




**C254 Archaeology West
ILFORD DEPOT
ARCHAEOLOGICAL SITE SPECIFIC WRITTEN SCHEME OF
INVESTIGATION
CRL Document Number: C254-OXF-T1-GMS-CRG03-50007**

1. Contractor Document Submittal History:

Revision:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
2.0	24 Jul 2013	[REDACTED]	[REDACTED]	[REDACTED]	Revisions following CRL review (see Review Sheet Document Number: C254-OXF-T1-XCS-CRG03-50009)

3. Acceptance by Crossrail

 Crossrail Review and Acceptance Decal			
This decal is to be used for submitted documents requiring acceptance by Crossrail.			
<input checked="" type="checkbox"/>	Code 1.	Accepted. Work May Proceed	
<input type="checkbox"/>	Code 2.	Not Accepted. Revise and resubmit. Work may proceed subject to incorporation of changes indicated	
<input type="checkbox"/>	Code 3.	Not Accepted. Revise and resubmit. Work may not proceed	
<input type="checkbox"/>	Code 4.	Received for information only. Receipt is confirmed	
Reviewed/Accepted by: (signature)	Print Name:	Position:	Date:
[REDACTED]	[REDACTED]	PROV. ARCH.	21/9/13
<small>Acceptance by Crossrail does not relieve the designer/supplier from full compliance with their contractual obligations and does not constitute Crossrail approval of design, details, calculations, analyses, test methods or materials developed or selected by the designer/supplier.</small>			

This document contains proprietary information. No part of this document may be reproduced without prior written consent from the chief executive of Crossrail Ltd.

Document History continued

Revision:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
1.0	24 Apr 2013	[REDACTED]	[REDACTED]	[REDACTED]	For Crossrail review





Contents

1	Executive Summary	6
2	Project Background	9
2.1	Introduction	9
2.2	Site Description	10
2.3	Summary of Previous Studies	10
3	Geology and Topography	10
3.2	Archaeological and Historical Development of the Site	17
3.3	Historic Asset Gazetteer	29
3.4	Deposit Survival Summary	32
3.5	Built Heritage Summary	32
4	Construction Impacts	33
4.1	Summary	33
5	Archaeological Mitigation - Aims and Objectives	37
5.1	Research Aims and Objectives	37
6	Scope of the Investigations	38
6.1	Archaeological Mitigation	38
6.2	Photographic survey	39
6.3	Geoarchaeological trial pit excavations	39
6.4	Trench excavations or purposive borehole drilling	39
6.5	General Watching Brief	39
6.6	Targeted Watching Brief	40
7	Programme	40
7.1	Introduction	40
8	Archaeological Contractor Specification and Requirements	41
8.1	Generic Standards	41
8.2	Potentially Nationally Important Remains	42
8.3	Human Remains	42
8.4	Treasure Act	42
8.5	Health and Safety	42
8.6	Location and Ground Elevation of Interventions and Survey Grids	42



8.7	Specification for photographic survey.....	43
8.8	Geoarchaeological trial pit evaluation	43
8.9	Specification for archaeological trench excavations	43
8.10	Specification for purposive borehole drilling.....	49
8.11	Specification for the general and targeted watching brief	49
8.12	Archaeological Science and Finds	51
8.13	Environmental sampling.....	53
9	Archaeological Contractor Deliverables	54
9.1	Archaeological Contractor’s Method Statement	54
9.2	Site Archives.....	56
9.3	Digital Data.....	56
9.4	Interim Statement	57
9.5	Survey Report.....	58
9.6	Fieldwork Report	58
9.7	GLHER Summary Sheet.....	60
9.8	Summary Report	60
9.9	Post Excavation Assessment	60
10	Site Monitoring and Progress Reports	61
11	Personnel Requirements	61
12	References.....	62
13	Definitions/Abbreviations/Acronyms	63
Annex 1	Site Information.....	65
Annex 2	Health and Safety Requirements.....	65
Annex 3	Personal Protective Equipment (PPE).....	67
Annex 4	Labelling of Hazardous Substances, Contaminated Land	67
Annex 5	CRL Health and Safety Management System, CRL Drugs and Alcohol Policy 67	
Annex 6	CRL and work on Network Rail Land.....	67
Annex 7	Environmental Protection Requirements	67
Annex 8	Programme and Order of Work for Implementation of Works and Integration with Other Activities.....	67
Annex 9	Enabling and Temporary Works Design Requirements, Attendances and Implementation.....	68
Annex 10	Security Requirements.....	68

Annex 11 Need for screening or other protective works	68
Annex 12 Procedure for Notification of the Discovery of Human Remains	69
Annex 13 Procedure for notification of the material falling under the Treasure Act 1996 69	
Annex 14 Procedure for notification of major unexpected discoveries	70

List of Figures

Figure 1: Site location	7
Figure 2: Plan of existing site	8
Figure 3: Projected survival of Ilford Silt member within the site	14
Figure 4: Model of the extent of surviving geological deposits within the site	16
Figure 5: Stratigraphy recorded from Cauliflower Pit from description by Cotton, 1847 (after July 2011, Fig. 6.16)	18
Figure 6: Detail of the Eastern Counties Railway proposal map of 1835 (ERO ref Q/RUM 1/56)	21
Figure 7: Detail of the Tithe map of the Parish of Barking of 1846 (ERO ref D/CT 18b)	22
Figure 8: 1st edition OS map of 1846-1875	23
Figure 9: Ilford sidings and the main line - looking west towards Ilford station. The footbridge is visible in the first plan and was later extended. Photograph taken on 11 May 1911 (Great Eastern Railway Society collection)	24
Figure 10: New Series OS map of 1919-1921	25
Figure 11: Aerial photograph dated 18 May 1932, showing the triangular junction (upper right corner) and the allotment gardens in the background (English Heritage ref EPW037930)	26
Figure 12: 1953 British Rail Ilford EMU (ERO ref D-Z 346-3003-53)	28
Figure 13: Plan showing the location of known historic assets at Ilford Depot. Note: the location of these buildings and structures is approximate only.	31
Figure 14: Bombardier Transportation Training Centre	33
Figure 15: Extract from dwg C161-MMD-T-DDA-CR112_SD007_1-40001 Rev C.01, showing proposed layout	35
Figure 16: Areas of impact from proposed construction overlaid on position of known historic assets. Note: the locations of historic structures is approximate only	36

List of Tables

Table 1: Historic Asset Gazetteer	30
Table 2: Trial trenches	45

1 Executive Summary

- 1.1.1 This Site Specific Written Scheme of Investigation (SSWSI) applies to proposed Crossrail works at Ilford Depot which is located between Ilford and Seven Kings railway stations in the London Borough of Redbridge (Fig.1). The site is bounded to the west by Griggs Approach, to the north by residential and commercial premises on Ley Street and Vicarage Lane, to the east by Aldborough Road South and to the south by residential buildings and a retail park fronting High Road. Ilford Depot is centred on Ordnance Survey National Grid Reference at TQ (5)44506 (1)86889.
- 1.1.2 Ilford Depot, which is an operational light maintenance depot, stabling yard and contract train maintenance depot owned by Network Rail and operated by Greater Anglia and Bombardier Transportation, is the location chosen for a Crossrail stabling yard. In summary, the proposals necessitate the demolition of Workshop B and several lightweight buildings and structures within the depot, rearrangement and realignment of permanent way track within the site, construction of OLE, general landscaping provisions the construction of a new Paint Shop and Traverser building, a Crossrail Operations and Welfare building and a Logistics and Stores Building, modifications within Workshop A, a new sub-station, sub-surface service diversions and installations and general landscaping works including access roads. These works have the potential to impact on historic structures and sub-surface archaeological remains on the site. The works will be undertaken under contract C828 Ilford Yard Stabling Project.
- 1.1.3 This SSWSI provides a strategy for mitigating the impacts on historic structures and sub-surface archaeological remains on the site that will arise from the construction activities listed above. It covers any impacts deemed to affect the known archaeological resource of the site that may be interpreted from the following information provided by Crossrail:
- 1.1.4 The mitigation strategy proposes a photographic survey and catalogue of those structures and parts of the depot which will be affected by the development proposals, a series of geoarchaeological test pits in areas of the site affected by construction impacts, trench excavations or purposive borehole drilling to recover archaeological information and deposit samples, a general watching brief during specific construction operations and a targeted watching brief during the construction of the Logistics and Stores Building.

