Archaeology South-East

ASE

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

NGR TQ 593 744

ASE Project No. 5197
Site Code: KRG11
Report Ref: 2012083

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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 process in order 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. Fifteen geoarchaeological test pits were excavated and assessed for stratigraphy, the presence of artefacts/ecofacts and sampled for palaeoenvironmental evidence.

The investigation determined that deposits of direct equivalence to those of the Middle Pleistocene Boyn Hill terrace recorded at Barnfield Pit, are present across 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 finding 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 were identified, a possible buried soil as part of the Late Pleistocene-Early Holocene sequence determined and feasibility of Amino Acid dating (for the Mid-Pleistocene) and OSL dating (for the Late Pleistocene/Holocene) established. These aspects should be pursued and built upon 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. The site preserves deposits of national importance but these include deposits which are poorly understood and under researched (Upper gravels and Upper Loams). In moving forward a balance must be struck between the degree of impact, heritage management and the academic benefits of further study of this locale.

CONTENTS

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 3) 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 comprise 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 Due to the sites' archaeological potential and a need to clarify the nature of geological deposits described in the preceding geotechnical report (CgMs 2011, Appendix 3) the geo-archaeological works were carried out pre-planning submission in order to inform any planning decision relating to the site. The programme of geo-archaeological evaluation required to meet this need was developed between ASE's 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). The overall objective of the project was to progress the determination of a planning application so that assessment of impact of development could eventually be assessed. This was to be achieved through the following key aims:

- 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 3) 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 914; 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 been 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 (Trongontherium) and the shell deposits contained a Rheinish 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. Further historic maps taken from the CgMs DBA are presented in Appendix 2.

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 veterbrate 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 to prepare the site, 11 geoarchaeological test pits (GTP's 1-11) were mechanically excavated across the area of proposed development under direct supervision. These 11 test pits were arranged to provide three transects of investigation across the site (Figure 2). The test pits were excavated to a maximum depth of 4m and 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.

3.7 Each unique deposit was given an identifying designation. This designation comprised a suffix indicating test pit number and a suffix indicating the sequential order of deposition with each test pit. Hence deposit number ¾ would be the fourth deposit within test pit 3.

3.8 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. Fluvial and fine-grained deposits were sampled (40 litres) and kept for off-site sieving/floatation and subsampled for vertebrate and invertebrate microfauna and palynological analysis.

3.9 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

4.1 Stratigraphic Observations (Appendix 1, Figures 2-5)

4.1.1 The detailed observations made from each test pit are shown in Appendix 1. These observations comprise both objective descriptions of sediment characteristics (**Lithology**) and initial interpretations of these sediments in terms stratigraphic correlation with the Barnfied Pit sequence (**Stratigraphy**).

4.1.2 The main stratigraphic units identified are shown in Table 1, alongside a list of contexts identified for each main unit. They are also presented in the correlated cross sections (Figures 2-5)

Stratigraphic Unit	**Identified Contexts** (Test Pit# / Deposit#)
Topsoil	1/1 2/1 3/1 4/1 5/1 6/1 7/1 8/1 9/1 10/1 11/1 12/1 13/1 14/1 15/1
Made Ground	1/2 2/2 3/2 4/2 5/2 6/2 7/2 8/2 9/2 10/2 11/2 12/2 13/2 14/2 15/2
Head	3/3 3/4 3/5 3/6 4/3 4/4 4/5 4/6 4/7 5/2 5/3 5/4 5/5 5/6 5/7 9/3 9/4 9/5 9/6 10/3 10/4 10/5 10/6 11/3 11/4 12/3 14/2 13/3
Upper Gravels	1/3 1/4 2/3 6/3 6/4 6/5 7/3 7/4 15/3
Upper Loams	1/5 1/6 2/4 6/6 6/7 6/8 7/5 7/6 7/7 8/3
Middle Gravels	8/4 8/5 8/6
Solid	3/8 4/8 5/8 5/9 8/7 9/7 14/3 13/4 10/7

Table 1: Identified Stratigraphic units and correlated deposits.

4.2 Distribution of Sediments. (Appendix 1, Appendix 3, Figures 2-5)

4.2.1 The geoarchaeological assessment has allowed deposits to be mapped and correlated across the site to a useful but still relatively coarse degree. The fieldwork has also allowed reconsideration of the earlier geotechnical results (presented in Appendix 3). Taken together it is possible to make the following statements about the distribution across the site of the stratigraphic units presented in Table 1:

4.2.2 At the western margins of the site (GTP 1, 2, 6, 7, 8 & BH 1) Topsoil and Made Ground provide between 0.6 and 1.1m of cover. These modern deposits immediately overly the Upper Gravels which vary between 1 and 3m in surviving thickness. These are replaced downwards by dense clay/silt units (sometimes with blocky structure) of the Upper Loam (presented in GTPs 1, 2, 6, 7 and 8 & 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.

4.2.2 In the central parts of the site Head deposits comprising sands, clay/silts and

gravels (in places chalky) immediately underlie topsoil and made ground. They appear to generally 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

4.2.3 Across the levelled, lower eastern part of the site a similar series of stratified Head deposits comprising sands, gravels and clay/silts occur. Within this area Chalk was reached in GTPs 11-1 as well as geotechnical test pits 4, 5 and BH 2 and 4. Observations made in section in the Craylands Gorge suggest the underlying chalk bedrock surface is locally undulating in profile due to the effects of solution.

4.2.4 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 TP2 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 these deposits actually comprised stratified Pleistocene sediments.

4.2.5 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 northwest of the site, truncated by later erosion relating to valley incision and emplacement of Head Deposits of Late Pleistocene and Holocene age.

4.3 Palaeoenvironmental Analysis Overview

4.3.1 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.

4.3.2 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).

4.3.3 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).

4.3.4 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 sample.

Sample Designation (Test Pit#/Context#)	**Sample Volume** (litres)	**Volume floated/subsampled** (litres)
7/5	40	10 subsampled 30 floated.
7/6	40	40
7/7	40	40
7/8	40	40
7/9	40	40
6/4	40	40
6/5	40	40
6/6	40	10 subsampled 30 floated.
6/7	40	10 subsampled 30 floated.
6/8	40	40
1/3	40	40
1/4	40	40
1/5	40	10 subsampled 30 floated.
3/3	40	40
3/4	40	40
3/5	40	40
3/6	40	40
8/3	40	40
8/4	40	40
8/5 (top of unit)	40	40
8/5 (base of unit)	40	10 subsampled 30 floated.
9/3	40	10 subsampled 30 floated.
9/4	40	10 subsampled 30 floated.
9/5	40	10 subsampled 30 floated.
9/6	40	10 subsampled 30 floated.
9/7	40	40
2/4	40	10 subsampled 30 floated.
5/4	40	40
5/6	40	40
4/4	40	40
4/6	40	10 subsampled 30 floated.
11/4	<1	Subsampled in entirety

Table 2: Palaeoenvironmental Sampling

4.4 Flotation

4.4.1 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 4). 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).

4.4.2 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.

4.4.3 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].

4.4.4 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.

4.5 Microfossil Assessment by Dr John Whittaker

4.5.1 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.

4.5.2 *Microfossil Analysis Materials and Methods*

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)			**Head (Late Pleistocene)**	
Sample	**Weight processed**		**Sample**	**Weight processed**
1/5	275g		4/6	275g
2/4	275g		9/3	275g
6/6	225g		9/4	225g
7/5	225g		9/5	225g
8/5	225g		9/6	275g
			12/3	275g

Table 3: Microfossil Assessment Samples

4.5.3 *Microfossil Analysis Results*

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, samples 1/5 and 2/4 were barren, but perhaps surprisingly, the remaining two samples, 6/6 and 7/5 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.

Devensian Solifluction Deposits

Samples 4/6, 9/3, 9/4, 9/5 and 9/6 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 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.

4.6 Pollen Assessment by Rod Bale

4.6.1 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.

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

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

Devensian Solifluction Deposits
KRG 11 4/6 - no pollen (except lycopodium)
KRG 11 9/3 - occasional (2 grains) non lycopodium pollen.
KRG 11 9/4 - no pollen (except lycopodium).
KRG 11 9/6 - no pollen (except lycopodium)
KRG 11 9/5 - no pollen (except lycopodium)
KRG 11 9/6 - no pollen (except lycopodium)

4.6.3 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.

4.7 Mollusc Assessment by Dr Martin Bates

4.7.1 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.

4.7.2 **Boyn Hill Terrace**

Sample 6/4:	4 Vallonia sp., 3 *T.hispida*, 3 *C.acicula* and fragments of shells.
Sample 7/5:	6 *T.hispida*, 2 Vallonia sp., 2 *P.muscorum* and fragments including *C.acicula*.
Sample 7/6.	4 Vallonia sp., 3 *T.hispida*, 1 possible Cochlicopa sp., and fragments of *C.acicula*.

4.7.3 **Devensian Solifluction Deposits**

Sample 4/4.	3 *Trichia hispida* shells, 2 Vallonia sp., 1 *Pupilla*

muscorum and 3 *Ceciloidies acicula* shells.
Sample 9/4. 5 *T.hispida* and 1 Vertigo sp.

4.7.4 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.

4.7.5 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.

4.8 Palaeoenvironmental Summary

4.8.1 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.

4.8.2 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.

4.8.3 Further sampling of sediments for contained palaeoenvironmental remains (at least molluscs and possibly small mammals) must however be considered. 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 4). 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 were technologically consistent with having been part of a Lower Palaeolithic industry. The presence of these artefacts within the gravels at the site indicates an 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 equates with artefacts which have travelled little or no distance and therefore raises the likelihood of in-situ preservation conditions existing at the site relating to both wider landscape and on-site activity.

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)	Middle Gravels	2	208	Includes core
8/5 (base)	Middle Gravels	1	82	Soft hammer Flake
8/6	Middle Gravels	6	120	
Total		**24**	**968**	

Table 4: 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 form 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 particle 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 with the type of 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 accord well with the Middle Gravels in Barnfield Pit.
- The surface of the chalk between BH 1 and TP8 is broadly horizontal and 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 (from the original geotechnical study).
- Our observations for GTP's 1, 2, 6, 7 and 8 confirm these records and suggest two major gravel bodies (Upper and Middle Gravels) separated by finer grained clays with sand (Upper Loam)
- We have thus 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 laid down under cold-climate conditions. These appear to have truncated the older Middle Pleistocene deposits to the west and thus 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, across the lower, eastern part of the site (across the levelled area of the former valley bottom) intact Head deposits of probable late Pleistocene age have now been determined to be present. 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 could conceivably comprise made ground related to the restoration of pits to the north. Investigation of this section as part of any proposed mitigation would be thus essential in understanding the development of the site.

7.0 CONCLUSIONS (Figure 6)

7.1 Summary of Results

7.1.1 The investigation has successfully determined that deposits similar to those recorded at Barnfield Pit are present within the Knockhall Road site. Specifically they are present below made ground on the plateau and under the upper parts of the slope (Figure 6: Zone 1). These deposits are currently correlated with the Upper Gravels, Upper Loam and Middle Gravels of the main Barnfield Pit sequence.

7.1.2 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, the Upper Loam and Devensian Head Deposits. Some material from the Upper and Middle Gravels was unrolled and thus suggests human activity directly relating to the site locale and not fluvially transported material.

7.1.3 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 side of Ingress Vale. The slope profile suggests some possible human modification at both the top and the foot of the slope by terracing, the latter most likely relating to the creation of a sports ground in the valley bottom.

7.1.4 Across the slope, Head Deposits of Late Pleistocene age and overlying colluvium, of presumed Holocene age, thicken towards the base of the slope. They fill a valley incised through the older intact Middle Pleistocene sediments and the underlying bedrock (Figure 6: Zone 3 & 4). Thus the valley clearly post-dates the deposition of the Middle Pleistocene sediments and contains a later sedimentary sequence typical of other valleys within the Cretaceous landscape of north Kent. 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.

7.1.5 The area of flat ground comprising the former playing field at the base of the slope (Figure 6: Zone 4) does not appear to have been made level by the significant emplacement of made ground. It has, it appears, been levelled through the truncation of the valley deposit sequence in this area. In all observed test pits within Zone 4, superficial deposits of 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.

7.6 Statement of Importance

7.6.1 The archaeological assessment has been successful in establishing the range of depositional contexts, their distribution and potential for preserving

archaeology at the Knockhall Road site. In assessing the overall importance of the site on the basis of these results we have to judge these results against both national guidelines and the site's immediate heritage context, the latter defined primarily by the site's proximity to the nationally important SSSI of Barnfield Pit.

7.6.2 When considered in direct relation to established English Heritage guidance notes for management of Palaeolithic archaeology (English Heritage 1998), the site can be considered potentially important on the following grounds:

- The site has potential for undisturbed artefactual remains (Potential established on the basis of fresh-condition artefacts but in-situ scatters are not yet proved).
- The site has potential for well-preserved and directly associated palaeoenvironmental remains. (Potential established on the basis of mollusc and microfauna preservation)
- The site has potential for locally abundant artefacts concentrations. (Potential established on the basis of moderate artefact yields from our sample)

7.6.3 The site is conferred additional importance for two further reasons relating to its precise context with the local Swanscombe landscape:

- It preserves deposits which are the lateral equivalent to those preserved at the nearby Swanscombe site.
- It preserves deposits that have received little attention in the nearby Swanscombe site.
- The site comprises a block of relatively undisturbed Pleistocene sediment in a landscape which has been extensively quarried and developed.

7.6.4 When considered in these terms the site's unquestionable potential to contain nationally important archaeological remains could be invoked to make a case for preservation in-situ. However, we believe there are grounds to consider this an unconstructive and overly protective approach for the following reasons:

- The criteria outlined above for designation as a nationally important site have been made on assessed potential; the criteria have not yet been conclusively demonstrated (see 7.6.2).
- Development plans may leave large areas of the site essentially preserved *in situ* with impact restricted to a relatively minor percentage of total sediment volume.
- While the site lies close to the Swanscombe site, our assessment indicates that under-investigated parts of the Boyn Hill sequence are preserved at the site (Upper Gravels, Upper Loams). Thus a suitable programme of archaeological investigation undertaken as part of the development process will yield a valuable body of data relating to a poorly understood part of the resource.

7.6.5 We therefore conclude that while the site has potential to contain nationally important archaeological remains there is not at this stage a clear case for a presumption in favour of preservation *in situ*. Careful consideration of development plans in terms of percentage of surface impact and local impact depths should now be weighed against the academic value of investigation at

the site. A distinction should be drawn between development proposals which might involve the substantial removal, disturbance or redistribution of sediments (eg. quarrying, extensive piling or terracing) and developments which work with the existing landform and impact only locally in terms of foundation footings, linear developments with low impact depths. With a suitable mitigation strategy in place, the needs of developers, academic research and heritage protection could all be met.

