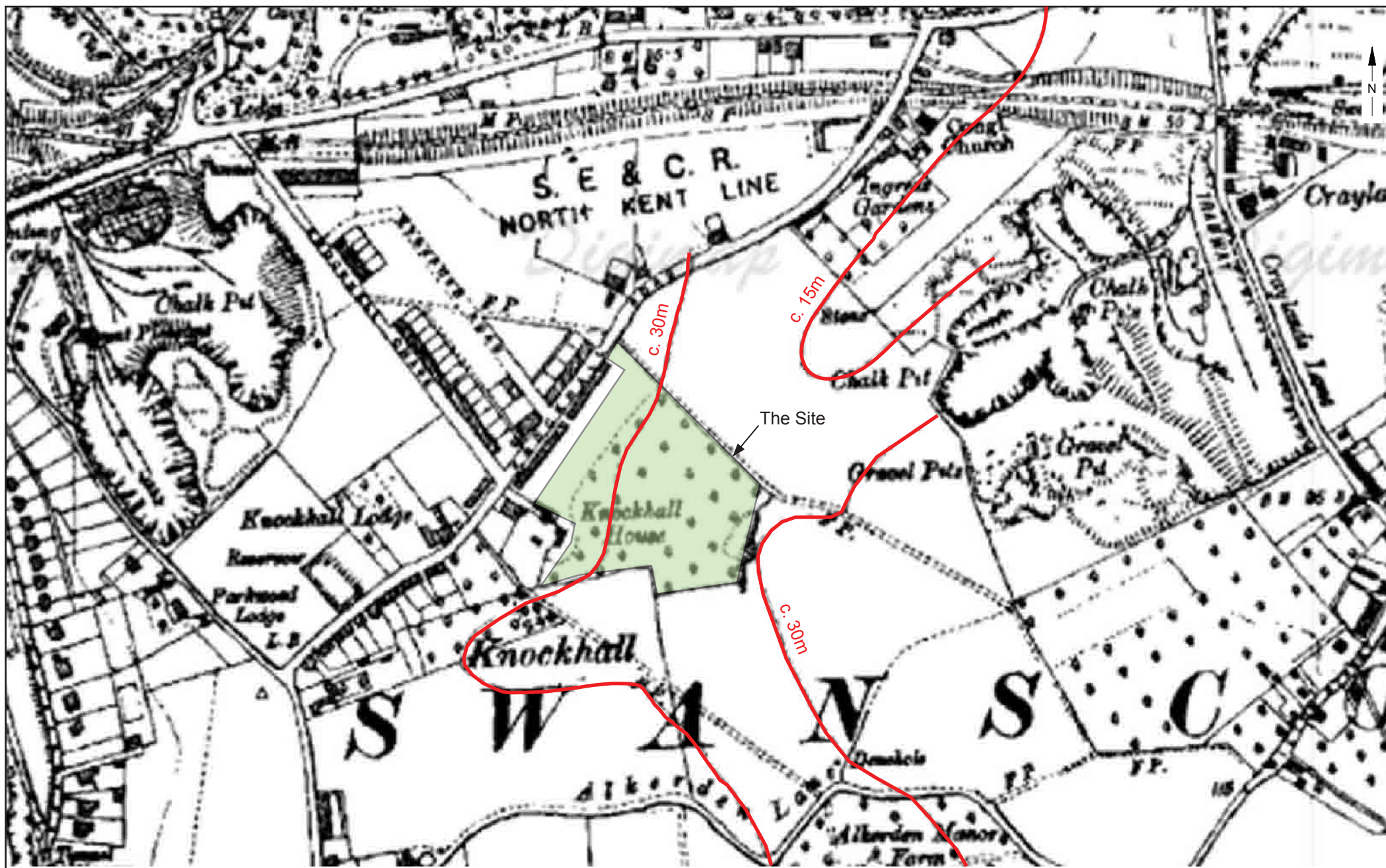








© Archaeology South-East		Former Empire Sports Ground, Greenhithe	Fig. 6
Project Ref: 5197	Jan 2012	Provisional geological zones	
Report Ref: 2012083	Drawn by: JLR		



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Project Ref: 5197
Report Ref: 2012083

Jan 2012
Drawn by: JLR

Former Empire Sports Ground, Greenhithe

OS 6" 1920 showing 50 and 100 ft contours

Fig. 7



GTP1



GTP2



GTP3



GTP4



GTP5



GTP6



GTP7



GTP8



GTP9



GTP10



GTP11

© Archaeology South-East		Former Empire Sports Ground, Greenhithe	Fig. 9
Project Ref: 5197	March 2012	Photographs	
Report Ref: 2012083	Drawn by: JLR		



GTP12



GTP13



GTP14

© Archaeology South-East		Former Empire Sports Ground, Greenhithe	Fig. 10
Project Ref: 5197	March 2012	Photographs	
Report Ref: 2012083	Drawn by: JLR		

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