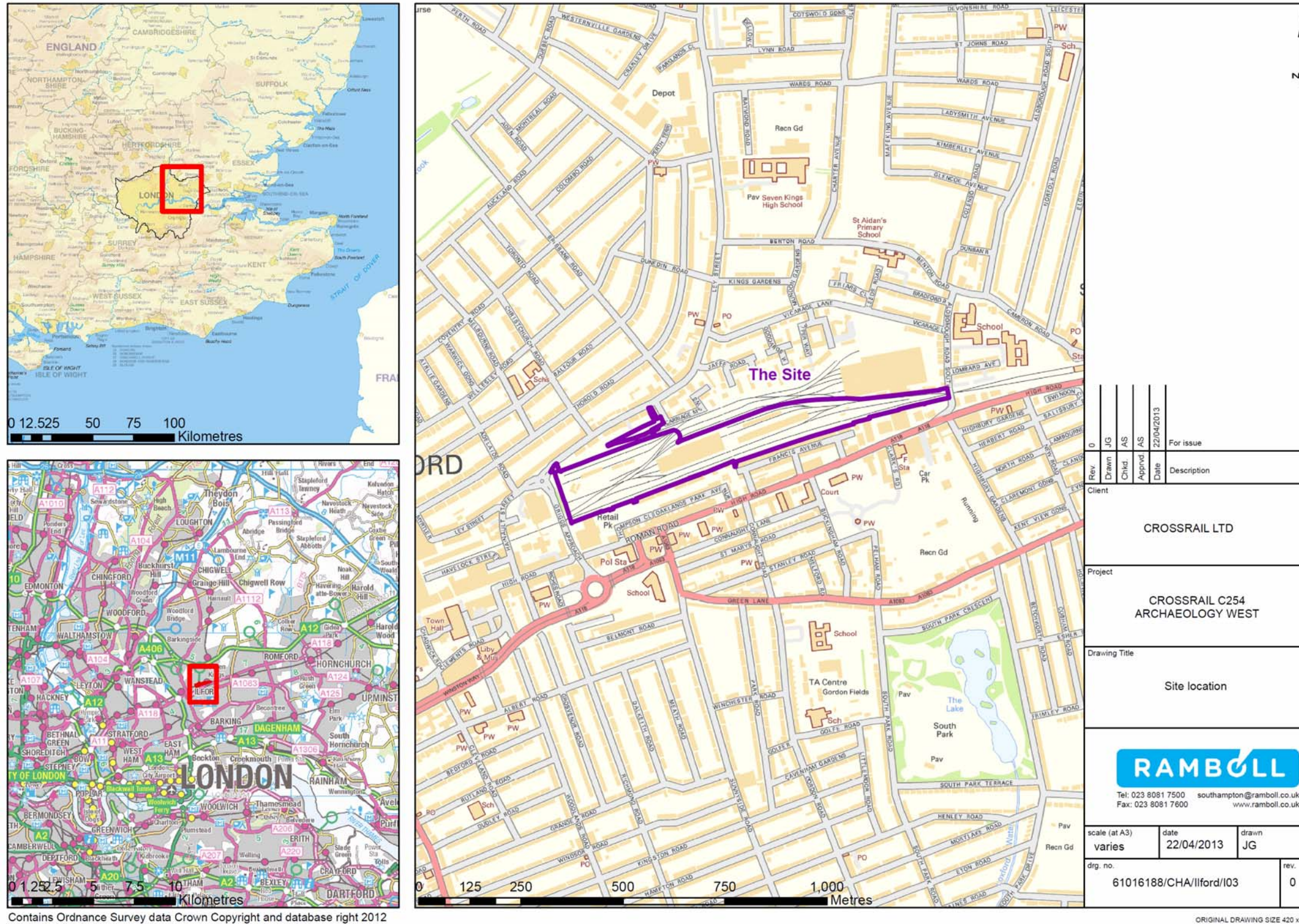


Figure 1: Site location

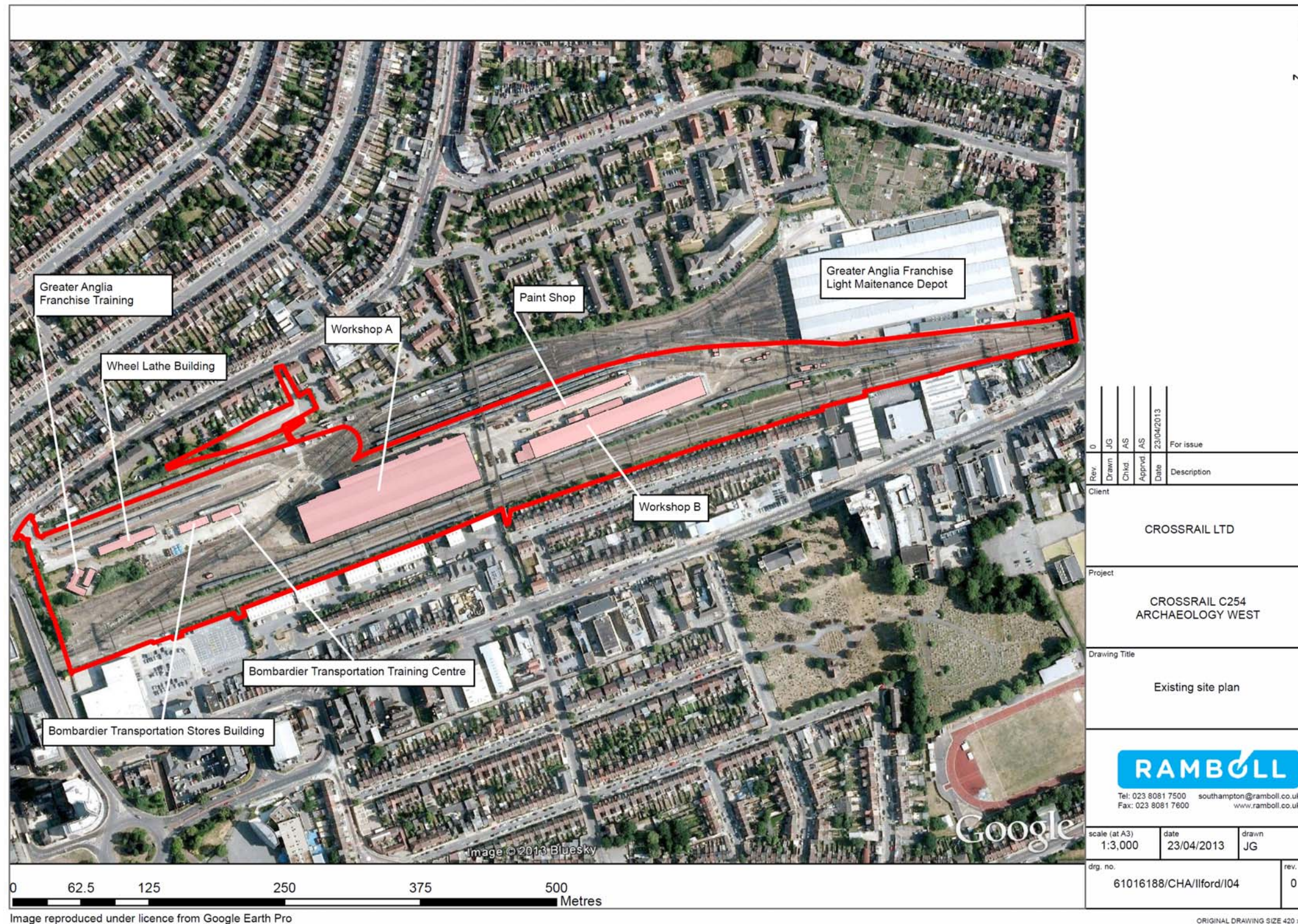


Figure 2: Plan of existing site

2 Project Background

2.1 Introduction

- 2.1.1 The overall framework within which archaeological work arising from the construction of Crossrail is undertaken is set out in the Environmental Minimum Requirements (EMR) for Crossrail (CR/HB/EMR/0001 (fifth draft July 2008)). Accordingly, the nominated undertaker or any contractors will be required to implement certain control measures in relation to archaeology before or during construction work.
- 2.1.2 The strategy for archaeological works on Crossrail has been set out in the Crossrail Generic Written Scheme of Investigation (SSWSI) (CR-PN-LWS-EN-SY-00001). The Generic SSWSI presents the strategy for archaeological design, evaluation, mitigation, analysis, dissemination and archive deposition that will be adopted for Crossrail and provides a general statement of objectives, standards and structure for the planning and implementation of archaeological works.
- 2.1.3 Ilford Depot, which is an operational light maintenance depot, stabling yard and contract train maintenance depot owned by Network Rail and operated by Greater Anglia and Bombardier Transportation, is the location chosen for a Crossrail stabling yard. In summary, the proposals necessitate the demolition of Workshop B and several lightweight buildings and structures within the depot, rearrangement and realignment of permanent way track within the site, construction of OLE, general landscaping provisions the construction of a new Paint Shop and Traverser building, a Crossrail Operations and Welfare building and a Logistics and Stores Building, modifications within Workshop A, a new sub-station, sub-surface service diversions and installations and general landscaping works including access roads. These works have the potential to impact on historic structures and sub-surface archaeological remains on the site. The works will be undertaken under contract C828 Ilford Yard Stabling Project.
- 2.1.4 This Site Specific Written Scheme of Investigation (SSWSI) provides a strategy for mitigating the impacts on historic structures and sub-surface archaeological remains on the site that will arise from the construction activities listed above. It covers any impacts deemed to affect the known archaeological resource of the site that may be interpreted from the following information provided by Crossrail:
- C161-MMD-T2-DDA-CR112_SD007_1-92017
 - C161-MMD-T-DDA-CR112_SD007_1-91000
 - C161-MMD-T-DDA-CR112_SD007_1-40001
 - C161-MMD-T-DDA-CR112_SD007_1-40000
 - C161-MMD-C-DDA-CR112_SD007_1-60001_p12
 - C160-MMD-R4-DDA-CR112_SD007_1_00003 Rev 01
 - C161 - Construction Programme C05
 - Works Information Volume 2A - C828 Ilford Yard Stabling Project v2 0
- 2.1.5 Any design changes arising from notified updates to this information will be addressed in future revisions to this SSWSI.

2.2 Site Description

- 2.2.1 Ilford Depot is located between Ilford and Seven Kings railway stations in the London Borough of Redbridge (Fig.1). The site is bounded to the west by Griggs Approach, to the north by residential and commercial premises on Ley Street and Vicarage Lane, to the east by Aldborough Road South and to the south by residential buildings and a retail park fronting High Road. Ilford Depot is centred on Ordnance Survey National Grid Reference at TQ (5)44506 (1)86889.
- 2.2.2 The southern part of the site is occupied by the Great Eastern Main Line railway operated by Greater Anglia (GA) and originally constructed in 1839 by the Eastern Counties Railway. The Ilford Depot is operational and contains the following principal buildings (Fig. 2):
- the GA light maintenance depot building (located to the east of the current development);
 - a small depot control building manned by GA;
 - a paint shop leased by Bombardier Transportation (BT);
 - Workshop B leased by BT;
 - a new train wash plant being installed separate to this project;
 - Workshop A leased by BT;
 - a BT training facility;
 - a storage facility leased by BT;
 - a wheel lathe building leased by BT; and
 - a training centre leased by GA at the western part of the site (this is being retained).
- 2.2.3 The site also comprises stabling trackwork and headshunts at both ends of the site, together with some smaller ancillary buildings.

2.3 Summary of Previous Studies

- 2.3.1 Previous studies and documents of specific relevance to this SSWSI relate to works undertaken by the Museum of London Archaeology (MOLA, formerly MoLAS) in the early stages of the Crossrail Bill process (such as Specialist Technical Reports: Assessment of Archaeology Impacts (Part 3 of 6), prepared in support of the Environmental Statement 2005) and an internal archaeological review of Ilford Depot GRIP4 survey works (memo to J. Carver dated 05-07-2011),

3 Geology and Topography

- 3.1.1 Information on the geology and topography of the site has been largely summarised from the *Ilford Yard Ground Investigation Report* (C161-MMD-G-RGN-CR112-50003) and *London before London: Reconstructing a Palaeolithic Landscape* (Juby 2011).
- 3.1.2 Ilford Depot lies within a broad railway cutting enlarged progressively during the first half of the 20th century. This formed a terraced land parcel located between Ley Street to the north, the Great Eastern mainline railway to the south and residential areas to the east and west.

- 3.1.3 Ilford Depot is located to the west of the River Roding. The site lies within an area of complex geology where fine grained deposits of the Ilford Silt Member (termed brickearth) overly the junction of Hackney and Taplow Gravel terraces, which in turn overly the solid geology of London Clay.
- 3.1.4 The Hackney and Taplow gravel terraces are representative of former floodplain deposits, and are broadly correlated with the Wolstonian Stage (c. 352,000-130,000 BP), the Hackney gravels (MIS¹ 10-9-8) predating the Taplow gravels (MIS 8-7-6). The Ilford Silt Member deposits were initially believed (Gibbard 1994) to have formed during the moderate climatic conditions of the Ipswichan Interglacial (c. 130,000-114,000 BP, MIS 5). A recent study of the lithostratigraphic and palaeoenvironmental data from Ilford (Juby 2011) indicates, however, that the Ilford Silt Member deposits are more likely to be correlated with the Corbets Tey Formation (MIS 10-9-8) and, therefore, the Hackney Gravel terrace. Based on the lithostratigraphic, mollusc, pollen and faunal remains analysed from within the site (a former quarry called Cauliflower Pit which will be described later), the Ilford Silt Member probably formed during MIS 9 (c. 334,000-301,000 BP).
- 3.1.5 This interpretation is at odds with some of the information in the model of deposits provided by the C161 Ground Investigation Report (C161-MMD-G-RGN-CR112-50003), which suggests that the Ilford Silt Member, where found within the site, rests on Taplow Gravel terrace. Although the Ilford Silt Member deposits were found overlying Taplow Gravel terrace to the south-west of the site (at Uphill Pit), studies by Green (2006) and Juby (2011) provide strong evidence that the Ilford Silt Member within the site formed during MIS 9, and should therefore be associated with the Hackney Gravel terrace. This apparent discrepancy may be partially explained by the fact that the topographic difference between the Hackney and Taplow Gravel terraces is not large, due to the Taplow Gravels representing the back edge of the lower (later) terrace and the Hackney Gravels representing the leading edge of the upper (earlier) terrace (Bridgland 1994).
- 3.1.6 Geotechnical and geo-environmental conditions within the site were investigated as part of the geotechnical ground investigations for the GRIP Stage 4 multidisciplinary design under Crossrail Contract C161 undertaken between December 2011 and March 2012. The site was investigated by exploratory hole investigations, as detailed below in Table 1. The records of five historic boreholes held by British Geological Society were also consulted for the GRIP Stage 4 report (C161-MMD-G-RGN-CR112-50003).

¹ Marine Isotope Stage - alternating warm and cool periods in the Earth's paleoclimate, deduced from oxygen isotope data reflecting changes in temperature derived from data from deep sea core samples.

Exploratory Hole Technique	No of holes	Maximum Depth (mbgl)
Cable Percussion boreholes (BH)	6	16
Windowless Sampling (WS)	21	6
Dynamic Probing (DP)	6	6
Cone Penetration Testing (CPT)	3	15
Hand Dug Trial Pits (HDTP)	6	2.5
Automatic Ballast Samples (ABS)	8	1

Table 1: Scope of ground investigations

- 3.1.7 The results of the intrusive ground investigation works has indicated significant variations in the ground conditions between the western and eastern parts of the site, principally due to the historic brickearth extraction. Given the variation in ground conditions across the site, the ground model has been subdivided into two areas:
- The eastern site ground model – the extents of which can be defined as an area between the easternmost end of Workshop A to the site boundary (approximately two-thirds of the length of the site); and
 - The western site ground model – the extents of which can be as an area between the westernmost end of Workshop A to the site boundary (approximately one-third of the length of the site).
- 3.1.8 The central area of the site occupied by Workshop A and its sidings to the north of the building was subject to GI works as any construction works were deemed unlikely to take place in this location. For the purpose of this study any modern hardstanding and ballast or the historic levelling deposits itemised in the ground investigation report are presented here collectively as made ground.

- 3.1.9 The stratigraphic sequence within the site, including the results of the historic boreholes, is summarised below in Table 2:

Stratum	Western model		Eastern model	
	Elevation at top, mLG	Thickness, m	Elevation at top, mLG	Thickness, m
Made Ground	114.79 to 111.27	3 to 0.15	112.10 to 110.92	6.5 to 0.9
Ilford Silt Member ¹	113.19 to 110.27	3.15 to 0.6	110.80 to 108.74	2 to 0.5
Hackney Gravel ²	112.31 to 107.90	6.8 to 0.6	109.29 to 105.13	8 to 7.2
London Clay ³	111.31 to 101.10	Not proven	110.94 to 97.13	Not proven

Notes: ¹ Recorded in BH02, BH05, WS02-WS04, WS08, WS10-WS1 and historic boreholes

² Recorded in BH01-BH06, WS02, WS15, WS17, WS18ABS01-ABS03 and historic boreholes except for TQ48NW/146

³ Recorded in BH01-BH04, BH06, WS02, WS05, WS06, WS15, WS17, WS18 and historic boreholes

Table 2: Stratigraphic summary for the upper terrace east of the GWS

- 3.1.10 The ground investigations confirmed a natural slope of the underlying geology towards the south-west. The investigation also confirmed that the site has been subjected to significant truncation relating to the historic brickearth quarrying and, to a lesser degree, excavation of the East Counties Railway cutting, and construction of railway buildings and track layout. The depth of truncation and made ground was noted as variable.
- 3.1.11 Although the scope of ground investigations within the site and in its proximity is insufficient to create a comprehensive three-dimensional model of superficial geology strata, the available results have allowed an indicative extent of the Ilford Silt Member within the site to be predicted (Fig. 3).