7.3 Mitigation Approach

7.3.1 Detailed mitigation plans can only be developed once detailed construction plans have been submitted. In the advent of planning permission being granted without detailed plans in place, the necessary archaeological condition will have to be appropriately flexible and open in order to be able to respond to impacts on the deposits.

7.3.2 We would anticipate at least a two-fold approach to mitigation involving a further phase of assessment (including test pitting) once a detailed construction plan is available followed by appropriate mitigation where necessary.

7.3.3 Field approaches to be considered should include geophysics (resistivity transects), further test pitting and geological modelling, scope for recovery of in-situ material from threatened deposits and evaluation ahead of footings, drainage works.

7.3.4 For the levelled area at the base of the slope, strip trench evaluations will be necessary to determine whether any surviving truncated Holocene features are present.

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© **Archaeology South-East**		Former Empire Sports Ground, Greenhithe	Fig. 1
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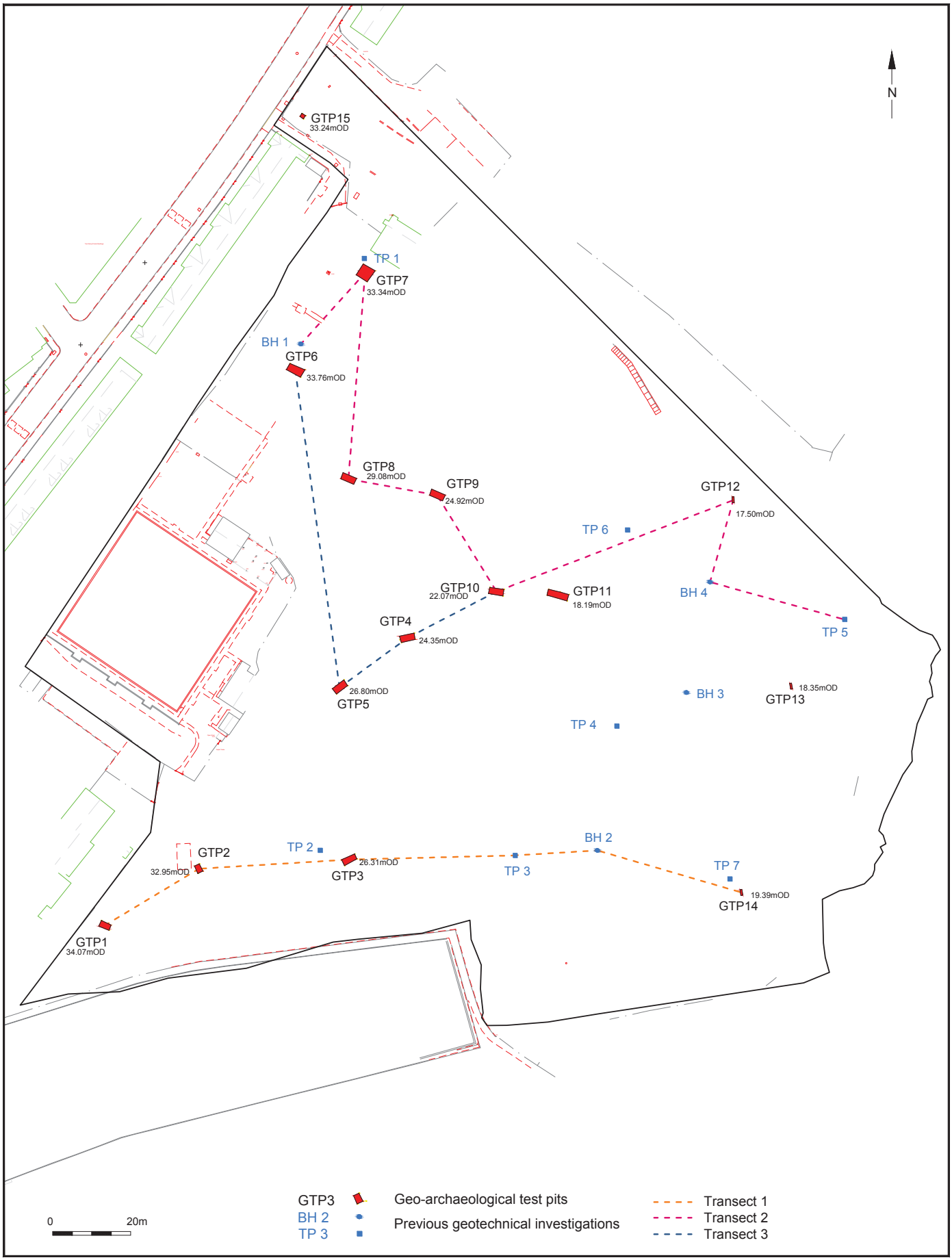
Report Ref: 2012083	Drawn by: JLR		



© Archaeology South-East		Former Empire Sports Ground, Greenhithe	Fig. 2
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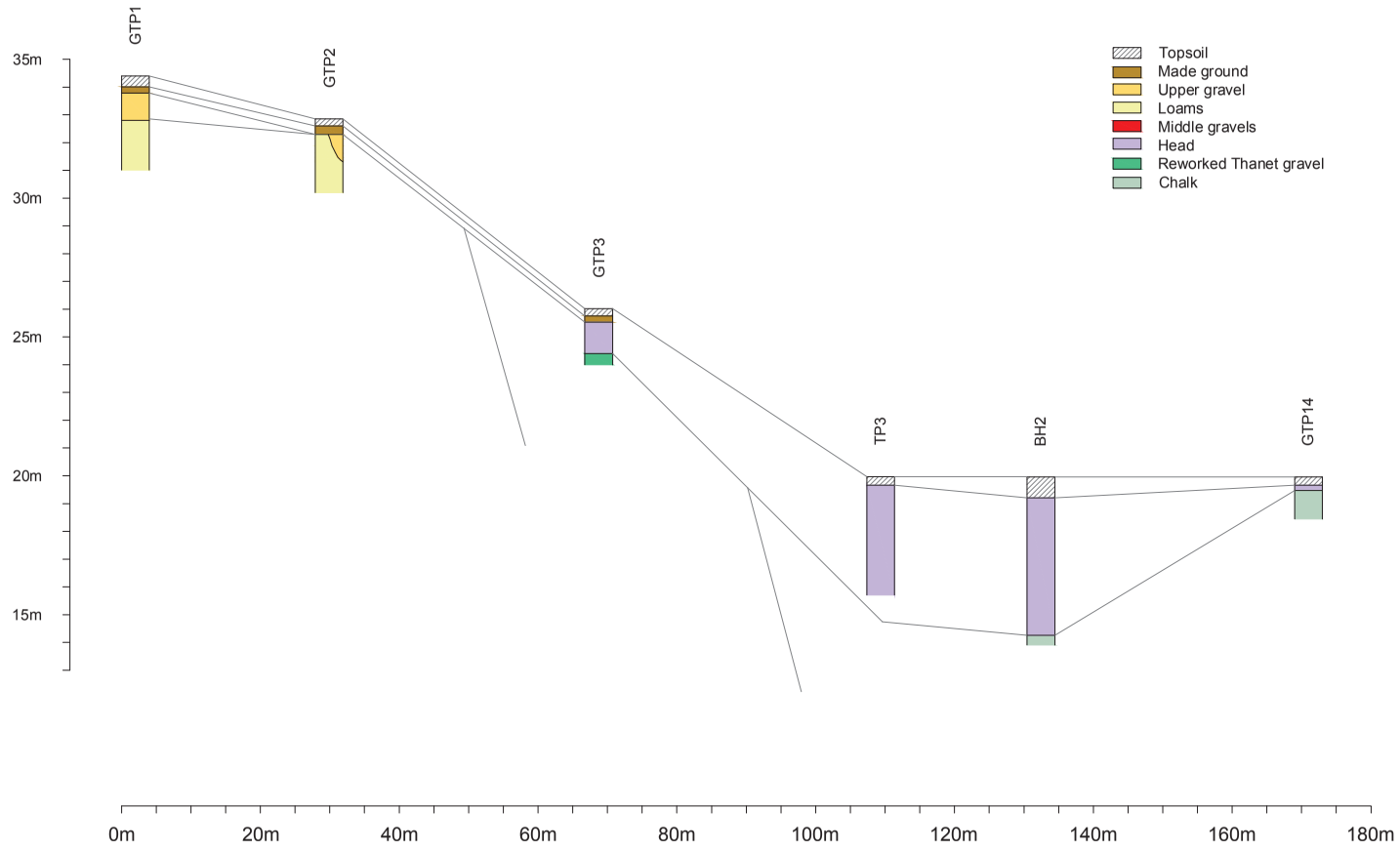
Report Ref: 2012083	Drawn by: JLR		



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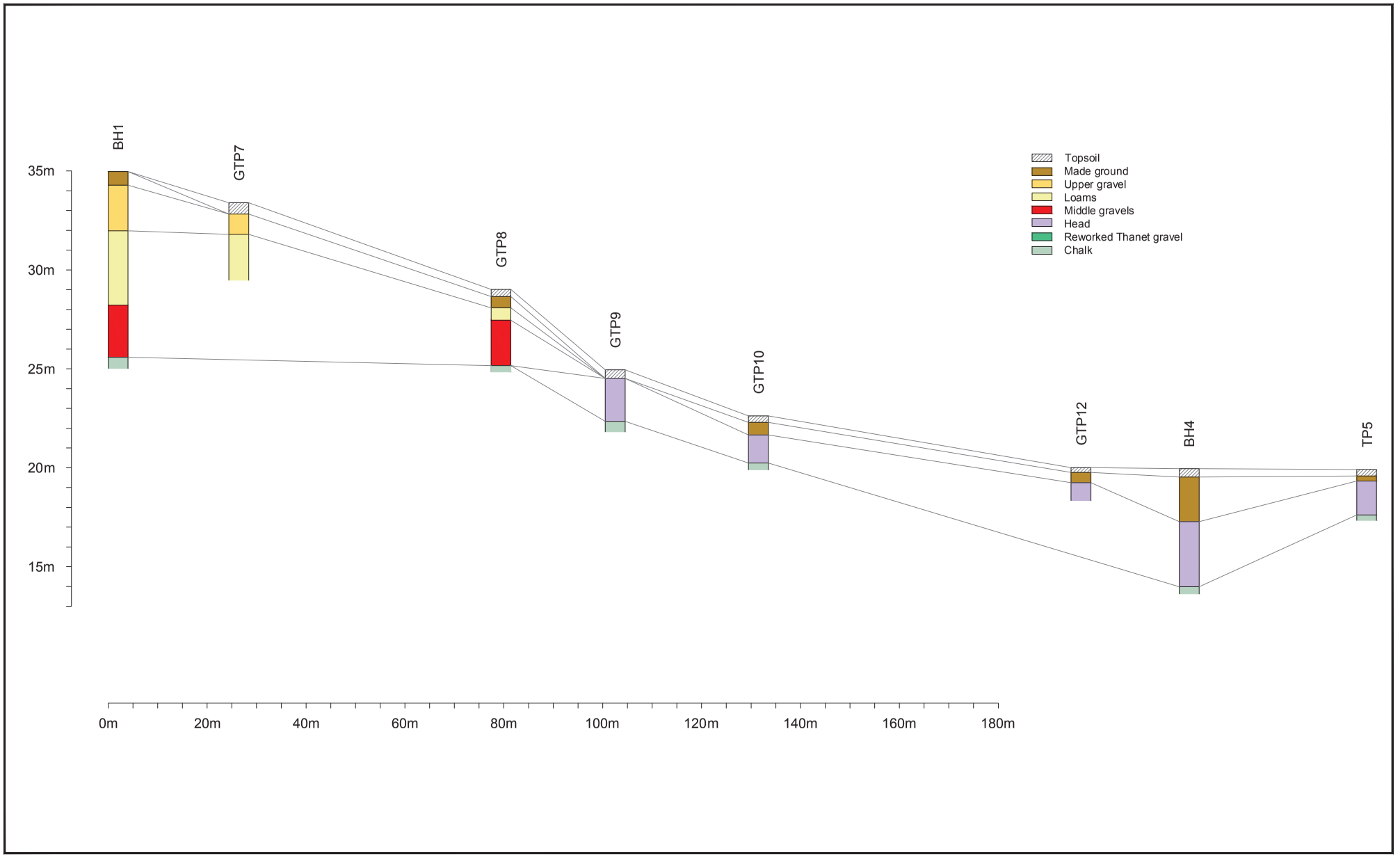

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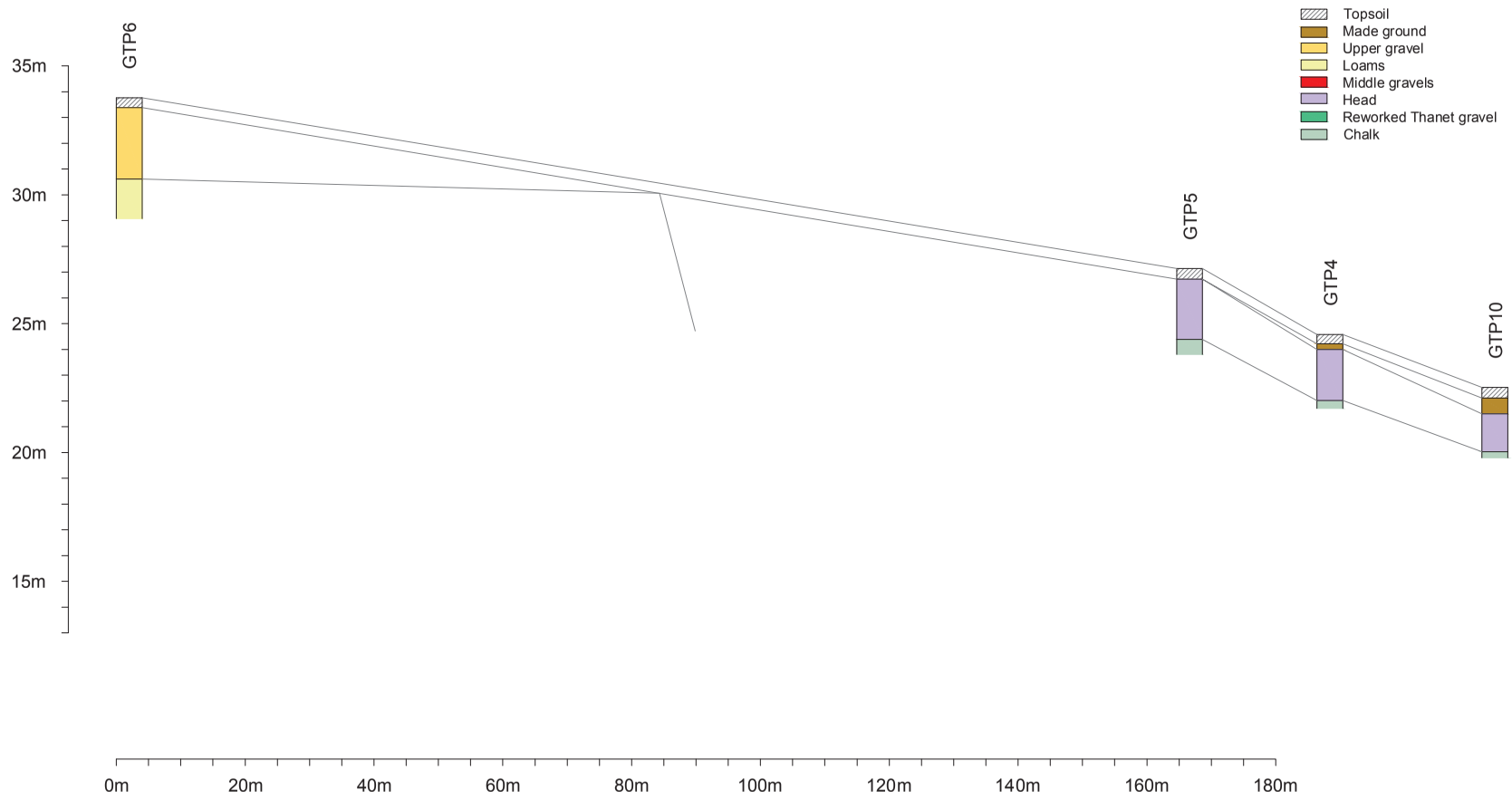

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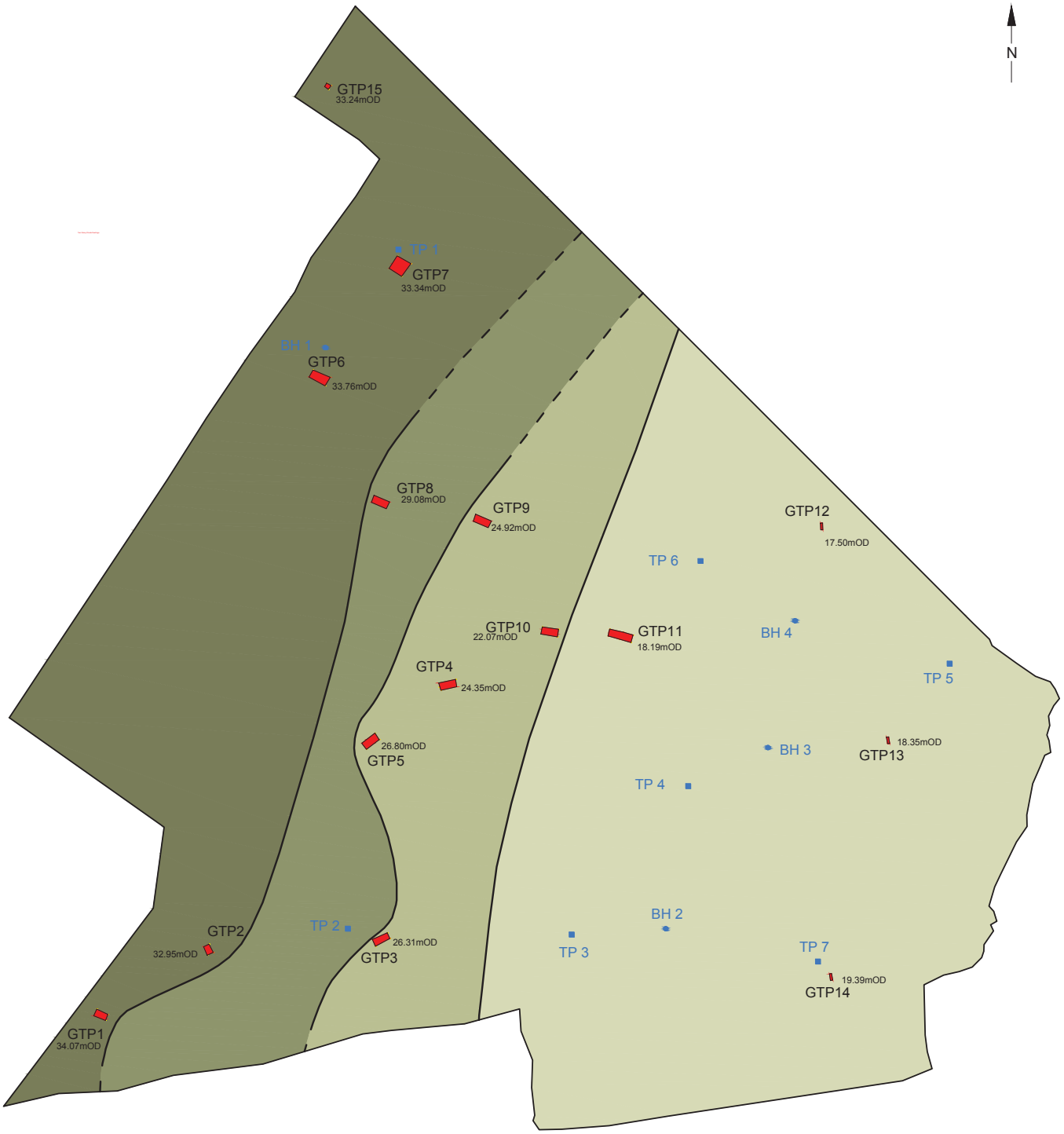

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Report Ref: 2012083	Drawn by: JLR		

© Archaeology South-East		Former Empire Sports Ground, Greenhlthe	Fig. 7
Project Ref: 5197	Jan 2012	OS 6" 1920 showing 50 and 100 ft contours	
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GTP1

GTP2

GTP3

GTP4

GTP5

GTP6

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GTP7

GTP8

GTP9

GTP10

GTP11

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GTP12

GTP13

GTP14

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APPENDICIES

Appendix 1: Test Pit records

GTP 1 34.07m OD

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	1/1
	---diffuse contact---		
0.3	Subsoil/made ground	Made Ground	1/2
	---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	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	1/3
	----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	Upper Gravels Medium energy fluvial conditions in cold climate braided channel environment	1/4
	---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.	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	1/5
	----diffuse contact---		
2.4	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm and impenetrable below 4m	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	1/6
	---Base of GTP 4.0m---		

GTP 2 32.95m OD

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	2/1
	---sharp contact---		
0.20	Made ground	Made ground	2/2
	---sharp contact---		
0.50	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.	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	2/3
	---sharp/dipping contact---		
2.5	2.5Y 6/4 light yellowish brown sandy clay with 7.5YR 6/8 reddish yellow patches. Cohesive and structureless.	Upper Loam Low energy fluvial floodplain	2/4
	---base of GTP 2.70m---		

GTP 3 26.31m

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Top soil	3/1
	---diffuse contact---		
0.25	2.5Y 5/4 light olive brown clayey silt with common rounded to sub-angular clasts (<5cm) and occasional CBM	Made ground	3/2
	---diffuse contact---		
0.40	10YR 5/4 yellowish brown sandy silty gravel with clasts <5cm. Clasts are rounded to subangular. Matrix supported and no structure.	Head Periglacial head gravel	3/3
	---diffuse contact---		
0.80	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.	Head Periglacial head gravel	3/4
	---abrupt contact---		
1.00	10YR 5/4 yellowish brown medium to fine sand with silt. Common gravel clasts that are poorly sorted (1-10cm) and rounded to subangular.	Head Periglacial head gravel	3/5
	---diffuse contact---		
1.40	7.5YR 4/6 strong brown gravel with Tertiary flint and occasional subangular flint clasts <10cm.	Head Periglacial head gravel	3/6
	---diffuse contact---		
1.60	5Y 6/3 pale olive sand with occasional green stained flint clasts	Solid Tertiary remnant	3/7

	---sharp contact---		
1.70 -	Chalk	Solid Upper Chalk	3/8
	---base of test pit 1.80m---		

GTP 4 24.57m OD.

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	4/1
	---diffuse contact---		
0.30	Made ground	Made ground	4/2
	---sharp contact---		
0.55	10YR 4/6 dark yellowish brown flint gravel. Clasts 2-6cm, subangular to rounded and rolled. Very loose and unconsolidated	Head Periglacial head deposits?	4/3
	---abrupt contact---		
0.65	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	Head Periglacial head deposits?	4/4
	---abrupt contact---		
1.40	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.	Head Periglacial head deposits?	4/5
	---abrupt contact---		
1.80	5YR 5/6 yellowish red dense clay silt with white chalky patches in places. Very compact and firm	Head Periglacial head deposits?	4/6
	---sharp contact---		
2.40	5YR yellowish red flint gravel – poorly sorted.	Head Periglacial head deposits?	4/7
	---sharp contact---		
2.50 -	Chalk	Solid Upper Chalk	4/8
	---base of test pit 2.60m---		

GTP 5 26.80m OD.

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

GTP 6 33.76m OD.

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	6/1
	---diffuse contact---		
0.35	Subsoil/made ground	Made ground	6/2
	---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	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	6/3
	----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	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	6/4
	----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	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	6/5
	----diffuse contact---		
3.1	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	6/6
	----diffuse contact---		
3.8	Pale yellow sand with clay	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	6/7
	----diffuse contact---		
4.2	pale yellow grey with reddish brown rooting psuedomorphs	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	6/8

	---Base of GTP 4.5m---		

GTP 7 33.34m OD

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00 – 0.20	Topsoil	Topsoil	7/1
	---diffuse contact---		
0.3	Subsoil/made ground	Made ground	7/2
	---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	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	7/3
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	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	7/4
	---sharp contact----		
1.6	10YR 5/4 yellowish brown sand with occasional sub-rounded flint gravel 10-80mm	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	7/5
	----diffuse contact---		
2.4	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	7/6
	----diffuse contact---		
3.3	7.5YR 6/8 reddish yellow with grey mottling, clay with sand. Very firm	Upper Loam Low energy fluvial conditions in cold climate braided channel environment	7/7
	---Base of GTP 4.0m---		

GTP 8 29.08m OD

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	8/1
	---diffuse contact---		
0.30	Made ground	Made ground	8/2
	---abrupt contact---		
0.90	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).	Upper Loam Low energy floodplain fines possibly some colluvial input	8/3
	---abrupt contact---		
1.60	7.5YR 6/8 reddish yellow flint gravel. Matrix slightly silty very coarse sand. Subangular nodules of flint (<8cm) rolled.	Middle Gravels High energy fluvial channel	8/4
	---abrupt contact---		
1.90	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.	Middle Gravels High energy fluvial channel	8/5
	---sharp contact---		
3.80	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.	Middle Gravels Gravel lag in low energy floodplain	8/6
	---sharp contact---		
3.90 -	Chalk	Solid Upper Chalk	8/7
	---base of test pit 3.90m---		

GTP 9 24.92m OD

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	9/1
	---diffuse contact---		
0.30	Made ground	Made ground	9/2
	---abrupt contact---		
0.40	7.5YR 5/6 strong brown clay silt. Very dense and compact. Structureless.	Head Periglacial head deposits?	9/3
	---abrupt contact---		
0.70	10YR 6/6 brownish yellow silt to very fine sand. Blocky structure.	Head Periglacial head deposits?	9/4
	---abrupt contact---		
1.40	10YR 7/6 yellow soft unconsolidated medium to fine sand with occasional chalky lenses. Occasional small flint clasts (<2cm) that are subangular to rounded.	Head Periglacial head deposits?	9/5
	---abrupt contact---		
2.20	7.5YR 6/6 reddish yellow medium sand with some silt. Occasional flint clasts. Chalky patches and occasional larger flint clasts. Slightly blocky structure.	Head Periglacial head deposits?	9/6
	---sharp contact---		
2.60	Chalk	Solid Upper Chalk	9/7
	---base of test pit 2.70m---		

GTP 10 22.07m OD.

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	10/1
	---diffuse contact---		
0.30	Made ground	Made ground	10/2
	---abrupt contact---		
0.90	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.	Head Periglacial head deposits?	10/3
	---abrupt contact---		
1.40	10 YR 5/8 yellowish brown sandy gravel. Very loose and poorly sorted (1-6cm, subangular to rounded).	Head Periglacial head deposits?	10/4
	---diffuse contact---		
1.70	10 YR 5/8 yellowish brown sandy gravel. Very loose and poorly sorted (1-6cm, subangular to rounded). Occasional carbonate patches and zones	Head Periglacial head deposits?	10/5
	---abrupt contact---		
2.00	10YR 5/8 yellowish brown clay silt with rare gravel clasts. Very dense and compact.	Head Periglacial head deposits?	10/6
2.30	Chalk	Solid Upper Chalk	10/7
	---base of test pit 2.30m---		

GTP 11 18.19m OD.

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0	Topsoil	Topsoil	11/1
	---diffuse contact---		
0.2	Made Ground	Made ground	11/2
	---sharp contact---		
0.6	Pale Yellow Brown clay silt with 40% rounded to sub-rounded flint gravels 10-40mm	Colluvium Slope wash/colluvium with infill of solution structure.	11/3
	---diffuse contact----		
1.6	Pale Yellow Brown clay silts. Stone free.	Head Periglacial Head deposits?	11/4
	Base of GTP 4.0m		

GTP 12 17.50m OD.

Depth (m)	Lithology	Inferred environment of deposition	Unit
0	Topsoil	Topsoil	12/1
	---diffuse contact---		
0.2	Made Ground	Made ground	12/2
	---sharp contact---		
0.69	Light Yellow Brown clay silt with chalk flecks	Head Truncated Head Deposits (Presumably Late Pleistocene/Early Holocene). Charcoal and earthworm granules suggest possible buried soil and human activity?	12/3
	Base of GTP 1.6m		

GTP 13 18.35m OD.

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0	Topsoil	Topsoil	13/1
	---diffuse contact---		
0.2	Made Ground	Made ground	13/2
	---sharp contact---		
0.4	Light Yellow Brown clay silt with chalk flecks	Head Truncated Head Deposits (Presumably Late Pleistocene)	13/3
	---sharp contact---		
1.1	Solid Chalk	Solid Upper Chalk	13/4
	Base of GTP 1.6m		

GTP 14 19.39m OD.

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0	Topsoil		14/1
	---diffuse contact---		
0.2	Light Yellow Brown clay silt with chalk flecks Made Ground	Head Truncated Head Deposits (Presumably Late Pleistocene)	14/2
	---sharp contact---		
0.5	Solid Chalk	Solid Upper Chalk	14/3
	Base of GTP 1.6m		

GTP15 33.24 OD.