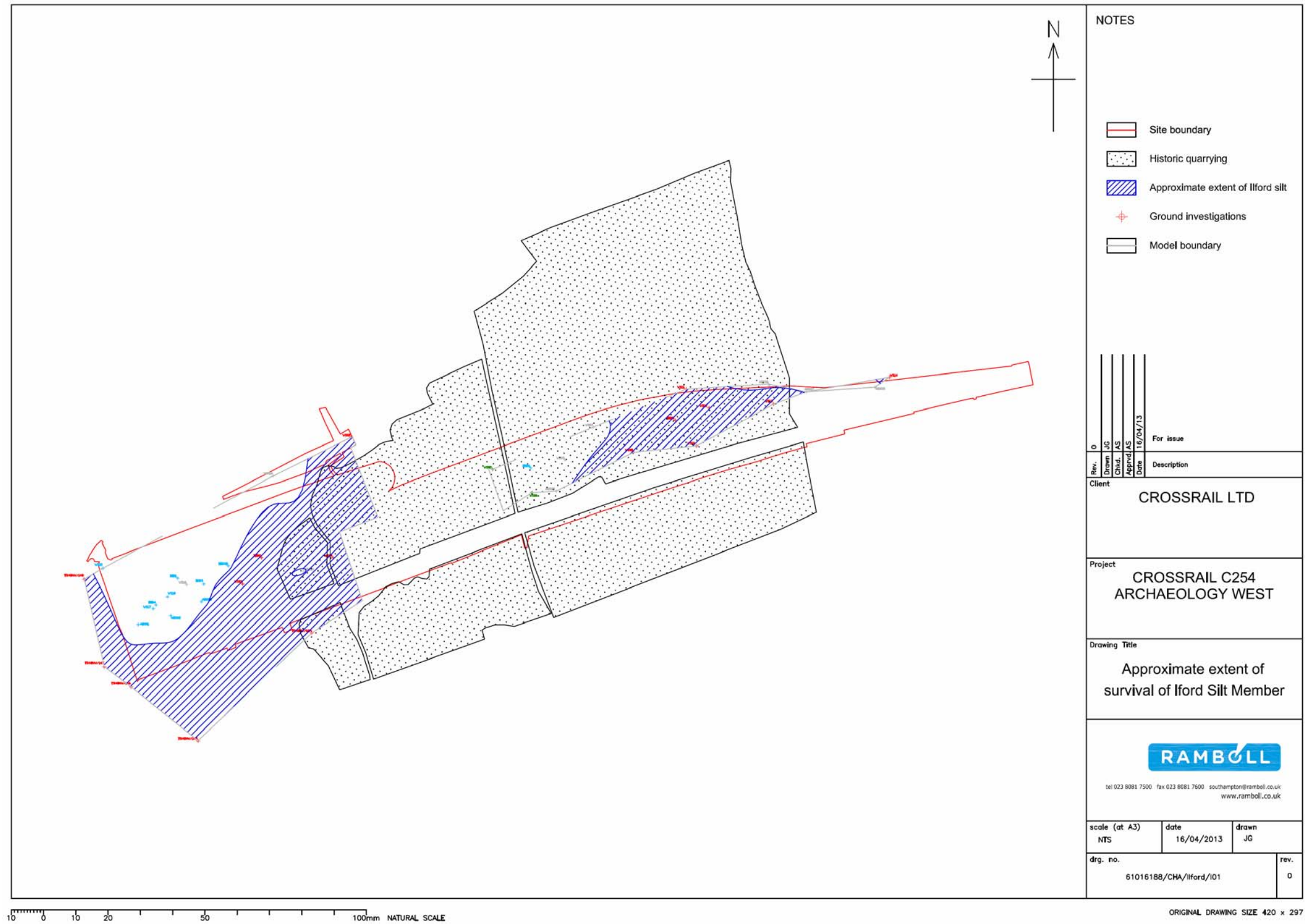


Figure 3: Projected survival of the Ilford Silt member within the site

- 3.1.12 The available data was used to create a contour model of the top of natural geology, or more accurately, the geological deposits below made ground (Fig. 4). The locations where the Ilford Silt Member was recorded were then identified and the probable extents of silt deposits were calculated and cross-referenced with the recorded levels. The resulting approximate extent of the Ilford Silt Member was subsequently superimposed onto the contour model and correlated with the extents of the historic quarrying.
- 3.1.13 The model suggests that the Ilford Silt Member is absent in the north-western part of the site, probably as a result of the cutting for the c. 1919 coal depot and sidings coinciding with the upper part of a geological downslope of the brickearth deposits. Equally, however, it is possible that this truncation has resulted from brickearth quarrying not recorded by the available historical sources. Surprisingly, the Ilford Silt Member is present within the area of the western site ground model, where the historic brickearth quarrying indicated by the 1864 and 1897 OS maps is known to have taken place. The silt deposits survive to a thickness between 0.6m (WS02) in the northern part of the site and 3.15m (TQ48NW/684) immediately to the south of the site.
- 3.1.14 The average thickness of the Ilford Silt Member in the western site ground model is c. 1.5m. However in two boreholes (BH2 and TQ48NW/684) the deposits exceeded 3m in depth. It is possible that these boreholes indicate locations of ice wedge casts, whereby the strata were exposed to permafrost conditions.
- 3.1.15 Within the eastern site ground model, the Ilford Silt Member is present in the south-eastern part of an area of possible brickearth quarrying indicated in the 1897 OS map as 'Brick Field'. The thickness of silt deposits, where recorded, varied between 0.5 and 2m. Borehole BH06 and window samples WS05, WS06 and WS09 seem to confirm the extents of the brickearth extraction to the west. Borehole BH06 identified the made ground to reach 6.5m below the ground level. This may suggest the location of another possible, quarried-out, ice wedge cast or where the brickearth extraction turned into an opportunistic gravel extraction exercise.
- 3.1.16 Outcrops of London Clay directly below made ground were identified in window samples WS05 and WS06, although it is not clear if these indicate the degree of truncation or are result of geological processes whereby the gravel terraces were not formed.

\\sparrow\sub\616188 - Crossrail Archaeology\Drawings\Ilford\Ilford\CA\61016188-CHA-Ilford-102_topo on natural.dwg - Plot date and time = 22/04/2013 16:31:47

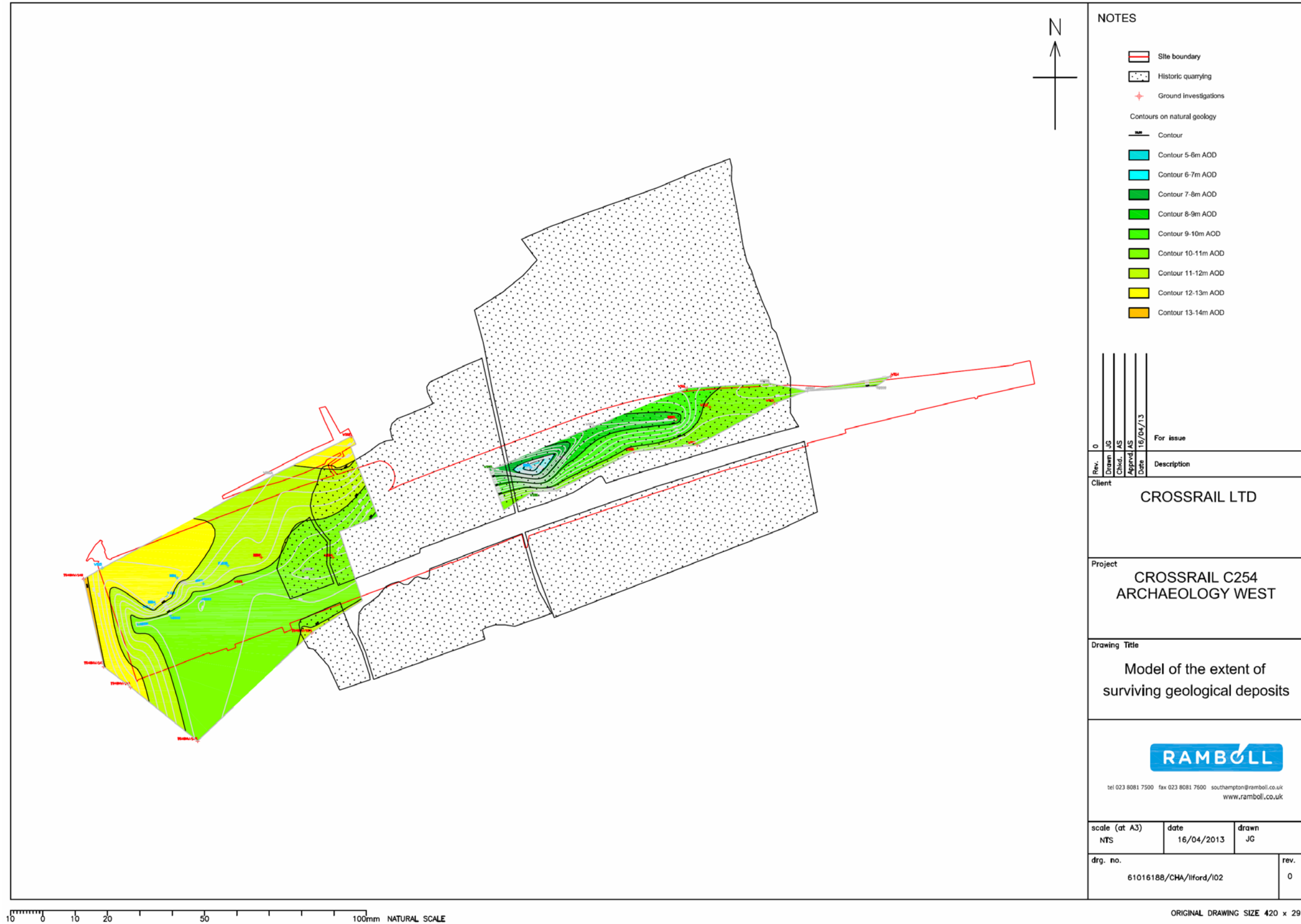


Figure 4: Model of the extent of surviving geological deposits within the site

3.2 Archaeological and Historical Development of the Site

- 3.2.1 A summary of the archaeological and historical development of the site is set out below and draws on the information provided in the documents listed in Section 2.3.1 and additional research undertaken during the preparation of this SSWSI, which included:
- Cartographic analysis of the available historic maps held by London Metropolitan Archives and Essex Record Office;
 - Review of data held by the Greater London Historic Environment Record (GLHER) accessed on 12 February 2013;
 - English Heritage GIS datasets and online database for designated heritage assets;
 - British Geological Survey Mapping; and
 - Secondary published and online sources.
- 3.2.2 A 1km radius area was defined for the HER and GIS datasets search - this is hereafter referred to as 'the study area'.
- 3.2.3 There are no World Heritage Sites, Scheduled Monuments or Registered Battlefields within 1km of the site. The site does not lie within a Conservation Area (CA) or Archaeological Priority Area (APA) designated by London Borough of Redbridge; However, immediately to the south of the site there is an APA which defines the route of the Roman road linking *Londinium* (London) with *Camulodunum* (Colchester). Another APA within the grounds of the Grade II Listed Valentines Park (List entry 1000843) is located c.630m to the north-west of the site. Mayfield CA lies c. 780m to the south-east of the site.
- 3.2.4 There are no designated buildings within the site. However, within the 1km-radius study area there are:
- Eight statutorily Listed buildings, of which one, the chapel at Ilford Hospital of St. Mary and St. Thomas of Canterbury, is Grade II* and seven are Grade II;
 - Thirty-two locally listed buildings designated by the London Borough of Redbridge.
- 3.2.5 The GLHER contains 59 entries for archaeological sites and findspots within the study area. However, only two are located within the site:
- MLO102907 - Palaeolithic artefacts and 19 mammalian fossil remains found in the 19th century in a brick earth pit; and
 - MLO63597 - Evaluation undertaken by F. Meddens for the Passmore Edwards Museum, in 1992 (site code IG-PS 92). Evidence for Pleistocene ice-wedges and layers of tufa were observed, but no cultural deposits predating the early 20th century.
- 3.2.6 The GLHER also lists 36 archaeological investigations or 'events', of which none are recorded within the site.
- 3.2.7 Generally, it is possible to state that the landscape of the site and its environs during the prehistoric period would have been dominated by the valley of the river Roding which would have provided a landscape ideal for hunter-gatherer activity and occupation.
- 3.2.8 The fossiliferous nature of the brickearths exploited commercially for brick production in Ilford area in the 19th century was recognised by local amateur collectors and geologists, chiefly by J. Morris and Dr R. P. Cotton, who first undertook the description of stratigraphy and mammalian fossils uncovered in the Cauliflower Pit located within the site. The exact extent and location of the Cauliflower Pit (also known as the Curtis' Pit, Sam's Green or Page's Pit) is not clear. However, the 1864 OS map depicts the central part of the site as being quarried and is annotated: '*Fossil remains of various large animals found in different parts of this field*'. The 1897 OS map also suggests that the quarrying took place to the

east, within a field labelled as *Brick Field* bounded to the north by Cauliflower Lane (now Vicarage Lane).