Depth (m)	Lithology	Stratigraphy & inferred depositional environment	Unit
0.00	Topsoil	Topsoil	15/1
	---diffuse contact---		
0.3	Subsoil/made ground	Made ground	15/2

	---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	Upper Gravels High energy fluvial conditions in cold climate braided channel environment	15/3
	Base of TP: 0.8m		

Appendix 2: Map Regression (taken from Desk Based Assessment, CgMs 2011)

Site Location

N

Project title: Empire Sports Ground, Knockhall Road, Greenhithe, Kent	
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Figure 5: 1769 Andrews, Drury & Herbert Map of Kent

Site Boundary

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Figure 6: 1799 Ordnance Survey

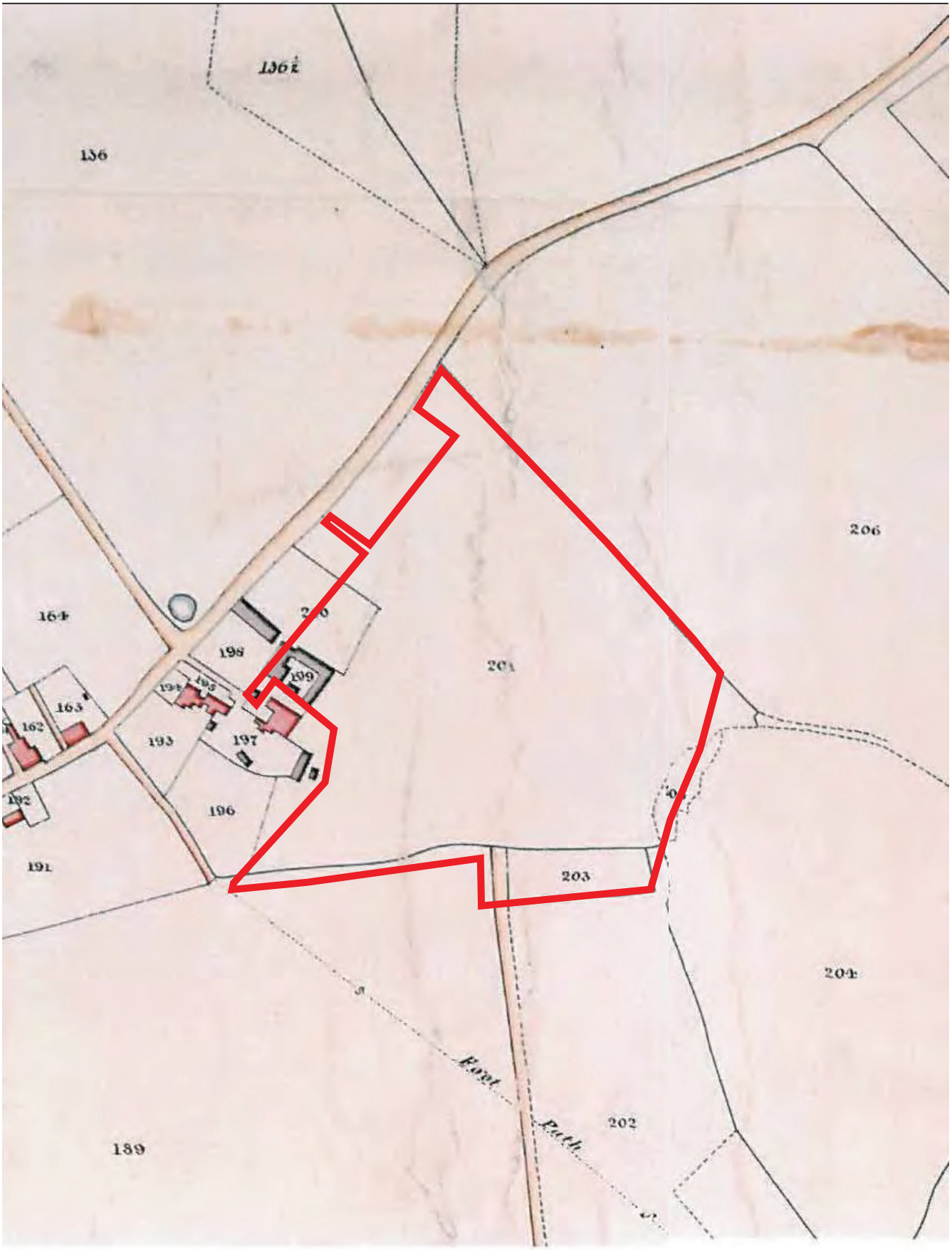

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Figure 7: 1844 Swanscombe Tithe Map

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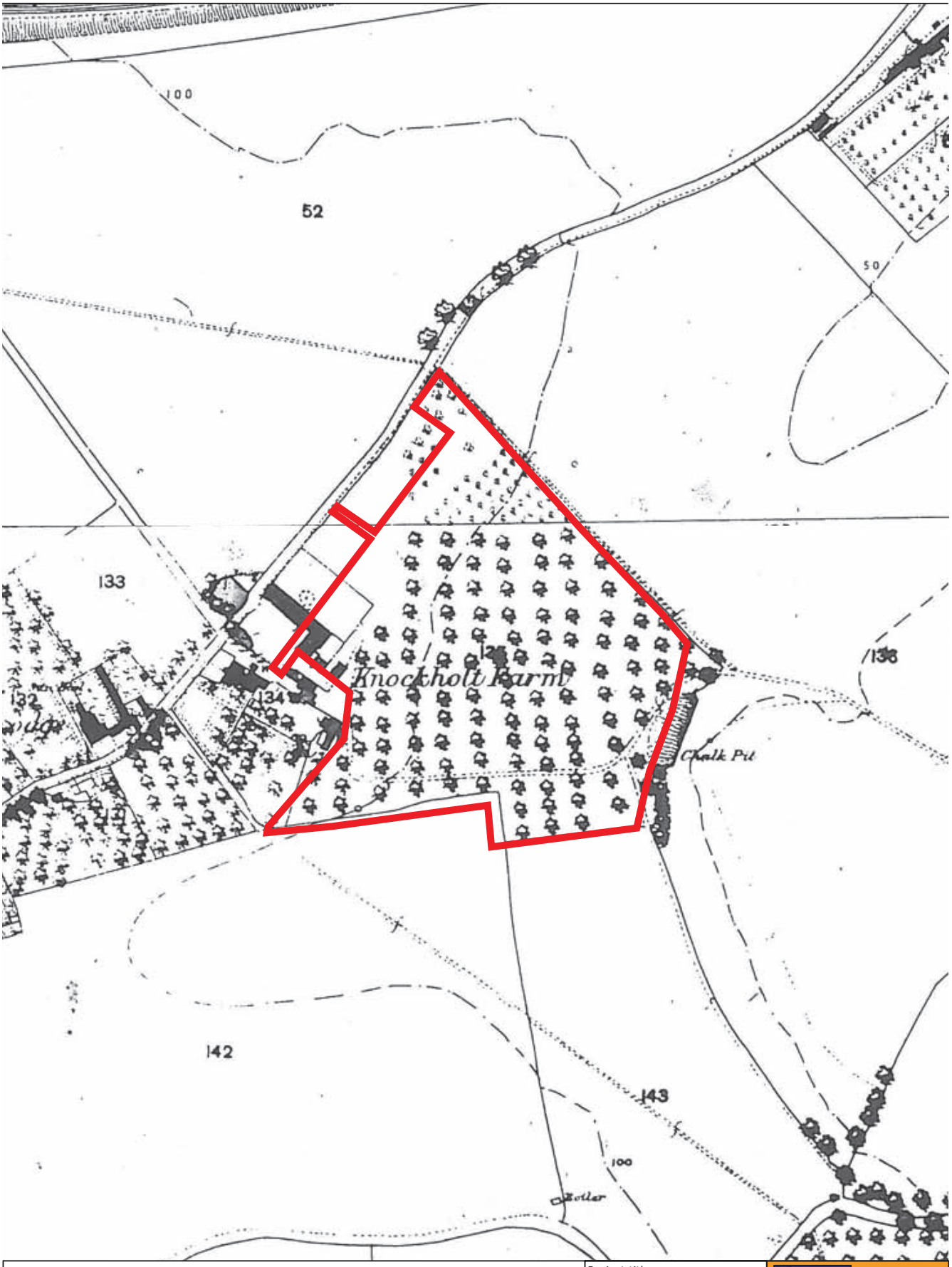

Site Boundary

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Figure 8: 1864 Ordnance Survey

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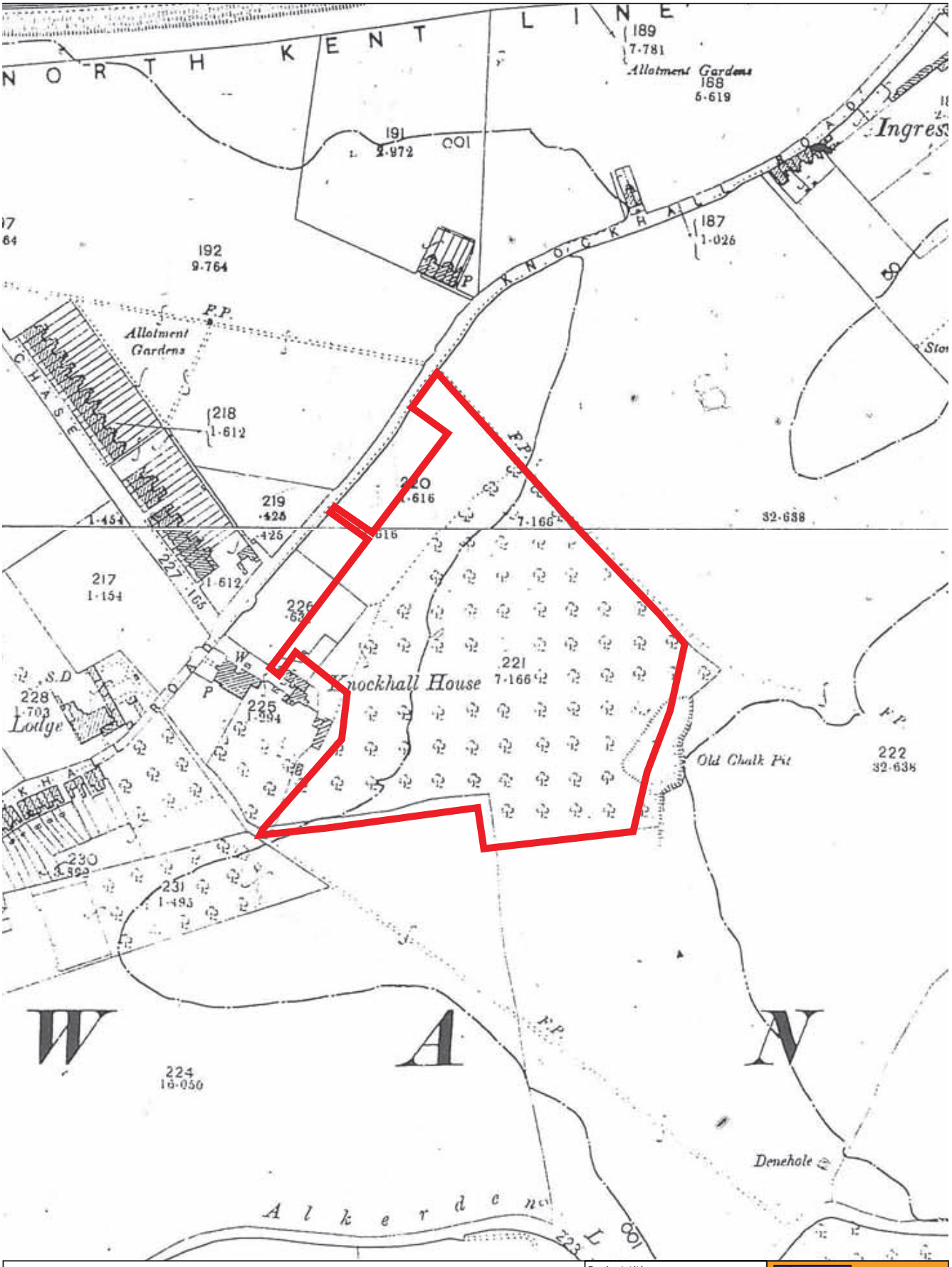

Site Boundary

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Figure 9: 1895 Ordnance Survey

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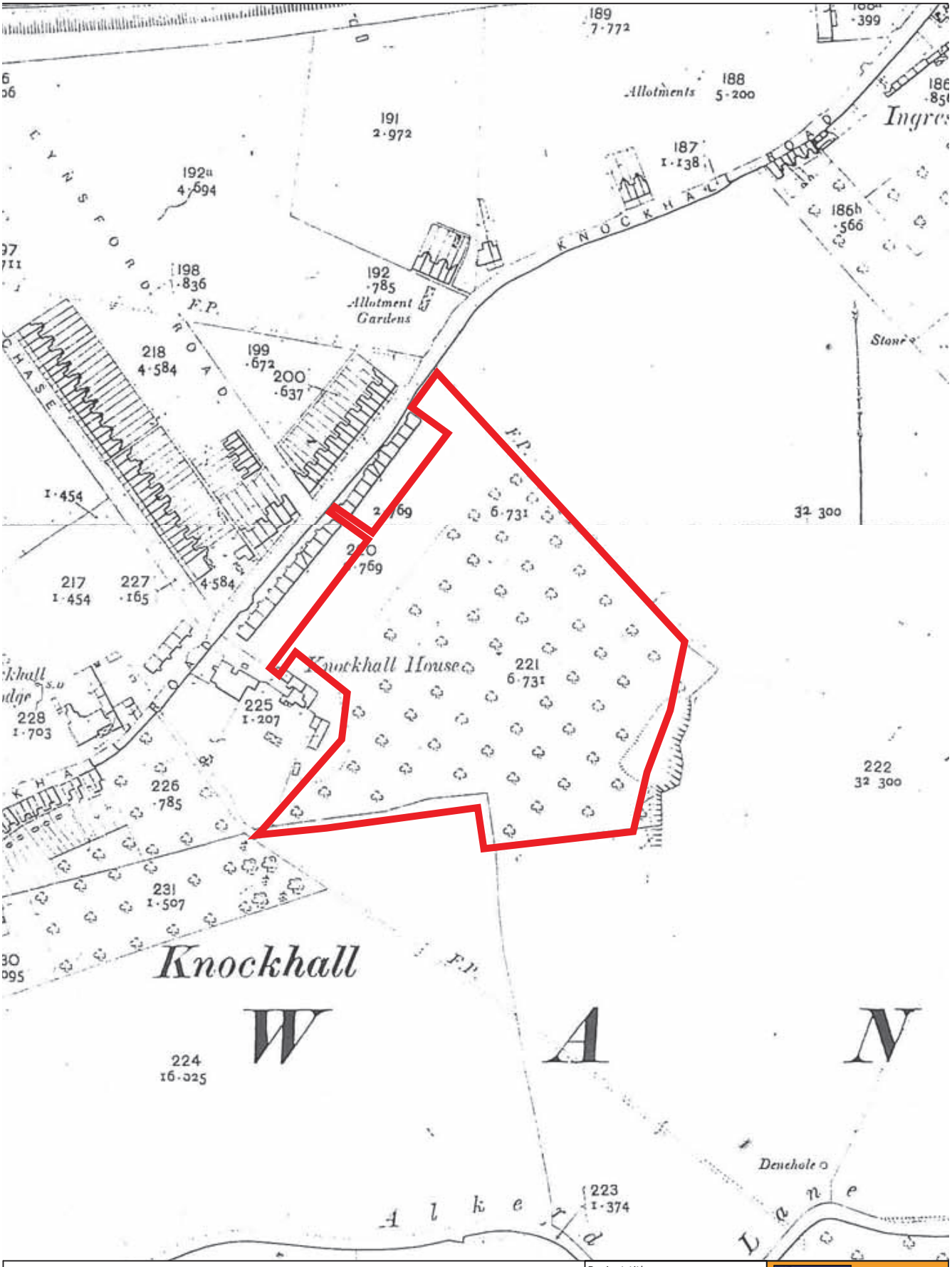

Site Boundary

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Figure 10: 1907 Ordnance Survey

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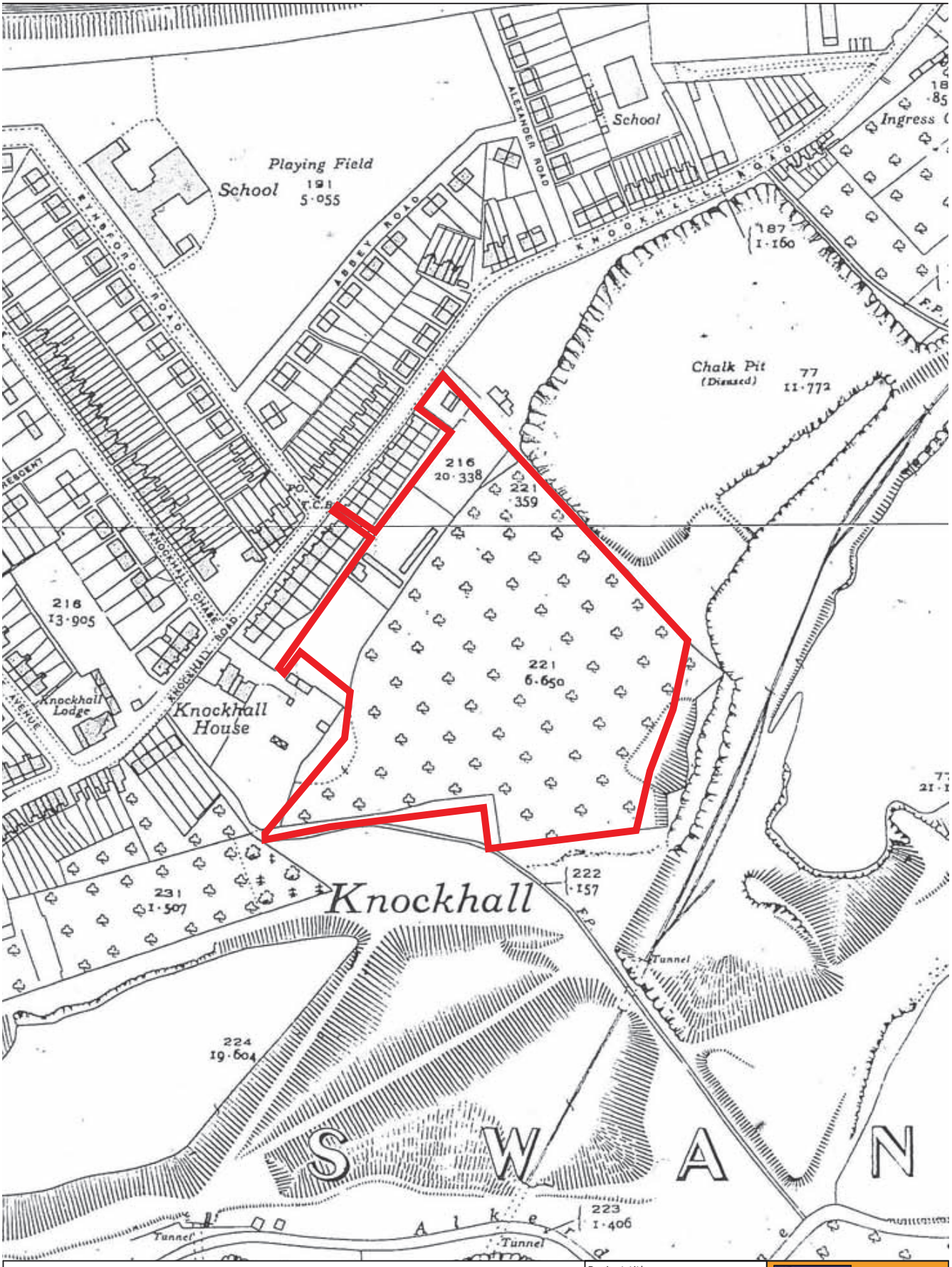

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Figure 11: 1938 Ordnance Survey

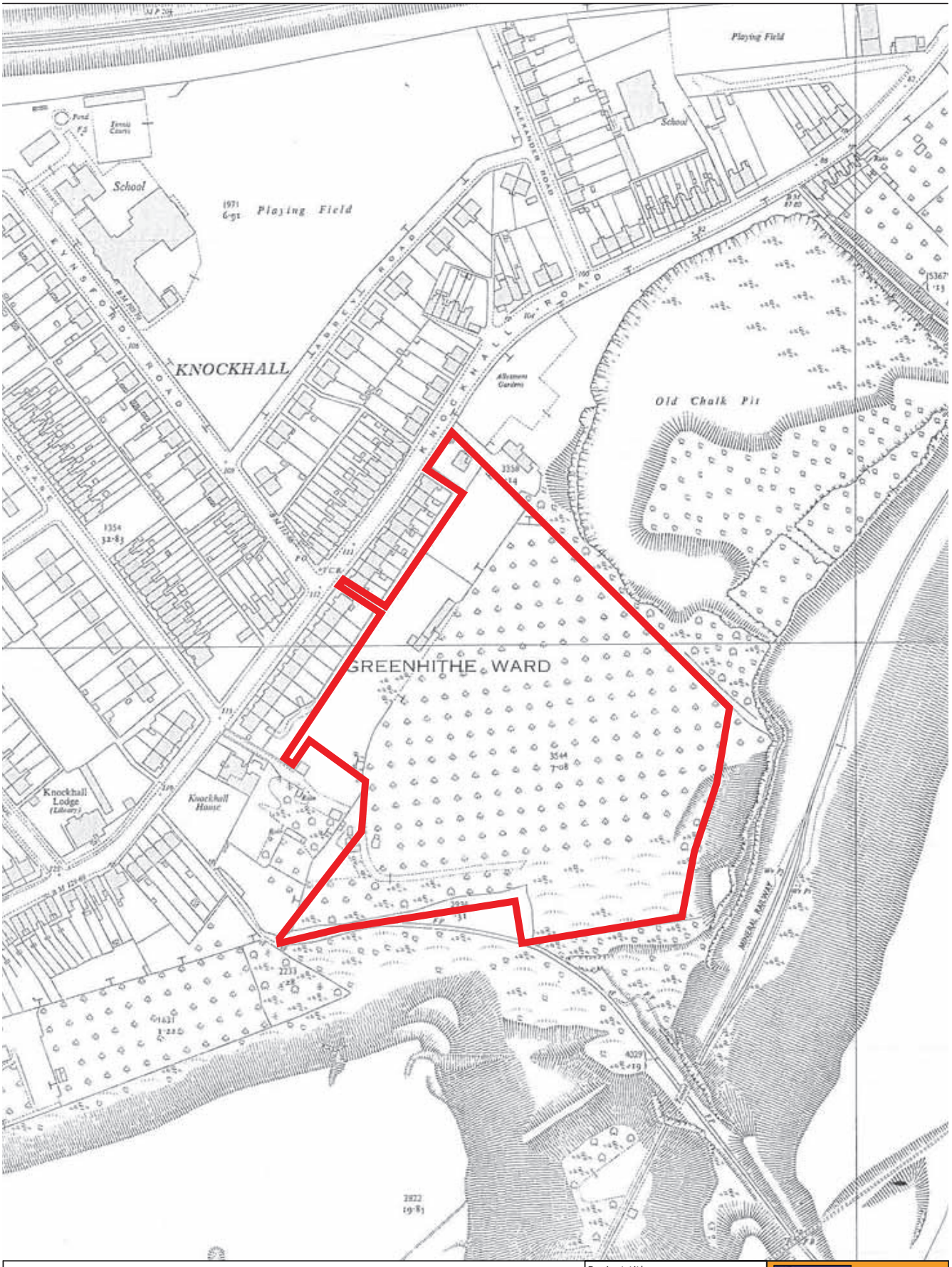

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Figure 12: 1954 Ordnance Survey

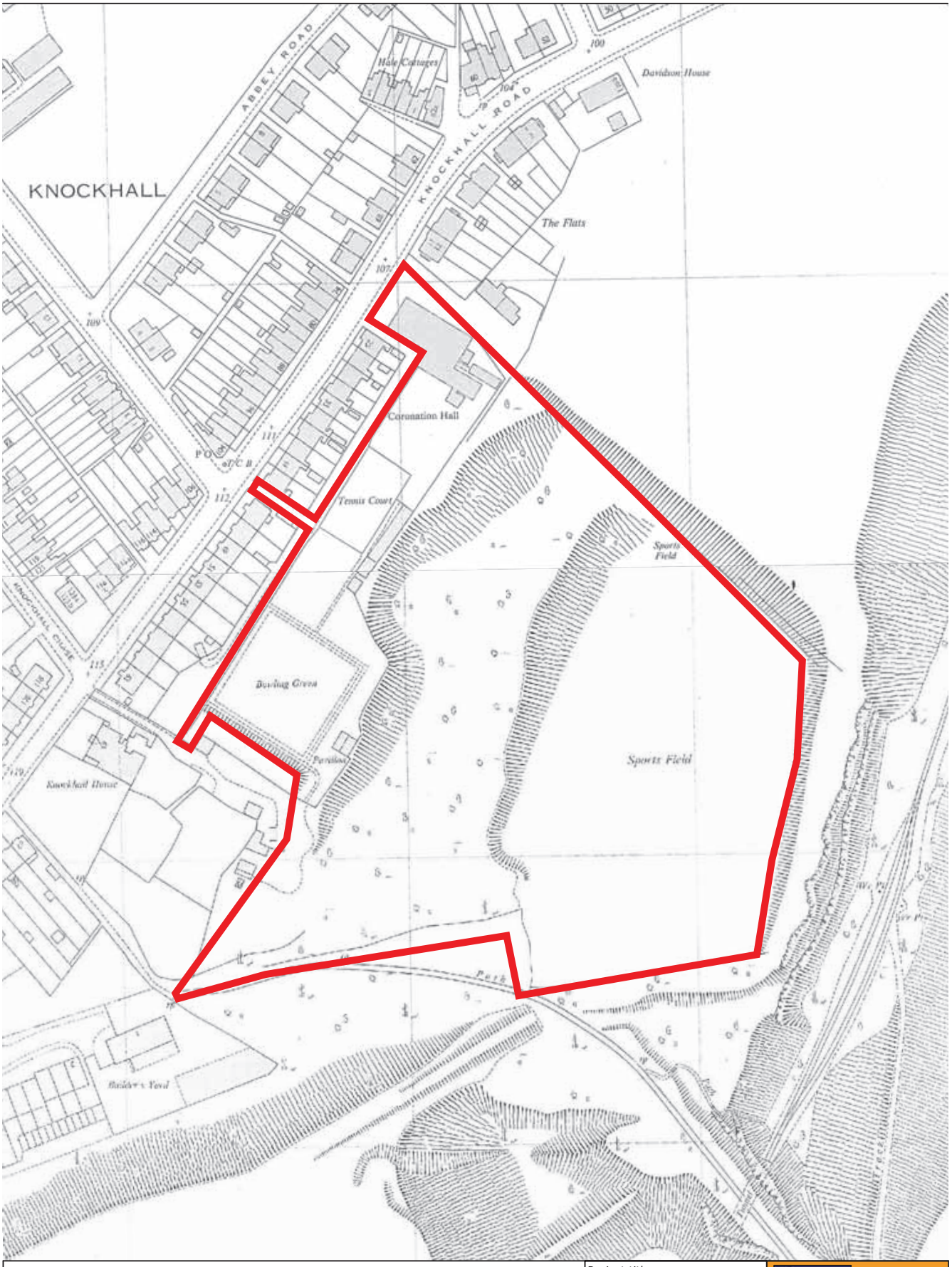

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Figure 13: 1969 Ordnance Survey

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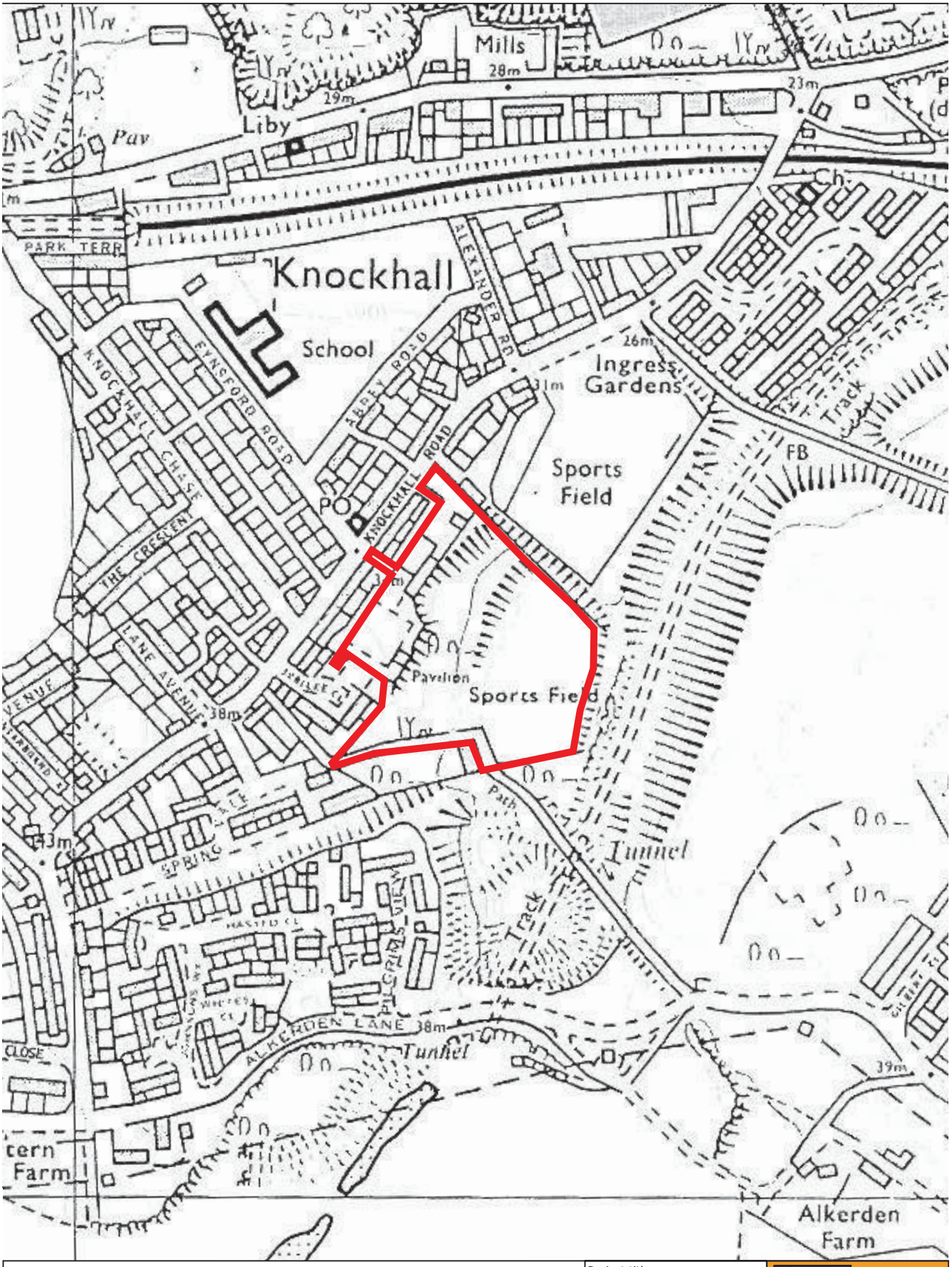