- 3.2.9 Antiquarian records (interpreted by Juby [2011], see Fig. 5) indicated that these remains were found at the level where the interface between Ilford Silt and underlying gravels occurs. Excavations in 1957 at nearby 1 Gordon Road, by Rolfe, appear to confirm this position within the geological sequence.

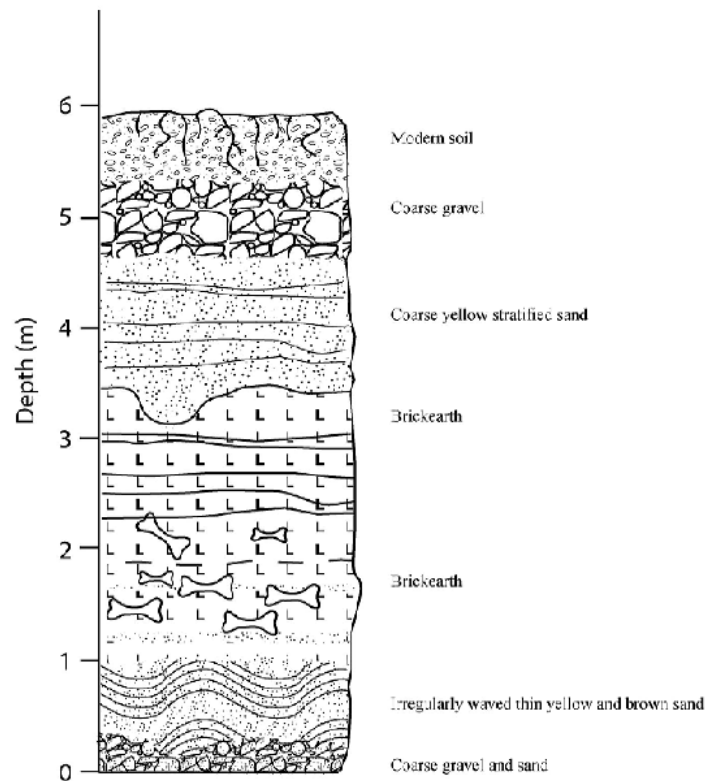


Figure 5: Stratigraphy recorded from Cauliflower Pit from description by Cotton, 1847 (after Juby 2011, Fig. 6.16)

- 3.2.10 Over 1600 Pleistocene mammalian fossil bone fragments are known from Ilford, including the skull of 'Ilford Mammoth' – the largest found in Britain. However, a recent study has identified only 19 bone fragments which can be provenanced to the Cauliflower Pit with any certainty (Juby 2011). These include the remains of *Panthera leo* (lion), *Equus ferus*

(wild horse), *Stephanorhinus hemitoechus* (narrow-nosed rhinoceros), *Stephanorhinus kirchbergensis* (Merck's rhinoceros), *Cervus elaphus* (red deer) and undetermined remains of a large bovid, probably *Bos primigenius* (aurochs). Other Pleistocene mammalian fossil remains known from the study area (but not the site) include *Canis lupus* (wolf), *Ursus arctos* (brown bear), *Palaeoloxodon antiquus* (straight-tusked elephant), *Mammuthus primigenius* (woolly mammoth), *Megaloceros giganteus* (giant deer), *Capreolus capreolus* (roe deer) and *Bison priscus* (bison).

- 3.2.11 The assemblage is generally representative of open environments, with *S. hemitoechus*, *E. ferus*, *Bovidae* sp., all predominantly being grazers and inhabiting grasslands. Woodland environments are also indicated by the presence of *S. kirchbergensis*. The analysis of molluscs recorded from the Cauliflower Pit indicates a presence of a slow flowing river, probably a tributary to the palaeo-Thames. These results are corroborated by the analysis of pollen retrieved from a 1964 borehole located to the east of the site, in the Seven Kings area of Ilford (West 1969, July 2011). The earliest recorded palynological sequence, which could be broadly correlated with MIS 10-9-8 (c. 364,000-244,000 BP), confirms open environments were present, with low tree pollen and high levels of grasses and sedges. Marsh and aquatic habitats were well represented, suggesting the presence of a small pond or slowly flowing water.
- 3.2.12 Only one Palaeolithic flint tool is confirmed to have originated from the Cauliflower Pit. However, many more were described by the Victorian antiquarians Hinton and Johnson (July 2011). Approximately twenty-two Palaeolithic items are known to have been discovered from the area of the probable location of the Cauliflower Pit to the north of the railway; these include eight Lower Palaeolithic handaxes, flint flakes (two of which were retouched), five Lower to Middle Palaeolithic Levallois flakes and one core. All Palaeolithic finds identified in the proximity or within, the Cauliflower Pit were abraded, suggesting that none were *in situ* deposits.
- 3.2.13 A Lower Palaeolithic handaxe is also known from the area of Seven Kings, c. 180m to the east of the site. Another handaxe and a flake were recovered during 19th-century clay extraction at Wanstead Pit in the area of the Buckingham Road Cemetery, c. 100m to the south of the site. A broken handaxe and a core were also found at Station Road, c. 670m to the west of the site.
- 3.2.14 The presence of handaxes (probably Acheulian) indicates the study area had been at least sporadically occupied during the Lower Palaeolithic period (c. 2,600,000 – 300,000 BP). The evidence for Levalloisian technology, which was first introduced in the latter stages of the Lower Palaeolithic but is most commonly associated with the Neanderthal Mousterian industries, suggests that the occupation continued into the Middle Palaeolithic (c. 300,000 – 30,000 BP).
- 3.2.15 The evidence for Mesolithic, Neolithic and later prehistoric period archaeological remains is scarce, being confined to a number of worked flint artefacts recovered at Dudley Road c. 720m to the south-west of the site. A single tanged and barbed Early Bronze Age arrowhead was discovered nearby, at Windsor Road.
- 3.2.16 Although the site is located in close proximity to the Roman Road to *Camulodunum* (Colchester), now shadowed by Ilford High Road, the archaeological evidence dating to this period within the study area is confined to a single find of a ceramic 'brownware' bottle discovered in 1912.

- 3.2.17 The early medieval village of Ilford is first recorded in the Domesday Book of 1086 as Ilfort which in Old English means 'ford over the Hyle'. Hyle, which means 'trickling stream', was an historic name for the River Roding.
- 3.2.18 The evidence for medieval occupation within the study area is concentrated to the west of the site, where the road to Colchester crossed the River Roding. The first evidence for a bridge in Ilford dates to 1321, and the structure is probably shown in an 18th-century drawing in the *Victoria County History*. One of the earliest documentary sources for the medieval development of Ilford refers to the foundation of the Ilford Hospital of St Mary and St Thomas of Canterbury in c. 1140 by Adelia, Abbess of Barking, as a leper hospital. Later, it became a hospice for aged and infirm men. It was initially built for the accommodation of a prior, a warden, two priests and thirteen lepers and was endowed with 120 acres of forest land, a mill and tithes of all the mills in Barking. The 1959-1960 excavations in the forecourt of the hospital and a 2005 evaluation revealed remains of a cemetery used continuously from the medieval to post-medieval period.
- 3.2.19 To the east of the site lay the medieval village of Seven Kings, first referred to in 1285 as *Sevekyngg* or *Sevekyngges*, meaning 'settlement of the family or followers of a man called Seofoca'.
- 3.2.20 During the 16th, 17th and 18th centuries Ilford remained a small rural settlement straddling the ancient road to Colchester. The Middlesex and Essex Turnpike Trust controlled and maintained the road from 1721. The River Roding was made navigable for barges as far as Ilford Bridge from 1737.
- 3.2.21 The 19th century saw a gradual expansion of Ilford, brought about brickworks, cement works, and coal yards to service the new buildings, largely centered on the River Roding. In 1801 the population of Ilford was 1,724 - by 1841 it had grown steadily to 3,742 inhabitants. On the 20 June 1839, a railway station was opened on the East Counties Railway line from Romford to Mile End. The early businesses gave way to new industries, such as paper making, and services such as steam laundries and collar-making to provide for the new commuting class created by the railway. A number of major businesses have been founded in the town, including the eponymous photographic film and chemicals manufacturer Ilford Photo, founded in 1879 by Alfred H. Harman (Ilford Photo moved from Ilford in 1983).
- 3.2.22 Despite the Victorian development of Ilford village a study of the historic maps indicates that the area of the site comprised open fields and clay pits well into the late 19th century (Fig. 6 and 7). The 1st edition Ordnance Survey (OS) map shows the twin-track Great Eastern Railway (GER) set within the cutting of its predecessor, the East Counties Railway (ECR, 1839-1862) (Fig. 8). The cutting intersects open fields, field boundaries and the remains of brickearth quarries. Groups of cottages lined the northern side of the London to Colchester road and to the north of the site terraced villas had appeared beside Ley Street. Where Ley Street veers to the north-east and forms a junction with Cauliflower Lane a building, possibly a farm labelled Sarns Green, is shown. Cauliflower Lane is undeveloped and at the east of the site forms a junction with a north-south lane which meets the London road by Cauliflower Cottage. This lane passes over the railway on Cauliflower Bridge. At this time a north-south lane occupied the western part of the site. Leystreet Cottages lined its western edge and its southern end is formed by an industrial building, possibly a brickworks because a track leads from it into the quarry to the east.

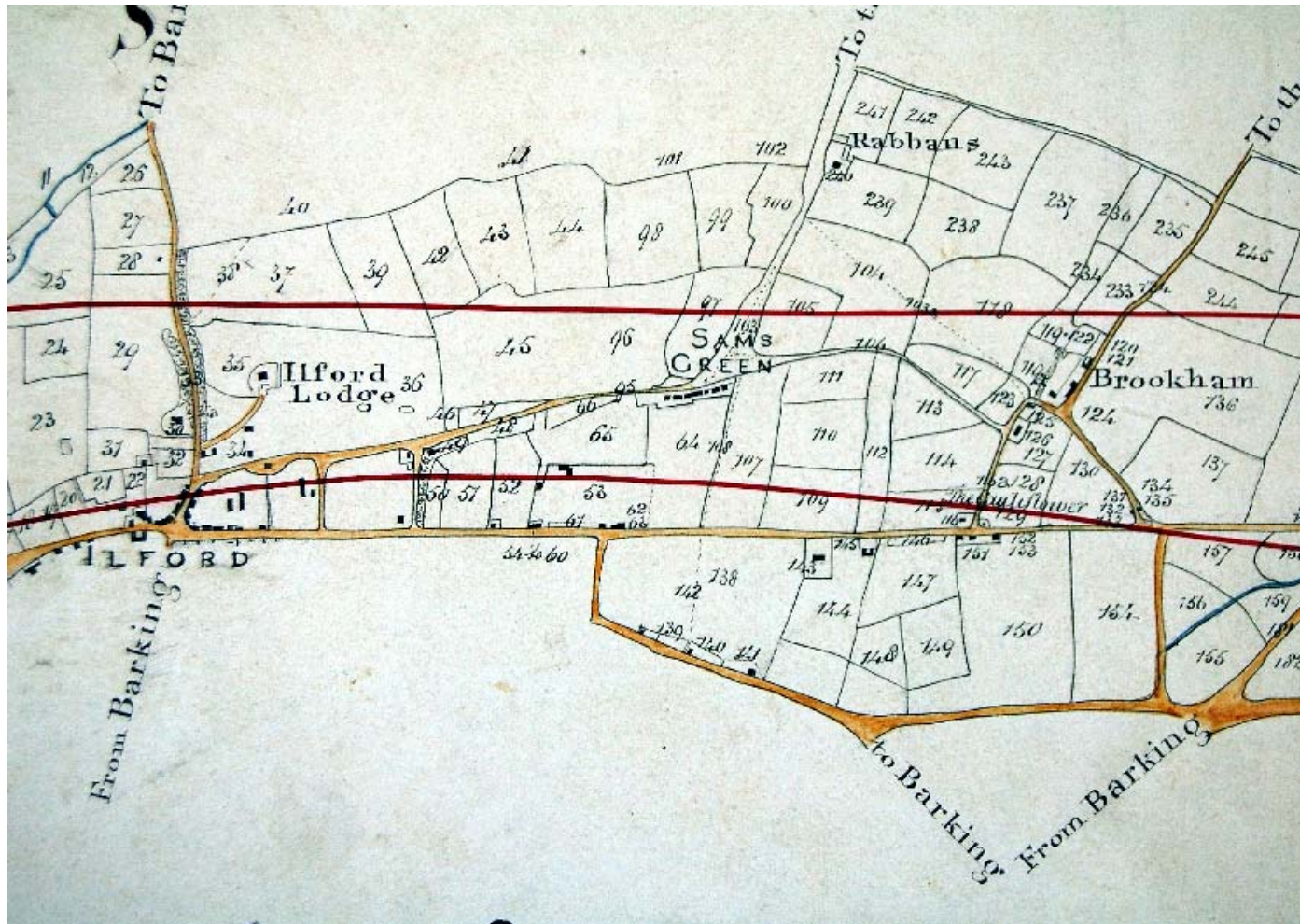


Figure 6: Detail of the Eastern Counties Railway proposal map of 1835 (ERO ref Q/RUM 1/56)
Page 21 of 21