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Figure 14: 1992 Ordnance Survey

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Figure 15: 2011 Ordnance Survey

Plate 1: 1940's aerial photograph

Plate 2: 1961 aerial photograph

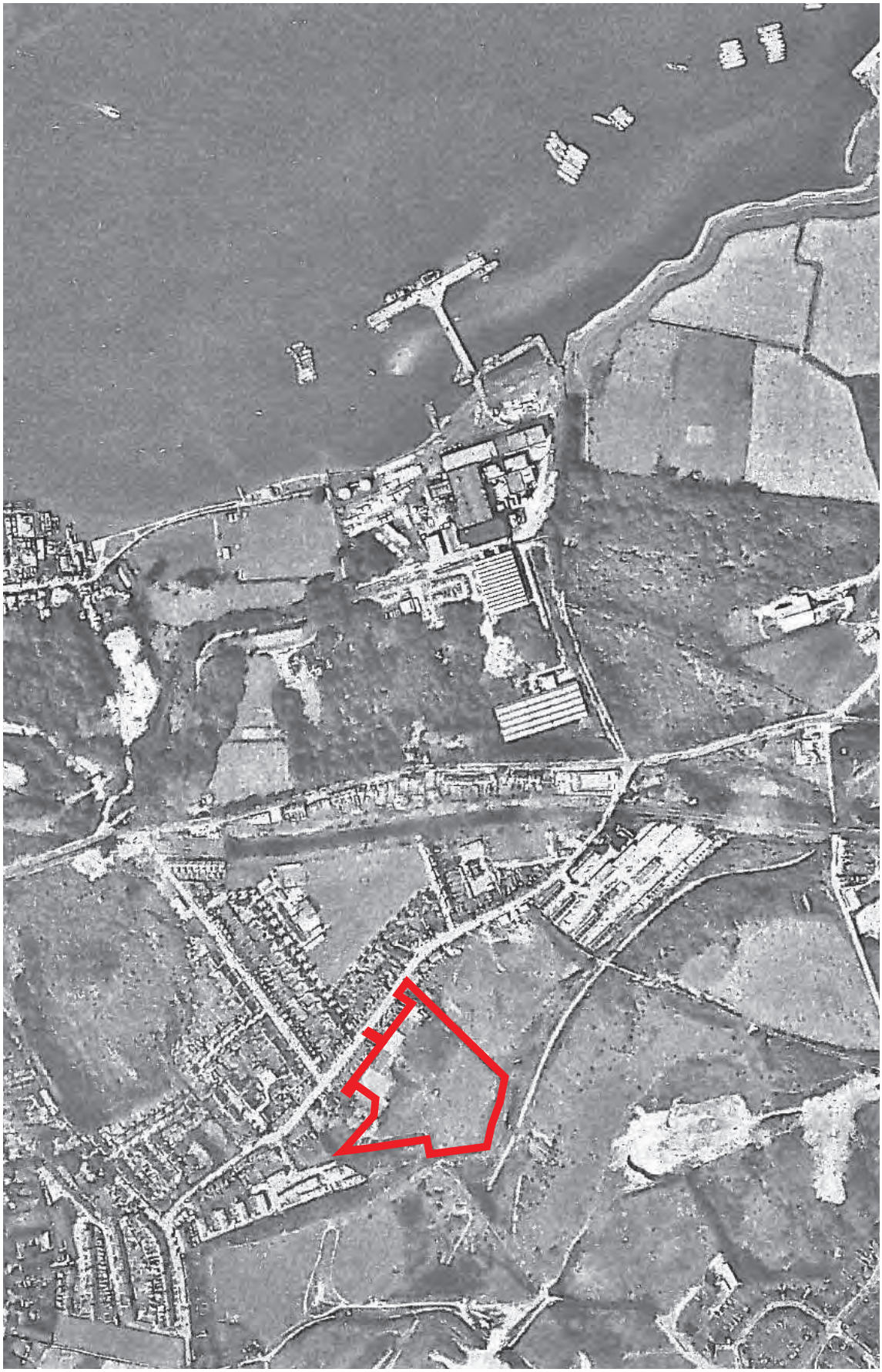


Plate 3: 1967 aerial photograph

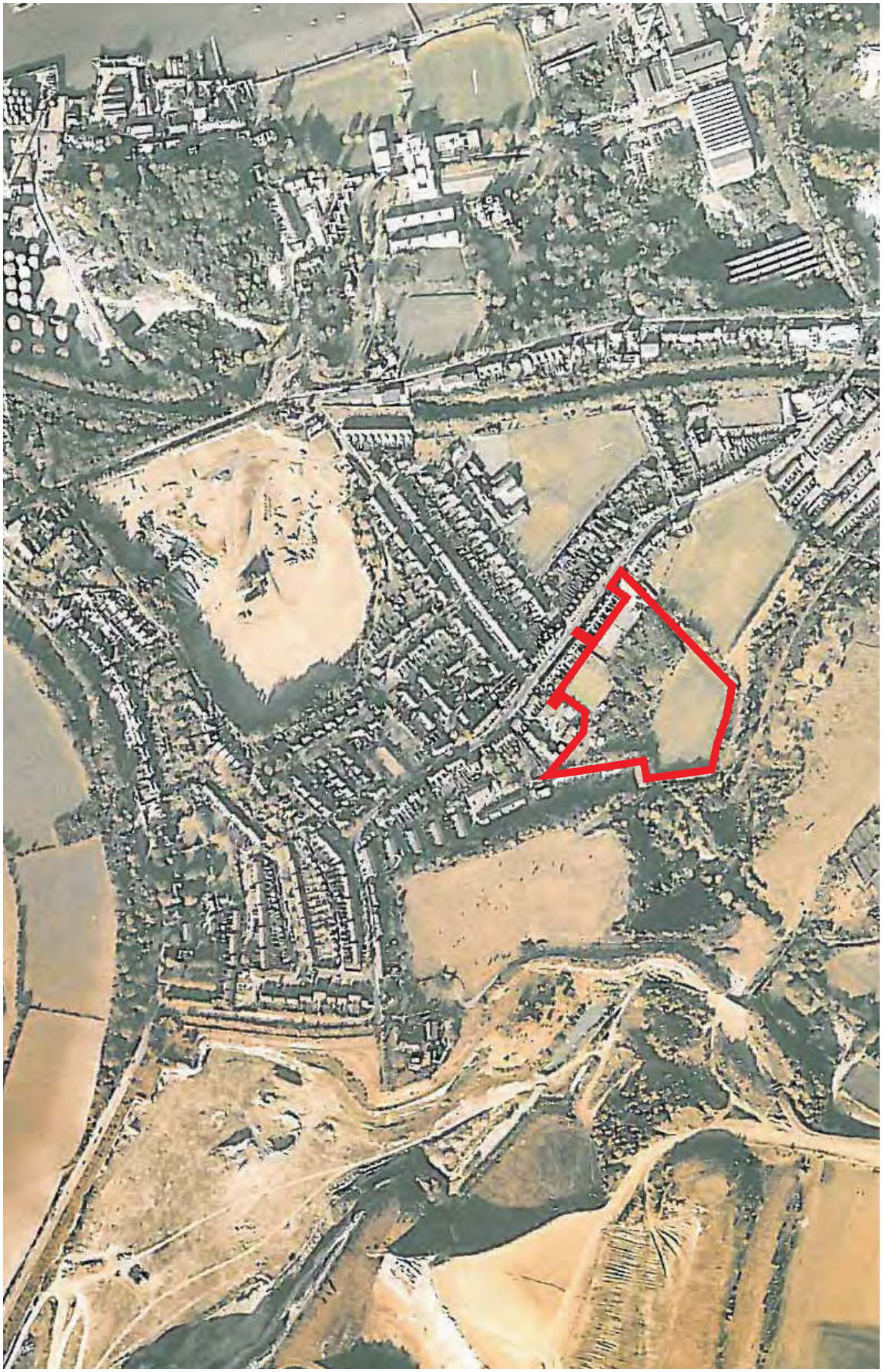
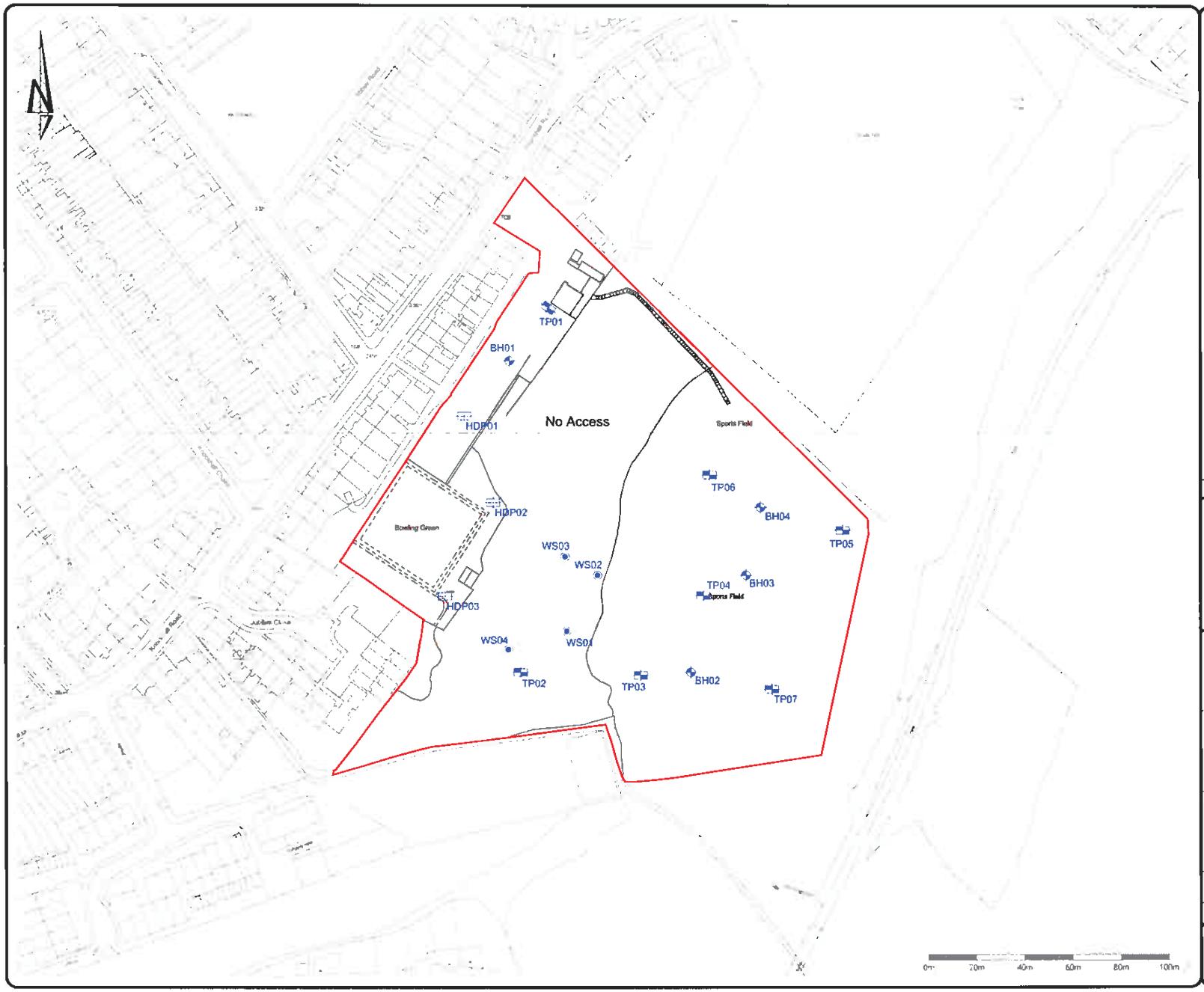


Plate 4: 1985 aerial photograph

Plate 5: 2006 aerial photograph

Appendix 3: Geotechnical Logs (taken from, Desk Based Assessment, CgMs 2011)



Legend

- Site Boundary
- TP02 Trial Pit Location
- HDP01 Hand Dug Trial Pit Location
- WS02 Window Sample Location

Rev	Date	Description	Ckd	By

Hydrock

Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 888
FAX: 01604 842 666
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

Client: JONES LANG LASALLE

Project: KNOCKHALL ROAD, GREENHITHE, KENT

Title: Exploratory Hole Location Plan

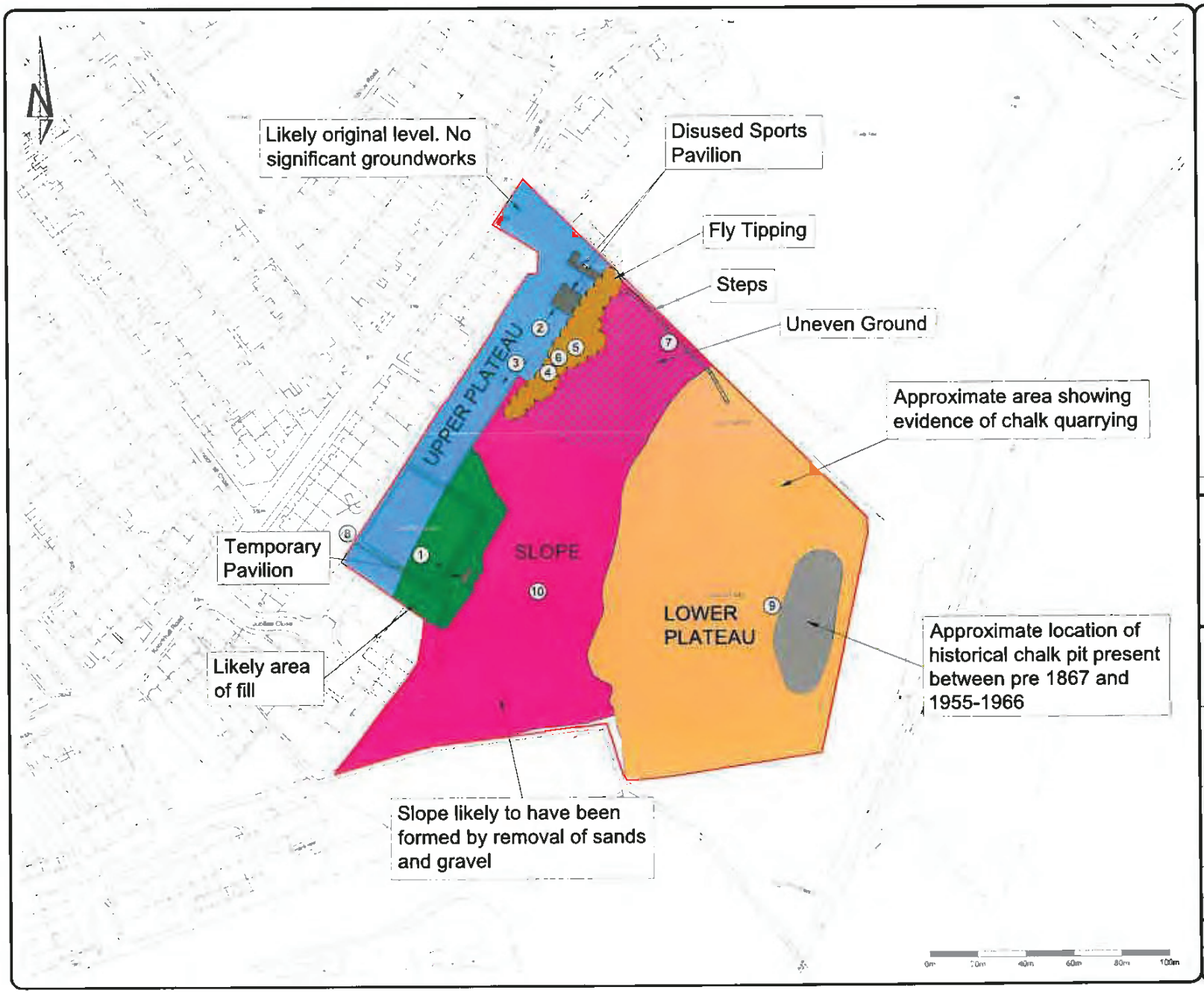
Drawing Status: INFORMATION

Job No.: C/10313

Drawn	Checked	Scale at A1	Date	Issue Date
SG	CV	1:1500	11/10/10	19/10/10

Drawing No.: 10313/D004

Revision: -



Legend

Site Boundary

Photograph Location and Orientation

Rev	Date	Description	Ckd	By

Hydrock

Unit 3 Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 668
FAX: 01604 842 666
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

Job No.: C/10313

Drawn	Checked	Scale at A3	Date	Issue Date
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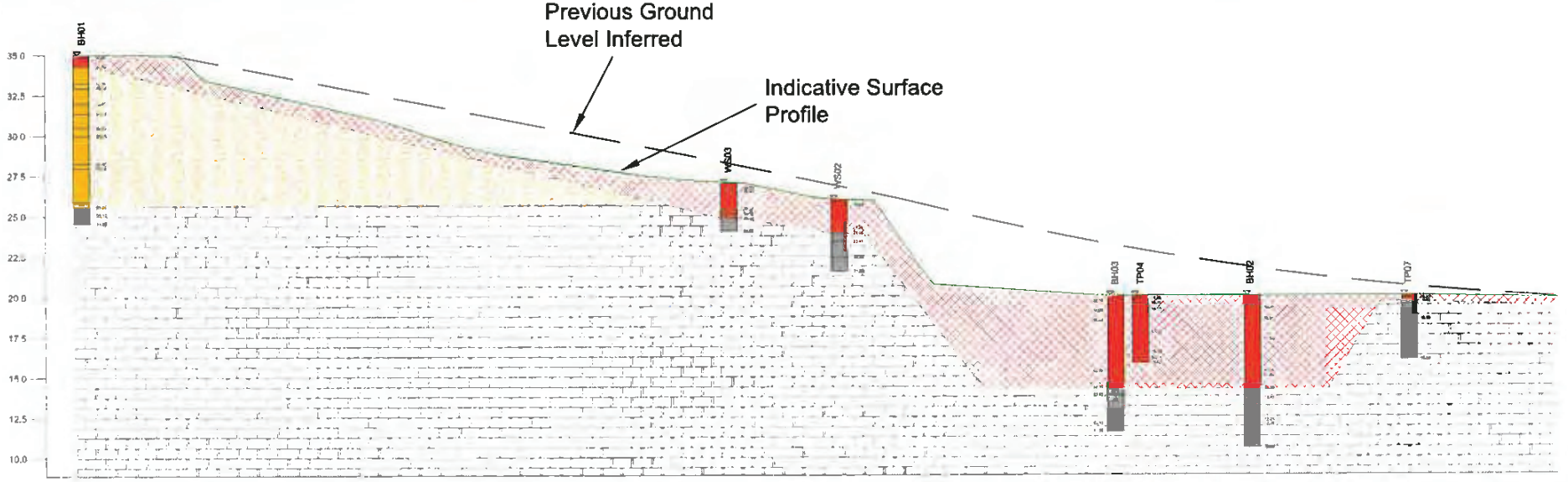
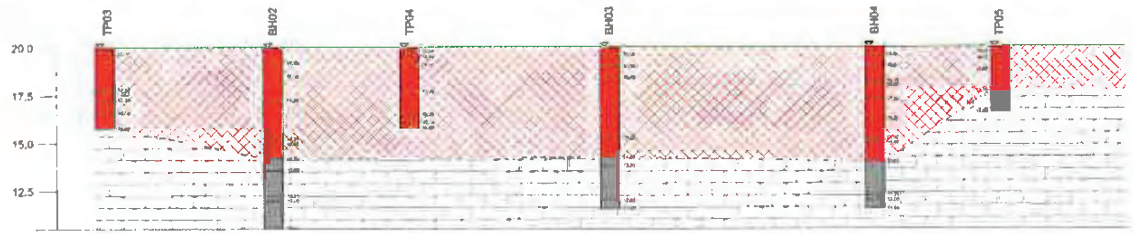
Drawing No.: 10313/D003

Revision: -



Section A - A'

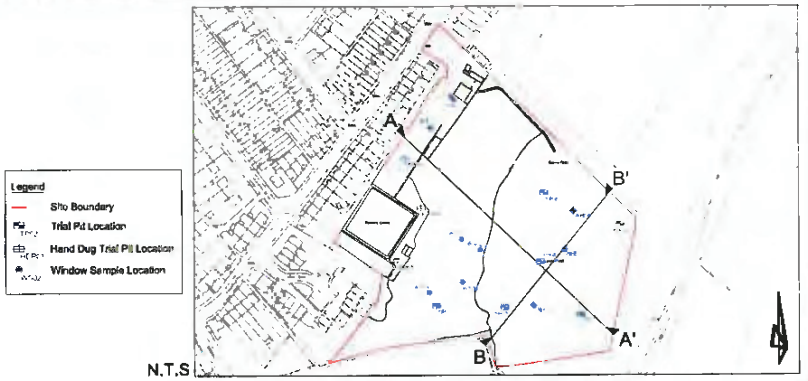


Section B - B'

Scale: Vert = 1:250
Horiz = 1:500

Legend

- Made Ground
- Boyn Hill Gravel
- Chalk



Legend

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

N.T.S

Rev	Date	Description	Ckd	By

Hydrock

Unit 3, Hawthorn Park
Holcomby Road
Spratton
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Client

Jones Lang LaSalle

Project

KNOCKHALL ROAD, GREENHITHE, KENT

Title

Geological Cross Sections

Drawing Status: INFORMATION

Job No.: C/10313

Drawn	Checked	Scale @ A3	Date	Issue Date
SG	CV	As Shown	18/10/10	19/10/10

Drawing No.: 10313/D005

Revision: -

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Trialpit No
TP01
Sheet 1 of 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: 0.40m x 2.50m	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).	34.95
				0.10	(MADE GROUND)	34.90
0.30	ES				Black ash fine to coarse SAND. (MADE GROUND)	
0.50	B				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)	
				1.10		33.90
1.20	ES				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)	
1.40	LB					
				1.60		33.40
1.80	HSV	35			Firm low to medium strength orange brown occasionally light grey very sandy SILT. (BOYN HILL GRAVEL)	
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 = Amber Jar
PT = Plastic Tub
V = Vial

Groundwater: No groundwater encountered during excavation.

Logged By : SC

Checked By : CV

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Trialpit No
TP02
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559304E - 174404N Level: 31.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 0.40m × 2.50m	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				
					Vegetation over dark brown sandy CLAY with many roots and rare angular brick gravel. (MADE GROUND)	
				0.30		30.70
0.40	ES				Stiff friable orange brown sandy slightly gravelly CLAY with some roots and occasional anuglar 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	ES					
1.00	LB					
				1.55		29.45
					Orange brown very sandy sub-angular to rounded quartzite and flint GRAVEL and COBBLES. (POSSIBLE MADE GROUND)	
				1.70		29.30
1.80	B			1.85	Orange brown mottled dark orange brown occasionally light grey SAND. (POSSIBLE MADE GROUND)	29.15
1.90	B					
				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)	
				2.70		28.30
					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)	
3.00	B					
				4.00	Trial pit complete at 4.00 m	27.00

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

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TrialPit No
TP03
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559355E - 174402N Level: 20.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 0.40m x 2.50m	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				
					Grass over brown sandy CLAY. (MADE GROUND)	
				0.30		19.70
0.40	ES				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					
				2.20		17.80
2.30	B				Orange brown very clayey slightly gravelly SAND. Gravel is sub-angular to rounded fine to coarse quartzite and flint. (PROBABLE MADE GROUND)	
				2.40		17.60
2.60	B				Stiff dark orange brown mottled orange brown very sandy CLAY with occasional pockets (<20mm dia.) of grey and yellow clayey sand. Some surbrounded flint and quartzite gravel and cobbles. (PROBABLE MADE GROUND)	
				2.70		17.30
3.00	B				Friable cream mottled brown sandy gravelly CLAY. Gravel is subrounded fine to coarse chalk. (PROBABLE MADE GROUND)	
				3.40		16.60
					Firm to stiff cream mottled brown sandy gravelly CLAY with occasional irregular flint cobble. Gravel is subrounded fine to coarse chalk. (PROBABLE MADE GROUND)	
				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

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Trialpit No
TP04
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559373E - 174428N Level: 20.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 2.50m × 0.40m	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				
					Grass over dark brown sandy CLAY. (MADE GROUND)	
				0.20		19.80
0.40	ES				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)	
				0.50		19.50
0.70	B				Friable orange brown very sandy CLAY with occasional subrounded to rounded flint and chalk gravel and cobbles. (PROBABLE MADE GROUND)	
				0.90		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		17.70
2.50 2.50	HSV B	40			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)	
3.00	HSV	38				
3.50	HSV	29		3.50		16.50
					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)	
				3.90		16.10
4.00	B				Brown sandy subrounded to rounded black flint GRAVEL. (PROBABLE MADE GROUND)	
				4.20		15.80
					Trial pit complete at 4.20 m	

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

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Trialpit No
TP05
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559408E - 174458N Level: 20.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 0.40m × 2.50m	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				
					Grass over brown sandy CLAY. (MADE GROUND)	
				0.25		19.75
0.40	ES				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)	
				0.60		19.40
1.00 1.00 1.00	HSV ES LB	62			Firm to stiff medium strength light brown slightly gravelly sandy CLAY. Gravel is subangular to rounded fine to coarse chalk. (PROBABLE MADE GROUND)	
				1.20		18.80
1.50	HSV	58			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) 1.3m mbgl - x2 150mm dia. metal pipes (north east / south west direction)	
2.00 2.00	ES B					
				2.30		17.70
3.00	B				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)	
				3.40	Trial pit complete at 3.40 m	16.60

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

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Trialpit No
TP06
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559379E - 174474N Level: 20.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 0.40m x 2.50m	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				
					Grass over dark brown sandy CLAY. (MADE GROUND)	
				0.30		19.70
0.40	ES				Brown very gravelly SAND with occasional pockets (<200mm dia.) of chalk gravelly chalk sandy silt. (MADE GROUND)	
				0.60		19.40
1.00 1.00	ES B				Orange brown slightly silty very gravelly SAND with brick. Gravel is quartzite, flint and occasionally chalk. (MADE GROUND)	
				1.30		18.70
1.50 1.50 1.50	HSV ES B	45			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)	
2.00	HSV	70				
2.50	HSV	50				
3.00	HSV	61				
3.50	HSV	58				
				3.60		16.40
4.00 4.00	HSV B	39			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)	
				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.