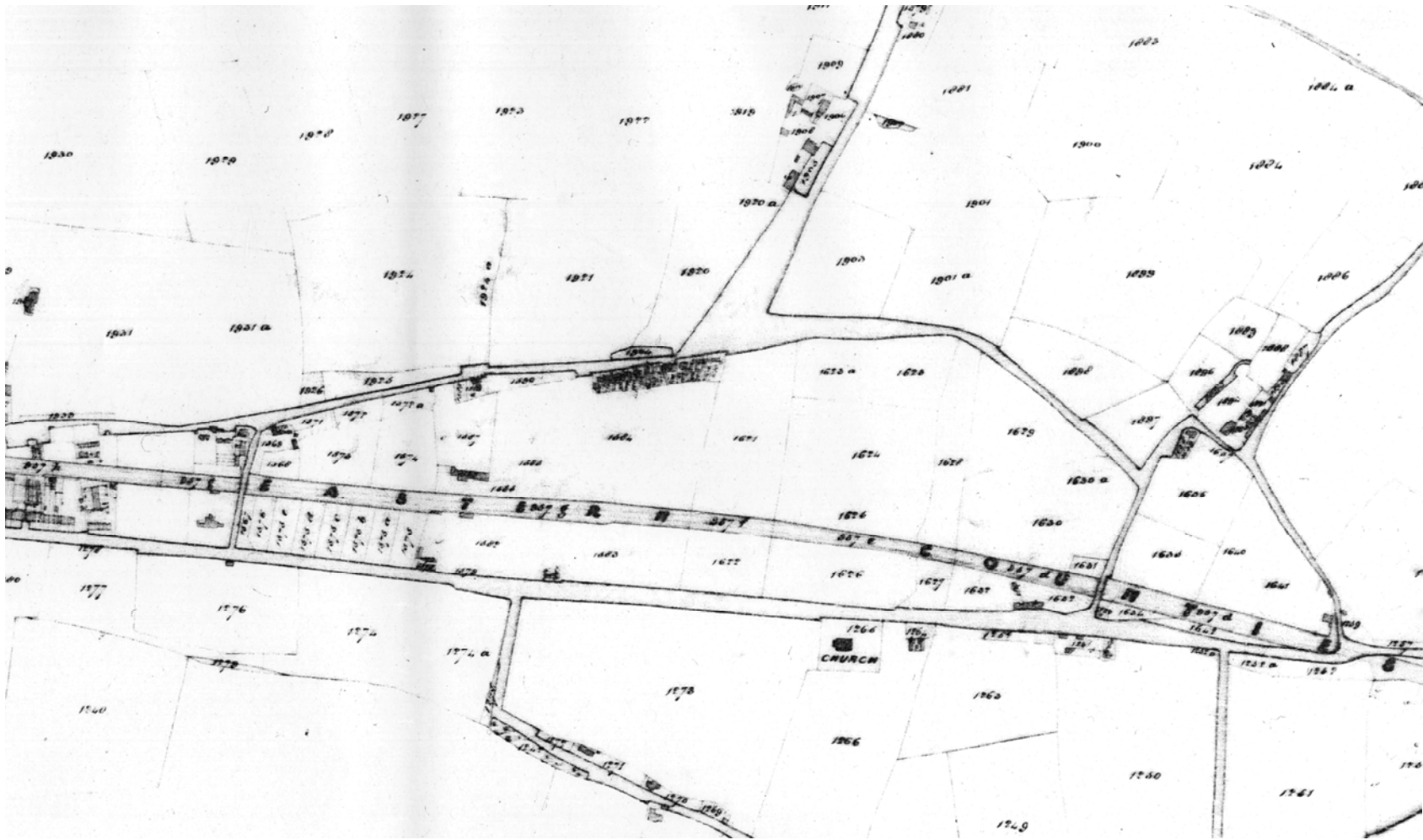


Figure 7: Detail of the Tithe map of the Parish of Barking of 1846 (ERO ref D/CT 18b)

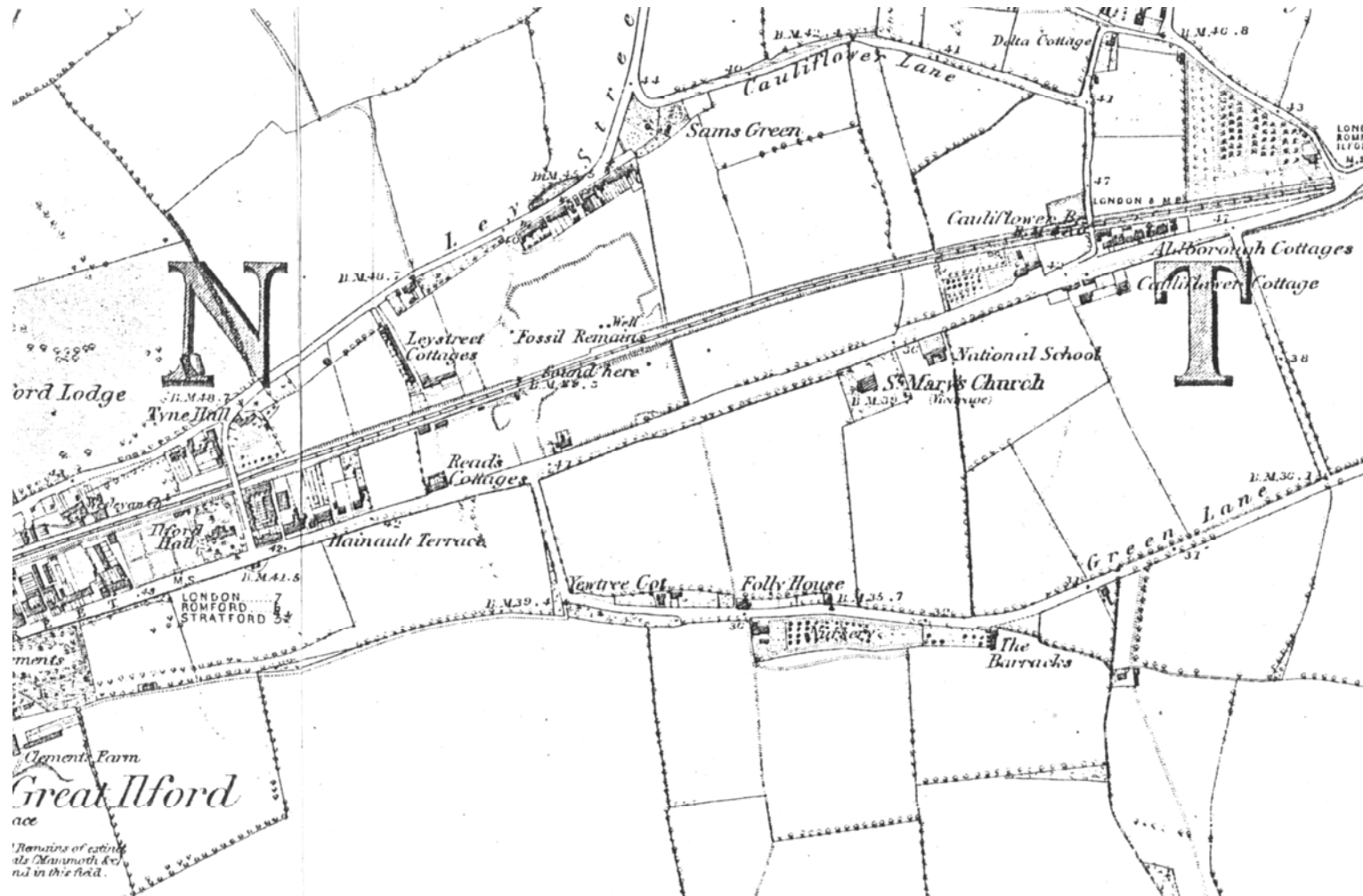


Figure 8: 1st edition OS map of 1846-1875
Page 23 of 23

- 3.2.23 The ECR was constructed in 1839 under the direction of engineer John Braithwaite. It was originally laid to a five foot gauge, but between September and October 1844 it was converted to standard gauge by Robert Stephenson.
- 3.2.24 At the time that the 1897 OS map was surveyed the site's layout had changed little, although Leystreet Cottages, their lane and the brickworks had disappeared since the 1875-1882 1:10,560 OS maps were published. However, the railway cutting had been enlarged to accommodate a siding to the north and to the south of the main line, with ancillary sidings feeding further south to service a goods yard and goods shed (Structure 1). A further short spur to the south led to a cattle pen (Structure 3) (these are all outside the site boundary or within the main line corridor). A junction on the north side of the main line (the up line) is also shown. This appears to be the start of the formation of the coal depot and stabling facilities that later developed to the north of the main line (and became the Ilford Depot). A short footbridge (Structure 2) spanning the railway corridor had been constructed to provide a link between Sam's Green and the High Road to the south. By this time also that part of the brickearth quarry to the south of the railway appears to have fallen from use - it is unclear if the northern part of the clay pit had been abandoned as well, but it is probably given that the Leystreet works had ceased to exist.



Figure 9: Ilford sidings and the main line - looking west towards Ilford station. The footbridge is visible in the first plan and was later extended. Photograph taken on 11 May 1911 (Great Eastern Railway Society collection)

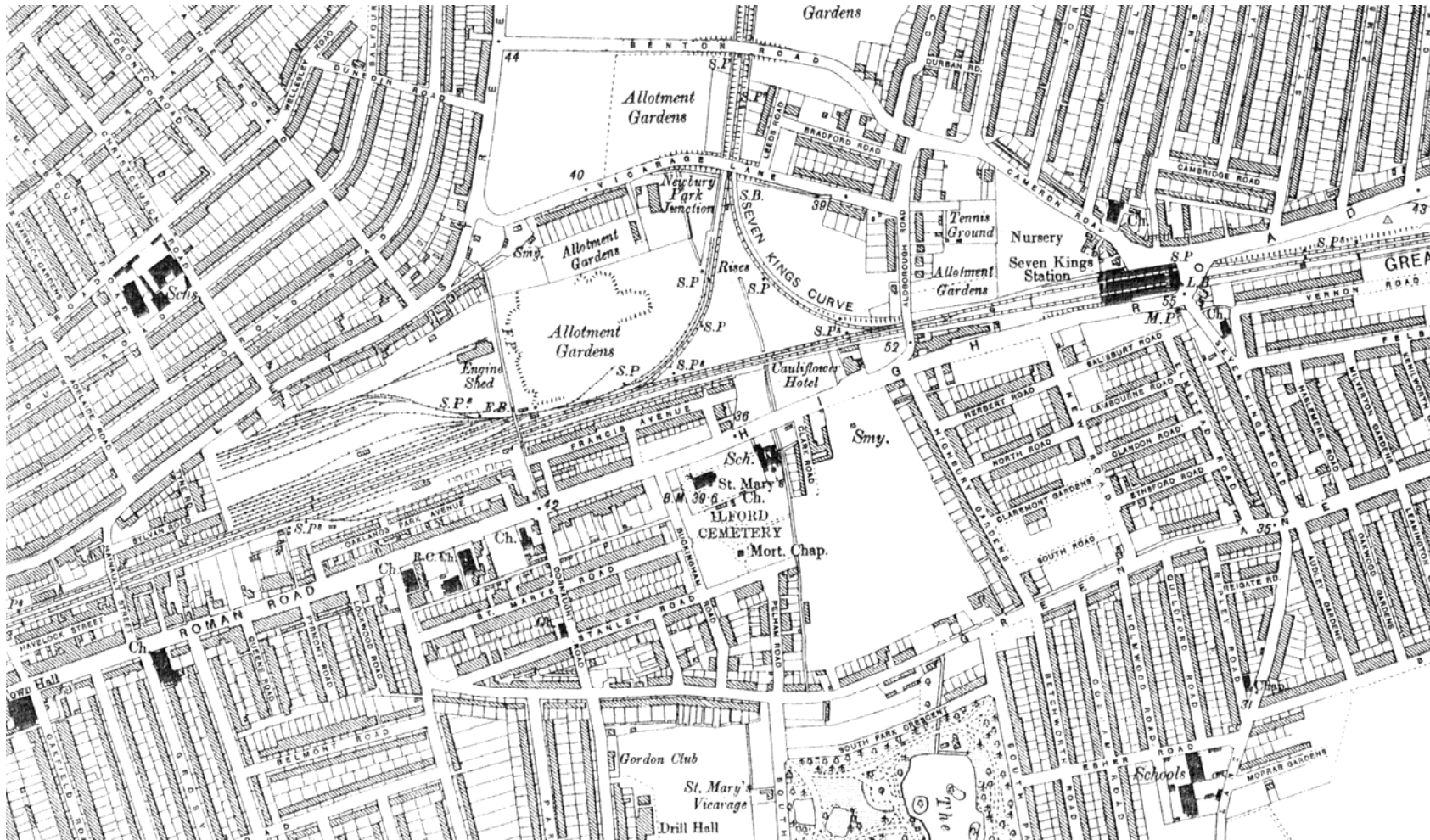


Figure 10: New Series OS map of 1919-1921

3.2.25 The new series Ordnance Survey map of 1919 (Fig. 10) shows how the study area had become rapidly urbanised, a consequence perhaps of increased rail connections associated with the opening of the Fairlop Loop in April 1903, designed by Great Eastern Railway to foster suburban growth in Edwardian Ilford and Chigwell. The Loop's southernmost triangular junction, named Seven Kings Curve, was located in the eastern part of the site. The north-west part of the site, hitherto gardens or fields, had by this time become developed into an extensive stabling yard comprising nine sidings. A further set of sidings to the north of the site of the stabling yard served the newly-built coal depot (Structure 10). The vehicular entrance to the coal depot was situated at the north-western corner of the yard. A rectangular three-road engine shed (Structure 7), associated well (Structure 8) and a rectangular water tower (Structure 9) stood to the east of the coal depot, all being to the west of the footbridge which had been extended northwards (Structure 5) to span the increased number of tracks. The area between the engine shed and the triangular junction was occupied by allotment gardens located within an irregular depression. The depression lay in an area of the 'Brick Field' shown on the 1897 OS map and probably originated as the clay pit, although no such depression had been represented on earlier maps in this location. Alternatively, the depression may have been the result of a cut and fill exercise associated with the construction of the new railway junction, stabling yard and the coal depot.



Figure 11: Aerial photograph dated 18 May 1932, showing the triangular junction (upper right corner) and the allotment gardens in the background (English Heritage ref EPW037930)

- 3.2.26 In 1923 the site was appropriated by London and North Eastern Railway, the second-largest of the 'Big Four' railway companies created by the Railways Act 1921. As suggested by the 1939 OS map, beyond small extensions to the engine shed (Structure 12) the change of ownership had little impact on the layout of the site. More land within and to the east of the triangular junction had been appropriated as allotment gardens, presumably a consequence of the national campaign to reduce the pressure on the public food supply brought on by the war effort (Fig. 11). A complex of engineering and printing works located to the north of the site had appeared by the outbreak of WWII, and these suffered bomb damage during the Blitz. The engine shed (Structure 12) was destroyed by a high-explosive bomb between 7 October 1940 and 6 June 1941. The main railway, stabling sidings and the goods depot (Structure 11) also suffered direct hits in that period. The ground investigations within the site (C161-MMD-G-RGN-CR112-50003) recorded significant magnetometer readings indicative of unexploded ordnance in the area to the south (BH3) and to the north (WS1) of the coal yard, and in the south-western corner of the triangular junction (WS13).
- 3.2.27 In 1948 the railways were nationalized to form British Railways (latterly 'British Rail') and the site became part of the Great Eastern Mainline. This change of ownership was manifested in the new layout of the site dominated by a new engine repair shed (Structure 15), a new carriage cleaning shed (Structure 16) and a new washing plant (Structure 17). The passenger connections through the Fairlop Loop were closed on 19 March 1956 and the triangular junction of the Seven Kings Curve was dismantled ahead of the expansion of Ilford Carriage sheds in 1959. The Essex Record Office hold a plan from 1953 entitled the British Rail Ilford EMU (ERO ref D-Z 346-3003-53), EMU standing for Electric Maintenance Unit. This shows the site in great detail, and the layout is not a great deal different from the site today. In the north-western corner lay the coal yard, which sat in a cutting marked by hachures. The road entrance was to the north-west, which led into the coal stacking area. To the north were three main sidings, the northern one with loops and spurs and to the south one further line, with two sidings in the middle. To the south of the coal yard was a long, rectangular strip of allotments, and to the south of this another cutting which had a number of sidings and a junction onto the main line. The northern edge of this cutting housed several store buildings (Structures 31 and 32) and two buried air raid shelters (Structures 39 and 40).
- 3.2.28 The coal yard and sidings to the south joined to the east, where there was a fire station (Structure 30) built on the location of an earlier garage (Structure 19) and cycle sheds (Structure 20). Further to the east the northern part of the site housed a 12-road siding, and to the south of this was a large rectangular carriage repair shed (Structure 15, now Workshop A). The engine shed (Structure 12) had gone, but the well to its north survived, with a little set of steps wrapping itself around the southern side. A car-park (not large, there being little requirement for car-parking in these early post-war years) was situated on the higher ground to the north above the cutting. To the east of Structure 15 the footbridge (labeled Footbridge No. B1, Structure 14) is shown in great detail, as are various huts, points levers and the like. To the east of this again the cleaning shed (Structure 16) with ancillary structures is marked.

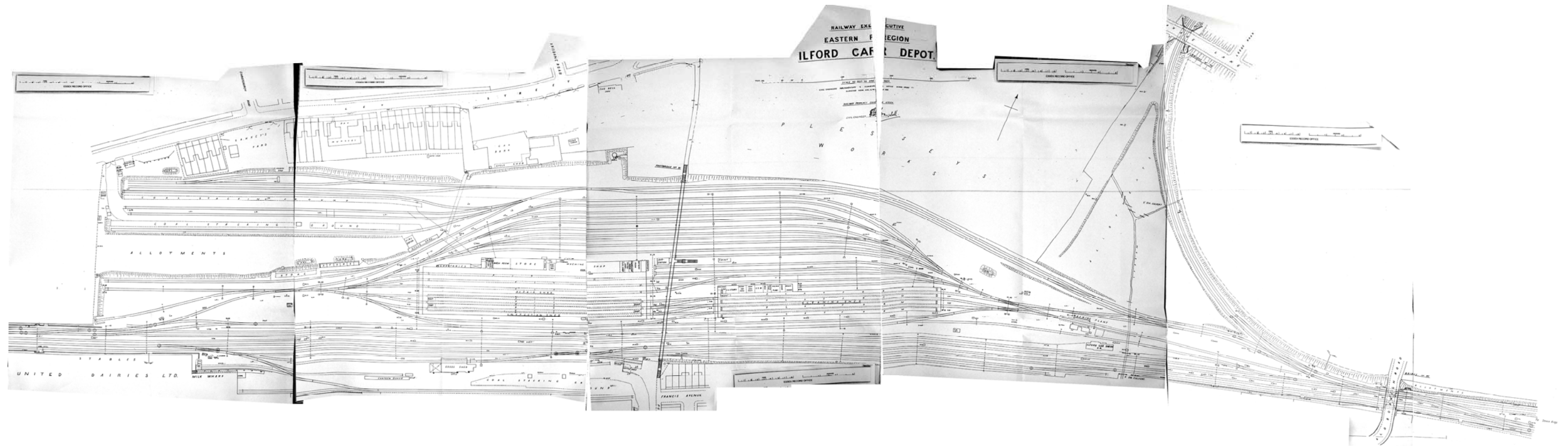


Figure 12: 1953 British Rail Ilford EMU (ERO ref D-Z 346-3003-53)

3.2.29 By the time of the 1963 OS map the layout of the site is confirmed as that recognizable today (and is little changed from the 1953 map). The allotments are still shown in the central strip of the western part of the site, and the two long, thin rectangular stores buildings lining the south-east part of this strip are still shown. The throat of this strip still housed the fire station and cycle sheds. The well is no longer shown. The southern goods depot, coal store and cattle pen also remain. A second, much larger rectangular carriage repair shed (Structure 43) had been built in the area formerly occupied by the triangular junction in the eastern part of the site. A water-tower (Structure 45) had been added to the south-east corner of the site.

3.2.30 Development subsequent to the 1963 OS map has added the GA Training Centre, constructed at some point between 1977 and 1990) in the area of the former allotments, swept away the goods shed, coal store, cattle dock and their associated siding that were situated to the south of the main line, added a wheel lathe building to the north of the former allotments, adapted the engine cleaning shed and added a paint shop to the north.

3.3 Historic Asset Gazetteer

3.3.1 The buildings, structures and elements of infrastructure discussed in the preceding sections are listed here, each being given a Structure Number and dates when they are either known to have been constructed and demolished or as they first appear on cartographic sources. A level of significance is given to each entry. This is based upon a system developed by Ramboll for Environmental Impact Assessment, and which draws on guidance provided by DCMS, English Heritage, the Department for Transport, and the Department of Arts, Heritage and the Gaeltacht in Ireland, amongst others. The gazetteer may be revised in the light of new information becoming available.

Structure Number	Description	Earliest known date	Level of Significance
1	Goods shed	1897	Local
2	Footbridge	1897	Local
3	Cattle pen	1897	Local
4	Goods shed extension	1919	Local
5	Footbridge extension	1919	Local
6	Cattle pen rebuild	1919	Local
7	Engine shed	1919	Regional
8	Circular well	1919	Local
9	Water tower	1919	Local
10	Cobbled surface associated with coal depot	1919 (?)	Local
11	Goods shed extension	1939	Local
12	Engine shed extension	1939	Local
13	Goods shed extension	1948	Local
14	Footbridge enlargement	1948	Local

15	Engine repair shed	1948	Local
16	Carriage cleaning shed	1948	Local
17	Washing plant	1948	Local
18	Signal box	1948	Not significant
19	Garage	1948	Not significant
20	Cycle shed	1948	Not significant
21	Sand dryer and substation	1948	Not significant
22	Lengthman's hut	1948	Not significant
23	Shunters' hut	1948	Not significant
24	Fog hut	1948	Not significant
25	Petrol tanks	1948	Not significant
26	Washing plant extension	1953	Local
27	Signal box extension	1953	Not significant
28	Permanent way hut	1953	Not significant
29	Permanent way hut	1953	Not significant
30	Fire station	1953	Local
31	Store	1953	Not significant
32	Store	1953	Not significant
33	Coach canteen	1953	Not significant
34	Stenters' cabins	1953	Not significant
35	Store	1953	Not significant
36	Charrington's coal office	1953	Local
37	Cycle shed	1953	Not significant
38	Air raid shelter	1953	Local
39	Air raid shelter	1953	Local
40	Air raid shelter	1953	Local
41	Air raid shelter	1953	Local
42	Workshop A platform extension	1963	Not significant
43	Carriage repair shed	1963	Local
44	Office block	1963	Not significant
45	Water tower	1963	Not significant

Table 1: Historic Asset Gazetteer

\\sparrow\SOCGE1\16188 - Crossrail Archaeology\Drawings\Gifford\Ilford\CAD\61016188-CHA-Ilford-ID5_Known assets.DWG - Plot date and time = 23/04/2013 16:02:27

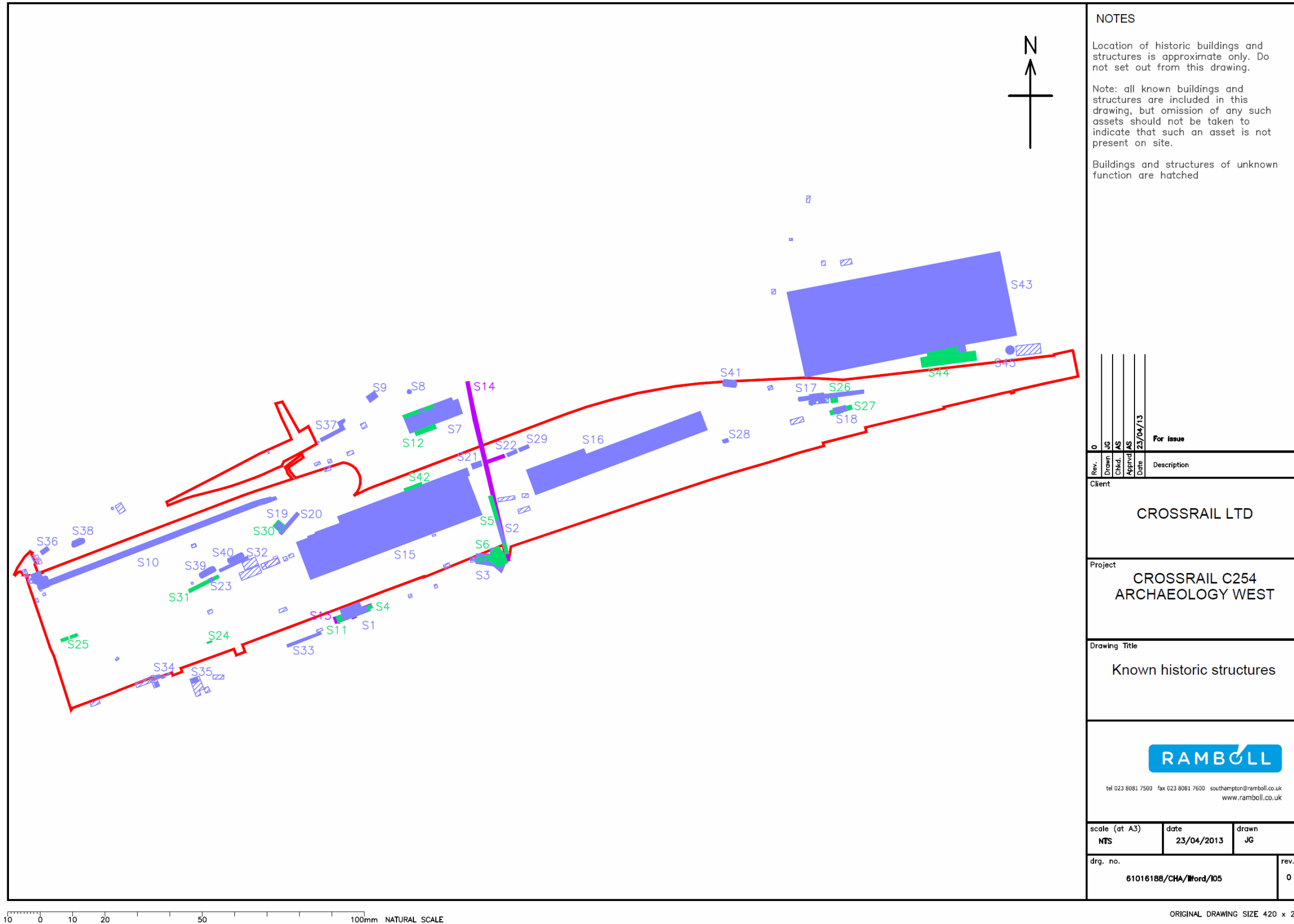


Figure 13: Plan showing the location of known historic assets at Ilford Depot. Note: the location of these buildings and structures is approximate only.