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Trialpit No
TP07
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559399E - 174407N Level: 20.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 2.50m × 0.40m	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				
					Grass over brown sandy CLAY. (PROBABLE MADE GROUND)	
				0.20		19.80
0.30	ES				Firm orange brown slightly gravelly very sandy CLAY. Gravel is subangular to subrounded fine to medium chalk. (PROBABLE MADE GROUND)	
				0.40		19.60
					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)	
1.00	B					
				1.50		18.50
					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)	
2.50	B					
				4.00	Trial pit complete at 4.00 m	16.00

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

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Trialpit No
HDP01
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559276E - 174507N Level: 35.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 0.30m x 0.30m	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				
					Grass over dark brown slightly gravelly sandy CLAY. (MADE GROUND)	
				0.25		34.75
					Orange brown slightly clayey sandy subangular to rounded fine to coarse quartz and flint GRAVEL with some subangular to subrounded flint cobbles. (MADE GROUND)	
0.50	ES					
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

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Trialpit No
HDP02
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559288E - 174471N Level: 35.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 0.30m x 0.30m	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	Grass over dark brown sandy CLAY. (MADE GROUND)	34.90
0.50 0.50	ES B				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)	
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

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Trialpit No
HDP03
Sheet 1 of 1

Project Name Knockhall Road	Project No. C10313	Co-ords: 559268E - 174432N Level: 35.00 m AOD	Date 07/09/2010
Location:Greenhithe, Kent		Dimensions: 0.30m x 0.30m	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	Grass over dark brown sandy CLAY. (MADE GROUND)	34.90
				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		34.20
0.90	ES				Orange brown slightly silty sandy subangular to rounded quartz and flint GRAVEL and COBBLES. (MADE GROUND)	
1.00	B			1.00		34.00
					Trial pit complete at 1.00 m	

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

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Borehole No **BH01**
Sheet 1 of 2

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)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
					0.10	34.90		Bituminous Material - Hard Standing. (MADE GROUND)
		0.30	ES					
		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)
					0.70	34.30		
		1.00	CPT	N=17 (4,6,5,4,4,4)				Stiff orange brown mottled dark orange brown and grey slightly gravelly sandy CLAY. Gravel is angular to rounded flint. (BOYN HILL GRAVEL)
		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)
		2.00	CPT	N=39 (4,7,10,10,9,10)	2.00	33.00		
		2.00-2.45	B					Dense orange brown slighlly silty very sandy subangular to rounded flint GRAVEL. (BOYN HILL GRAVEL)
		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)
		3.00-3.45	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)
		4.00-4.45	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)
		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)
		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 occaisonal black silty carbonaceous material. Gravel is subrounded to rounded flint and black flint. (BOYN HILL GRAVEL)
		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)
		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					
		9.55	SPT	N=14 (2,3,3,3,3,5)	9.40	25.60		Structureless CHALK composed of yellow occasionally white sandy SILT with many black specks.(Grade Dm) (WHITE CHALK)
		9.55-10.00	D		9.90	25.10		
		Type		Results				

Continued next sheet

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 Shear Vane
U Undisturbed Sample and number of blows

Borehole Types
DP Dynamic Sampling
Cable Cable Percussion
Rotary Rotary Core
RO Rotary Open Hole

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

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Project Name: Knockhall Road	Project No. : C10313	Co-ords: 559298E - 174539N	Borehole No **BH01** Sheet 2 of 2
Location: Greenhithe, Kent		Level: 35.00 m AOD	Hole Type Cable
			Scale 1:50
Client: Jones Lang LaSalle		Dates: 13/10/2010	Logged By SC

Well	Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		10.00	SPT	N=17 (3,3,4,4,5,4)				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		10.45	24.55		
								End of Borehole at 10.45 m

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19

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 Shear Vane
U Undisturbed Sample and number of blows

Borehole Types
DP Dynamic Sampling
Cable Cable Percussion
Rotary Rotary Core
RO Rotary Openhole

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

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Borehole No BH02
Sheet 1 of 1

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)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		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)
		1.00-1.45	U					
					1.50	18.50		Orange brown silty SAND woth some subangular to rounded flint gravel. (MADE GROUND)
		1.50-2.00	B					
		2.00-2.45	U					
		2.75	D		2.75	17.25		Brown very silty SAND with rare subrounded flint gravel. (MADE GROUND)
		3.00-3.45	U					
		3.75	D					
		4.00-4.45	U					
		4.75	D		4.75	15.25		Soft to firm dark brown slightly gravelly very sandy SILT. Gravel is subangular to rounded flint. (PROBABLE MADE GROUND)
		5.00	CPT	N=19 (2,3,5,4,5,5)	5.00	15.00		
		5.00-5.45	B					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)
		5.75	D		5.80	14.20		
		6.00	SPT	N=6 (1,1,1,1,1,3)				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)
		6.00-6.45	D		6.40	13.60		
		6.75	D					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)
		7.00-7.45	U					
		7.75	D		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)
		8.00	SPT	N=6 (1,1,1,2,2,1)	8.00	12.00		
		8.00-8.45	D					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)
		9.00	SPT	N=6 (1,1,2,2,1,1)				
		9.00-9.45	D					
					9.45	10.55		End of Borehole at 9.45 m

Type	Results

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 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
RO Rotary Open Hole

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

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Borehole No
BH03
Sheet 1 of 1

Project Name: Knockhall Road	Project No. : C10313	Co-ords: 559385E - 174445N	Hole Type Cable
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)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30	ES		0.40	19.60		Grass over dark brown SAND. (MADE GROUND)
		0.50	B					Friable brown slighlly 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	N=28 (4,5,5,7,8,8)	1.00	19.00		Stiff slighlly friable dark orange brown very sandy CLAY with some subangular to rounded flint gravel. (PROBABLE MADE GROUND)
		1.00-1.45	B					
		1.75	D		1.60	18.40		Firm dark orange brown very sandy CLAY with occasional subangular to rounded flint gravel. (PROBABLE MADE GROUND)
		2.00-2.45	U					
		2.75	D					
		3.00	CPT	N=10 (2,2,1,2,4,3)				
		3.00-3.45	D					
		3.75	D					
		4.00-4.45	U					
		4.75	D		4.75	15.25		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)
		5.00-5.45	U					
		5.75	D		5.75	14.25		Structureless CHALK composed of cream slighlly 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)
		6.00	SPT	N=12 (2,2,2,3,3,4)				
		6.00-6.45	D		6.20	13.80		Structureless CHALK composed of white slighlly gravelly sandy SILT.Gravel is extremely weak, low density, white with occasional cream staining and subangular to subrounded. Some flint gravel.(Grade Dm) (WHITE CHALK)
		6.75	D					
		7.00-7.45	U					
		7.75	D					
		8.00	SPT	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)
		8.00-8.45	D		8.45	11.55		End of Borehole at 8.45 m

Type | Results

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

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
RO Rotary Openhole

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

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Borehole No
BH04
Sheet 1 of 1

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)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.30	ES		0.40	19.60		Grass over dark brown slightly silty SAND. (MADE GROUND)
		0.50	B					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)
		1.00-1.45	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)
		2.00	CPT	N=14 (5,4,4,3,4,3)	2.00	18.00		
		2.00-2.45	B					Firm orange brown very sandy CLAY with occasional subangular to rounded flint gravel. (PROBABLE MADE GROUND)
		2.75	D		2.75	17.25		Very soft to soft orange brown very sandy CLAY with much iron staining. (PROBABLE MADE GROUND)
		3.00-3.45	U					
		3.75	D		3.75	16.25		Very soft dark orange brown very sandy CLAY. (PROBABLE MADE GROUND)
		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)
		5.00	CPT	N=10 (3,2,3,2,2,3)	5.00	15.00		
		5.00-5.45	B					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)
		5.75	D					
		6.00	SPT	N=11 (2,2,3,2,3,3)	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)
		6.00-6.45	D					
		6.75	D					
		7.00-7.45	U					
		7.75	D		7.75	12.25		Structureless CHALK composed of white slightly gravelly sandy SILT.Gravel is extremely weak, low density, white and clean, subrounded. Some rinded flints.(Grade Dm) (WHITE CHALK)
		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)
								End of Borehole at 8.45 m

Type	Results

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 (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 Openhole

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

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Borehole No
WS01
Sheet 1 of 1

Project Name: Knockhall Road	Project No. : C10313	Co-ords: 559323E - 174423N	Hole Type WS
Location: Greenhithe, Kent		Level: 31.00 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)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.20	ES		0.35	30.65		Dark brown SAND with many roots. (POSSIBLE MADE GROUND)
		0.40-1.40	D					Medium dense friable orange brown slightly silty gravelly SAND with some roots. Gravel is subangular to rounded flint, black flint and chalk. (POSSIBLE MADE GROUND)
		1.00	SPT	N=26 (7,10,8,7,5,6)				
		1.00-1.45	SPT					
		1.40-1.70	D		1.40	29.60		
		1.70-2.00	D		1.70	29.30		Very stiff slightly friable orange brown mottled grey slightly gravelly sandy CLAY. Gravel is subangular to rounded flint, black flint and chalk. (POSSIBLE MADE GROUND)
		2.00	SPT	N=53 (7,9,22,12,10,9)	2.10	28.90		Friable orange brown clayey very gravelly SAND. Gravel is subangular to rounded black flint, flint and chalk. (POSSIBLE MADE GROUND)
		2.00-2.45	SPT		2.40	28.60		Very stiff green brown occasionally orange brown sandy CLAY with many pockets (<60mm dia.) of white sandy silt. (POSSIBLE MADE GROUND)
		2.50-3.00	D					Structureless CHALK composed of friable sandy silty subangular GRAVEL. Clasts are extremely weak, low density, white, subangular to subrounded. Matrix is white.(Grade Dc) (WHITE CHALK) 2.4m to 2.6m: Many subangular flint cobbles.
		3.00	SPT	N=18 (6,4,5,5,4,4)				
		3.00-3.45	SPT		3.40	27.60		
		3.50-4.00	D					Extremely weak, low-density, white, occasional yellow staining and some black specks CHALK. Fractures are extremely close to very closely spaced, infilled with white comminuted chalk, with occasional iron staining. Occasional flint gravel. (Grade C4/C5) (WHITE CHALK)
		4.00	SPT	N=15 (4,3,3,4,4,4)				
		4.00-4.45	SPT		4.45	26.55		End of Borehole at 4.45 m

Type | Results

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 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
RO Rotary Openhole

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

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Borehole No
WS02
Sheet 1 of 1

Project Name: Knockhall Road	Project No. : C10313	Co-ords: 559333E - 174440N	Hole Type WS
Location: Greenhithe, Kent		Level: 26.00 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)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		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)
		1.00	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)
		2.00	SPT	N=34 (6,8,9,10,9,6)	2.10	23.90		
		2.00-2.45	SPT					
		2.10-2.50	D					Structureless CHALK composed of light brown, slightly gravelly sandy SILT. Gravel is extremely weak, low density, white, clean and subrounded. (Grade Dm) (WHITE CHALK)
		3.00	SPT	N=14 (3,2,2,2,2,8)	2.60	23.40		
		2.50-3.50	D					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)
		3.00-3.45	SPT					
		3.60-4.00	D		3.60	22.40		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)
		4.00	SPT	N=9 (2,2,2,2,2,3)				
		4.00-4.45	SPT					
					4.45	21.55		End of Borehole at 4.45 m

Type | Results

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
RO Rotary Open Hole

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

Hydrock Consultants

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Borehole No
WS03
Sheet 1 of 1

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)	Type	Results	Depth (m)	Level (m AOD)	Legend	Stratum Description
		0.20	ES		0.30	26.70		Dark brown gravelly SAND. Gravel is subrounded to rounded flint. (POSSIBLE MADE GROUND)
		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					
		1.00	SPT	N=19 (4,5,5,4,5,5)				Medium dense orange brown slightly silty gravelly SAND. Gravel is subrounded flint. (POSSIBLE MADE GROUND)
		1.00-1.45	SPT					
		1.00-1.50	D					
					1.60	25.40		
					1.80	25.20		Orange brown slightly silty slightly sandy subrounded flint GRAVEL. (POSSIBLE MADE GROUND)
					1.90	25.10		
		2.00	SPT	N=45	2.15	24.85		Friable orange brown slightly silty SAND. (POSSIBLE MADE GROUND)
		1.90-2.10	D	(3,4,5,7,18,15)				
		2.00-2.45	SPT					Very stiff friable orange brown very sandy CLAY with occasional subrounded to rounded flint gravel. (POSSIBLE MADE GROUND)
		2.20-2.40	D					
		2.50	SPT	52/150mm - Abandoned	2.95	24.05		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)
								End of Borehole at 2.95 m

Type | Results

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

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
RO Rotary Openhole

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

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Borehole No **WS04**
Sheet 1 of 1

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

Samples & In Situ Testing

Depth (m)	Type	Results
0.20	ES	
0.25-0.40	D	
0.40-0.80	D	
0.80-1.10	D	
1.00	SPT	N=29 (9,8,9,7,6,7)
1.00-1.45	SPT	
1.10-1.40	D	
1.40-1.80	D	
1.80-1.95	D	
2.00	SPT	N=19 (4,5,5,4,5,5)
2.00-2.45	SPT	
2.00-2.60	D	
2.60-2.90	D	
2.90-3.20	D	
3.00-3.45	SPT	
3.50	SPT	N=15 (4,3,3,4,4,4)

Depth (m)	Level (m AOD)	Stratum Description
0.25	33.75	Dark brown slightly silty SAND with many roots. (POSSIBLE MADE GROUND)
0.40	33.60	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)
0.80	33.20	Orange brown slightly clayey slightly sandy subangular to rounded flint and sandstone GRAVEL. (POSSIBLE MADE GROUND)
1.10	32.90	Very stiff friable orange brown very sandy CLAY with some thin laminations of light orange brown medium to coarse sand. (POSSIBLE MADE GROUND)
1.40	32.60	Medium dense orange brown slightly clayey sandy subrounded to rounded flint GRAVEL. (POSSIBLE MADE GROUND)
1.80	32.20	Friable orange brown very clayey SAND with some subangular to rounded flint gravel. (POSSIBLE MADE GROUND)
1.95	32.05	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)
2.60	31.40	Stiff friable green grey mottled green brown very sandy SILT. (POSSIBLE MADE GROUND)
2.90	31.10	Very stiff friable green slightly gravelly sandy SILT. Gravel is subrounded flint. (POSSIBLE MADE GROUND)
3.95	30.05	Stiff to very stiff orange brown very sandy CLAY with many pockets (<60mm dia.) of firm to stiff brown clay containing abundant pockets (<3mm dia.) of black silty carbonaceous material. (POSSIBLE MADE GROUND)

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 (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
RO Rotary Openhole

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

Appendix 4: 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	* *Sambucus nigra* (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. *Triticum* 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	** *Rubus fruticosus* agg./*idaeus, Chenopodiaceae*		*												
12	1/4	<2	10	97	2	* *Rubus fruticosus* agg./*idaeus*		* (1)	*											
13	1/5	2	35	98	2	* *Rubus fruticosus* agg./*idaeus*			*											
14	3/3	6	35	97	3	* *Rubus fruticosus* agg./*idaeus (1)*	* (2)	*	*	*	*Vicia/Pisum* sp. (1)	++								* (1)	
15	3/4	6	50	96	2	* *Sambucus nigra* (1), unid. fruit stone (1)	* (6)	*	*							*	CPR (3 small pcs)	+	** 2 types	
16	3/5	20	100	94	5	** *Rubus fruticosus* agg./*idaeus, unid. seeds*	* (4)	**	*										*	
17	3/6	4	45	98	2		* (1)	*	*											
18	8/3	6	65	98	2	* unid. fruit stones		*	*	*	cf. Cerealia (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	** *Rubus fruticosus* agg./*idaeus*, unid. Seeds, *Euphorbia helioscopia*, unid. thorn														
21	8/5	<2	<2	98	2	* cf. *Crataegus monogyna*														
22	9/3	20	170	95	1	* cf. *Crataegus monogyna*, Chenopodiaceae, unid. Seeds	* (9)	**	**				*	Poaceae (1 frag.)	++				* 2 types	
23	9/4	24	240	97	1	* cf. *Crataegus monogyna*, 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, *Euphorbia helioscopia*, *Rubus fruticosus* agg./*idaeus*													** 2 types	
31	4/6	4	40	99	1	unid. fruit stone (1)													* (3)	

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