3.4 Deposit Survival Summary

- 3.4.1 Current ground level across the site varies. The main line enters the site area at 11.20m OD and leaves the site area to the east at 10.45m OD. Between the training centre and the main line the two sidings lie at approximately 11.45m OD. The training centre (Structure XX) lies at c. 12.50m OD (the bund deriving from landscaping of its construction is up to 3m high, peaking at 14.48m OD) and the wheel lathe building lies at 12.3m OD. The sidings to the north of the training centre are at c.12.05m OD at their western end and 11.80m OD at their eastern end. The builders yard to the north of these sidings lies at approximately 14m OD.
- 3.4.2 To the immediate east of Workshop A (Structure 15) and the footbridge the main line lies at 11.60m OD, the roads east from Workshop A and all sidings to the north at 11.70m OD. The foot of the northern landing of the footbridge steps lies at 12.74m OD.
- 3.4.3 The available geotechnical data has been used to attempt the construction of a contour model which shows the extent of surviving below-ground geological deposits (Fig. 14). The results of this work are imperfect because of the wide spacing between geotechnical interventions. Notwithstanding this, it has been possible to predict that within the western part of the site, the geological deposits survive to a height of 12.71m OD in the north-east and to c. 12.40m OD in the north-west of the site. The geological horizon slopes south-eastwards to the lowest depth of c. 10.25m OD immediately to the west of Workshop A and then rises gently southwards to reach c. 10.90 m OD at the southern boundary of the site. Within the eastern part of the deposit model, the surviving geology is recorded at its highest level along the northern boundary of the main line, where it survives to between 10.80m OD to the east and 10.94m OD to the west of Workshop B. The levels on the surviving geological deposits fall gradually north-westwards towards the centre of the site, where they reach their lowest level at 5.13m OD (recorded in borehole BH06, located to the west of existing Workshop B and the paint shop). This significant truncation probably derives from historic quarrying out of an ice wedge.
- 3.4.4 It was hoped that a study of historic maps and other documents would enable an understanding of the extents of quarrying on the site to be developed. In the event, the general lack of available information on the depths that quarrying attained (and, indeed, its extent in plan) have meant that its detailed impact on the geological deposit sequence of the site remains unknown.
- 3.4.5 In summary, the SI works have confirmed that there is survival of the Ilford Silt Member within the site despite the extensive and prolonged quarrying for this material that took place during the 19th century. This material lies close to the present ground surface in a number of locations, and the implication must be that there is therefore a potential for faunal-bearing deposits to survive on the site.

3.5 Built Heritage Summary

- 3.5.1 Very few buildings or structures of historic interest survive on the site. However, of immediate notice when visiting the site is the surface treatment of the entrance in the north-west corner of the site (beside the roundabout on Ley Street), which leads south into the site before turning east and running to the south of the northernmost two roads. This road (Structure 10) formerly provided access to the coal stacking area. The road is formed from granite setts. The earliest known date for the footbridge (Structure 14) that now straddles the entire site is 1897. This was lengthened on several occasions, most

recently in the years between WWII and 1953. Neither asset is affected by the development proposals shown on drawing C161-MMD-T-DDA-CR112_SD007_1-40001.

- 3.5.2 All other buildings and structures appear to be post-war. Workshops A and B (Structures 15 and 16) appear on the 1948 (not reproduced, ERO ref D/Z 346/5003/34) and 1953 British Railways plan (Fig. 12). All other buildings are more recent and are of functionary design and construction, such as the Bombardier Transportation Training Centre (Fig. 14).



Figure 14: Bombardier Transportation Training Centre

4 Construction Impacts

4.1 Summary

- 4.1.1 The proposed works to be undertaken at Ilford Depot are listed in this SSWSI at Section 2.1 and below, described in Works Information Volume 2A - C828 Ilford Yard Stabling Project (document number C828-XRL-N2-SPB-CR112_SD007_Z-50001) and shown on C161-MMD-T-DDA-CR112_SD007_1-40001 Rev C.01 (Fig. 15). From these documents and drawings the works which may have an impact on above ground and sub-surface archaeological remains are identified as:

- Construction of proposed domestic power sub-station to the north-west of the GA Training Centre;
- Service diversions and new installations, new sub-surface drainage provision and surface water attenuation;
- Removal of bund to south-east of the GA Training Centre;
- Removal of southern sidings and construction of paint shop and traverser building;
- Demolition of Bombardier Transportation Stores Building and Training Centre;
- Construction of Logistics and Stores Buildings;
- Track re-alignment and other modifications within Workshop A;
- Demolition of paint shop to east of Workshop A;

- Demolition of Workshop B and ancillary structures;
 - Construction of proposed Operations and Welfare building;
 - Construction of Signalling Power Supply Point building;
 - Construction of OLE and signalling foundations;
 - Removal of existing track layout to east of Workshop A and replacement with Crossrail Stabling Area permanent way;
 - Construction of ancillary Depot Drivers Locker Room and Cleaners Store Hut;
 - General re-arrangement of hard-standing areas and provision of new car-parking areas;
 - General landscaping.
- 4.1.2 The areas where these works will or will potentially impact on sub-surface archaeological remains are shown on Fig 15.

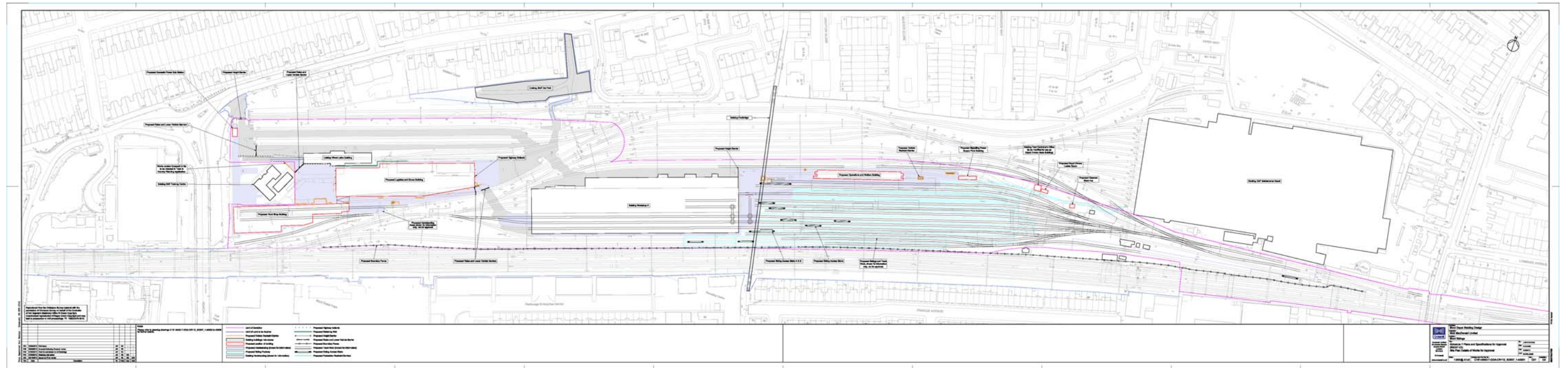


Figure 15: Extract from dwg C161-MMD-T-DDA-CR112_SD007_1-40001 Rev C.01, showing proposed layout

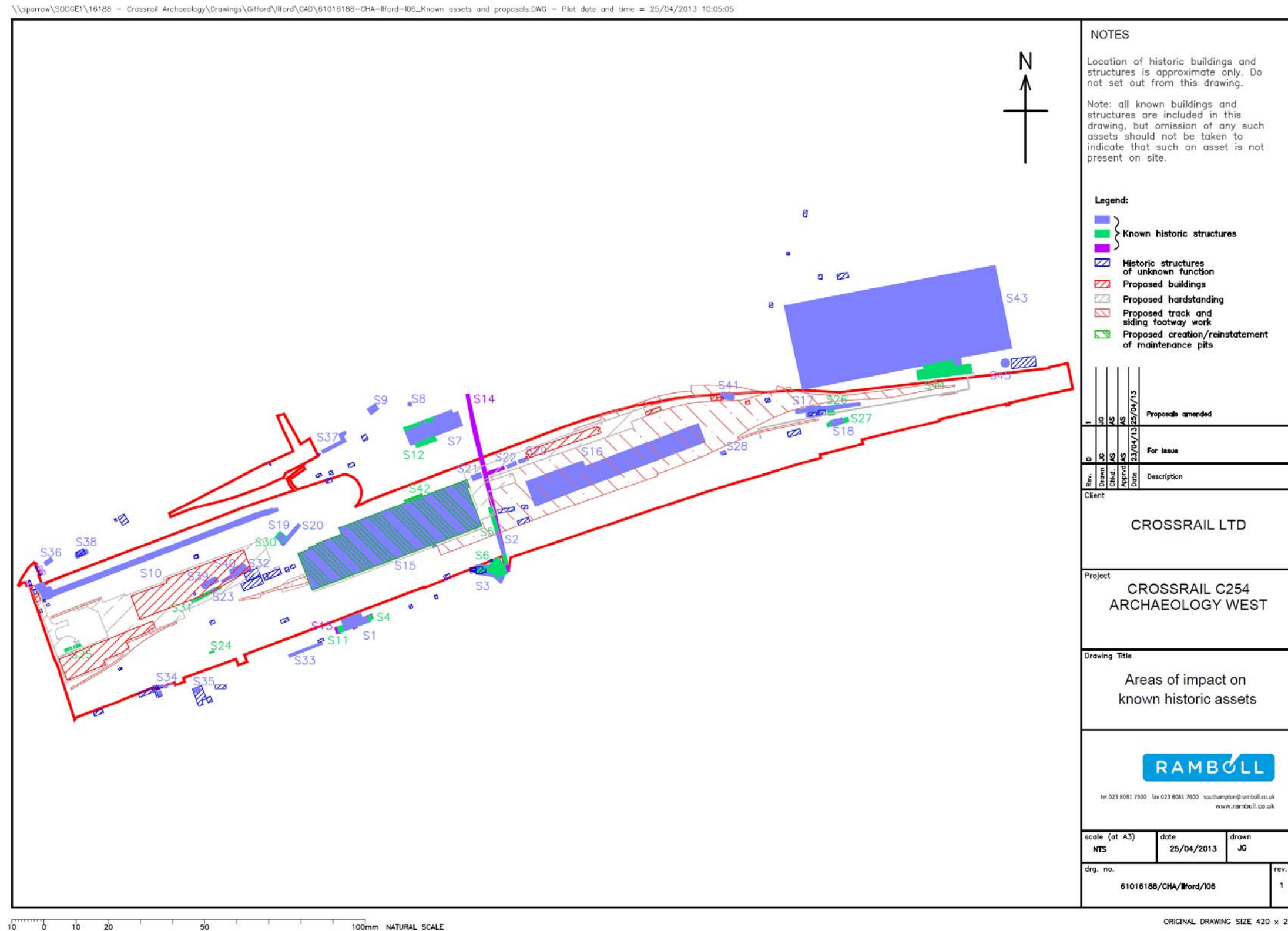


Figure 16: Areas of impact from proposed construction overlaid on position of known historic assets. Note: the locations of historic structures is approximate only.

5 Archaeological Mitigation - Aims and Objectives

5.1 Research Aims and Objectives

5.1.1 Archaeological mitigation of the impacts arising from the proposed works at Ilford Depot will be required in order to answer the following aims and objectives.

5.1.2 The main aim of the archaeological mitigation strategy set out in this SSWSI is to assess and record the nature, extent, character and significance of any geoarchaeological or archaeological features and deposits on the site.

5.1.3 Selected research themes derived from A Research Framework for London Archaeology 2002 (Nixon et al, 2003) are included in the Assessment of Archaeology Impacts Technical Report (Crossrail 2005). Of relevance to this SSWSI, archaeological investigation and mitigation within the Ilford Depot should provide evidence relating to the early prehistoric and modern developments of the area. This evidence would have the potential to contribute to the following research aims:

- Establishing firm regional chronologies tied into national chronological frameworks, taking the opportunity to clarify extant terrace sequences;
- Making comprehensive use of predictive digital terrain models based on borehole and other geophysical data, and opportunistically examining known sites and exposures;
- Reviewing palaeoecological reconstructions with specific regard to cognitive issues, such as the nature of the animal presence and human interaction with wild and domestic species;
- Further technological research into dating techniques, including Optically Stimulated Luminescence (OSL) and the testing of biostratigraphic dating against radiometric methods;
- Targeting specific areas and deposits with high potential: Stoke Newington, Ealing and Acton, Crayford, Southall and Ilford, the edges of gravel terraces and palaeoconfluences;
- Understanding the reasons for evolution of London's road systems, street layouts, river crossings and ferries, and their importance as engines of development and change;
- Examining the concept of core/periphery for different periods in London's past, as a means of understanding how evolving settlement patterns reflect the need for sustainable, beneficial relationships between a settlement and its environs, a city and its hinterland;
- Establishing how daily work and life in London reflected and contributed to the rise of London as the commercial centre of the British Empire, and to its continued eminence as a world city thereafter; and
- Examining the success with which small towns in the London region adapted to the capital's growth.

5.1.4 With regard to these broad research aims, the mitigation strategy outlined in this WSI presents an opportunity to address the following objectives:

- Confirm if possible the presence, and assess the extent of, survival of Palaeolithic archaeological, faunal and palaeoenvironmental remains associated with the Ilford Silt Member and gravel terraces within the site;
- Confirm if possible the absolute dating of the sequence of geological deposits within the site through the use of OSL and radiocarbon dating;
- Further our understanding of the gravel terrace sequence in Ilford, in particular the relationship between the Taplow and Hackney gravels;
- Confirm the presence/absence of any Mesolithic, Neolithic, Bronze Age and Iron Age activity within the site;
- Confirm the presence/absence of Roman activity associated with the Roman road to Colchester, located to the south of the site;
- Assess the character of the medieval activity within the site and its relationship with medieval settlements to the west and east of the site;
- Assess and record the nature and extent of post-medieval and early modern field boundaries and quarrying in relation to the layout recorded by historic maps;
- Assess and record the levels of truncation of surface deposits resulting from the development of the Great Eastern Railway and the Ilford Depot;
- Assess and record any evidence for built heritage assets associated with the development of the Ilford Depot. These are taken to include the site's workshops, coal depot, huts, stores, earlier track and siding layouts and also the remains of any associated railway infrastructure; and
- Assess and record any remains of WWII air raid shelters within the site.

6 Scope of the Investigations

6.1 Archaeological Mitigation

6.1.1 Archaeological mitigation of the impacts arising from Crossrail's development of Ilford Depot comprises:

- A photographic survey and catalogue (to English Heritage Level 2) of those structures and parts of the yard that will be affected by the development proposals;
- A combined geoarchaeological and archaeological trial pit evaluation centred on areas of the site where construction impacts (Logistics and Stores Building, Paint Shop and Traverser building, attenuation tanks *etc*) coincide with the predicted survival of Ilford Silt Member. Should this work not be possible, paleoenvironmental and geoarchaeological information will be obtained by the retrieval of core samples from purposive borehole drilling;
- A general watching brief during removal of the bund situated to the south-east of the GA Training Centre, groundworks associated with construction of the Paint Shop Building (if appropriate), general landscaping and car-parking provision works, construction of sidings and associated infrastructure provision within the Crossrail stabling area and Workshop A, sub-station construction and below-

ground service diversions, attenuation tanks and installations (as appropriate), and piling operations (if appropriate); and

- A targeted watching brief during groundworks associated with construction of the Logistics and Stores Building (targeting the air raid shelters).

6.1.2 All fieldwork interventions are specified below and in Section 8. The Event Code to be used during the activities listed above will be confirmed by the Project Archaeologist.

6.2 Photographic survey

6.2.1 A photographic survey of the yard, its buildings and its layout is intended to document by permanent record how Ilford Depot appeared and was used before its proposed development. An English Heritage Level 2 record is considered an appropriate response to the changes proposed and the significance of the buildings that will be altered or demolished.

6.3 Trial pit evaluation or purposive borehole drilling

6.3.1 Trial pit evaluation comprising excavation of 9 no. trenches, with enablement by the Principal Contractor, will be undertaken in areas where construction impact is proposed. The purpose of these test trenches is to facilitate:

- the geoarchaeological evaluation required to identify the level and depth of survival (if any) of the Ilford Silt Member and its underlying deposits and to test the proposed deposit survival model (Figures 3 and 4);
- the sampling of geoarchaeological deposits for scientific purposes and sample excavation of potential faunal-bearing deposits; and
- archaeological evaluation required to assess the presence/absence and level of survival (if any) of a number of historic assets identified in the gazetteer (Table 1).

6.3.2 Specifications for the trial pits, and any further works stemming from the results gained from these trenches, are provided in Section 8.8 below.

6.3.3 Should trench excavations not be possible, for whatever reason, a series of purposive geoarchaeological boreholes will be drilled in order to recover geoarchaeological and paleoenvironmental evidence.

6.4 General Watching Brief

6.4.1 A general watching brief will be undertaken during removal of the bund situated to the south-east of the GA Training Centre, groundworks associated with construction of the Paint Shop Building (if appropriate), general landscaping and car-park provision works, construction of sidings and associated infrastructure provision within the Crossrail stabling area and Workshop A, sub-station construction and below-ground service diversions, attenuation tanks and installations (as appropriate), and piling operations (if appropriate).

6.4.2 The purpose of the GWB is to retrieve if present any archaeological or railway-related artefacts contained within the bund (which purportedly derives from excavations undertaken during construction of the GA Training Centre), identify and record any Palaeolithic remains that might be contained within deposits impacted on by the Paint Shop Building, record any evidence of previous depot layouts or infrastructure impacted on by the general landscaping, construction of the Crossrail stabling area and general service installations, and (if previous

stages of work indicate that it is a worthwhile exercise) to recover Palaeolithic artefacts and ecofacts disturbed by pile drilling.

6.5 Targeted Watching Brief

- 6.5.1 A targeted watching brief will be undertaken during groundworks associated with construction of the Logistics and Stores Building. This will specifically aim to identify the location and extents of the WWII air raid shelters known to have been sited within the footprint of the proposed building, and should these be identified, to excavate and record these features.
- 6.5.2 A targeted watching brief will also be undertaken in any area not covered by Section 6.4 where excavations for foundations would extend downwards beyond construction levels in order to remove soft spots.

7 Programme

7.1 Introduction

- 7.1.1 Programme details are contained with C161's Construction Programme C161-MMD-N2-TSC-CR112_SD007-50002 Rev C05. This is dated 13 July 2012. Current programme dates will be advised to the Archaeological Contractor by the Principal Contractor.
- 7.1.2 The key dates shown on the July 2012 programme are mobilisation from 10 April 2013, site compound set-up from 9 May 2013 and Bombardier moving to the new facilities in August 2014.
- 7.1.3 Photographic survey will take place between 15 July and 31 July 2013 after method statements and inductions are completed. Trial trench evaluation, including the purposive geotechnical borehole drilling (should it be required) shall take place in August 2013.
- 7.1.4 Logistics and Stores Building - Construction of temporary access starts on 29 May 2013 with removal of existing tracks completed on 13 Aug 2013. Construction of the piling mat starts on 21 August 2013 and the new domestic sub-station is built between 29 August and 9 October 2013. Incoming services are installed from 29 August 2013 and an attenuation tank is installed in the hardstanding area from 26 September 2013. Piling and pile cap construction takes place from 12 Sep 2013. Connection to Ley Street sewers takes place from 12 September 2013, with internal drainage installed on 14 November 2013 and the ring beam constructed from 28 November 2013. Underground services are installed from 23 January 2014 and external paving and landscaping from 20 February 2014.
- 7.1.5 Paint Shop Building – Services diversions start from June 2013, piling mat preparation from 14 August 2013, piling and pile caps from 21 August 2013, internal drainage installation from 10 October 2013 and the construction of the ring beam from 24 October 2013. The traverser pit is constructed from 4 November 2013 and external paving and landscaping from 23 January 2014.
- 7.1.6 GA training centre – construction of access starts from 12 Jun 2013.
- 7.1.7 Workshop B and Paint Shop – Demolition of Workshop B and the Paint Shop starts on 18 June 2014 and is completed on 15 July 2015.

- 7.1.8 Stabling siding– Installation of drainage commences on 15 Jul 2015, with construction of OLE foundations commencing on 20 August 2015 and signal foundation son 28 August 2015. Preparation of the formation levels for the new permanent way starts on 7 September 2015.
- 7.1.9 Operations and Welfare Building – The piling mat is prepared from 16 July 2014 with piling and pile caps starting on 25 July 2014. Internal drainage is installed from 15 September 2014 and the ring beam is installed from 24 September 2014. OLE foundation construction commences on 7 September 2015. Permanent paving and landscaping is undertaken from 30 January 2015.
- 7.1.10 Permanent way tie-in at eastern end – Drainage and preparation to formation levels commences from 22 January 2016.
- 7.1.11 Any revisions to the archaeological mitigation strategy set out in this SSWSI which arise from revisions to the programme will be set out in revisions to this SSWSI.

8 Archaeological Contractor Specification and Requirements

8.1 Generic Standards

- 8.1.1 The archaeological mitigation works and scope of any archaeological scientific methods shall be designed and undertaken in accordance with the Generic SSWSI and relevant best practise guidance (and any subsequent revisions) *i.e*:
- Crossrail standards and specifications;
 - Institute for Archaeologists – Standard and Guidance for archaeological field evaluation, 2008 (revised);
 - Institute for Archaeologists – Standard and Guidance for archaeological excavation, 2008 (revised);
 - Institute for Archaeologists – Standard and Guidance for an archaeological watching brief, 2008 (revised);
 - Museum of London collections and archive policies and guidance; English Heritage – Geoarchaeology, 2007;
 - English Heritage - Archaeological Science at PPG16 interventions: Best Practice Guidance for Curators and Commissioning Archaeologists, 2003;
 - GLAAS Archaeological Guidance Papers 1999; Corporation of London archaeology guidance – Planning Advice Note 3, 2004;
 - Museum of London Archaeology Service site recording manual (MOLAS 1994); and
 - English Heritage – Understanding Historic Buildings – A guide to good recording practice, 2006
 - Archaeology Procedure for Non-Listed Built Heritage Recording, Document No: CR-PN-PRW-EN-PD-00010, 7 July 2009, (APNLB)

- English Heritage *Measured and Drawn: Techniques and practice for the metric survey of historic buildings* (2003);
- English Heritage *Understanding Historic Buildings: A guide to Good recording practice* (2006b); and
- Institute for Archaeologists *Standard and Guidance for the Archaeological Investigation and Recording of Standing Buildings or Structures* (1999 rev 2008)

8.2 Potentially Nationally Important Remains

8.2.1 Please refer to Annex 14.

8.3 Human Remains

8.3.1 Please refer to Annex 12.

8.4 Treasure Act

8.4.1 Please refer to Annex 13.

8.5 Health and Safety

- 8.5.1 The Archaeological Contractor shall undertake the works in accordance with the Employer's Health and Safety requirements, the Principal Contractor's Health and Safety Plan and the Designers Risk Assessment. Where specific health and safety constraints or requirements for the Archaeological Contractor's method of work are required, these shall be set out in this section and detailed in the Archaeological Contractor's Method Statement (in the Health and Safety Plan).
- 8.5.2 No ground intervention or other survey shall be made without approval of the Archaeological Contractor's Health and Safety Plan, Method Statement and Risk Assessment by the CDM co-ordinator.
- 8.5.3 Hand excavation or other remote sensing method may be required prior to any mechanical excavation in the first instance to locate any known or suspected below ground hazards. The Archaeological Contractor's Method Statement and Risk Assessment shall take account of any design information (including the Designer's and Principal Contractor's Risk Assessment) pertaining to above ground hazards such as buildings and other structures or public rights of way and below ground hazards such as services, utilities and infrastructure and shall contain a site specific Risk Assessment for unknown below ground hazards such as contaminants including unexploded ordnance. All appropriate mitigation measures shall be in place prior to commencement of any ground intervention or other survey.
- 8.5.4 Trial trench excavation method and earthworks support design shall conform to Health and Safety legislation and safety standards as well as incorporating current engineering best practice, where appropriate.

8.6 Location and Ground Elevation of Interventions and Survey Grids

- 8.6.1 The spatial extent of the investigation(s) shall be set out in accordance with the setting out co-ordinates supplied by the Project Archaeologist. All spatial setting out and recording shall be in accordance with The London Survey Grid Standard (formerly Crossrail Survey Grid). See Crossrail standard CR-STD-010.
- 8.6.2 Interventions shall be located to a horizontal accuracy of +/-500mm in relation to the detail illustrated in the contract drawing(s). The corner points of each excavation or the centre point of each soil core location shall be set out with a Total Station Theodolite or other suitable automated equipment referenced from approved Permanent Ground Marker (PGM) data supplied to the Archaeological Contractor by the Project Archaeologist. The positions of the trenches and survey points shall be verified by the Archaeological Contractor taking additional check measurements to additional known-location points of detail.
- 8.6.3 Surface heights shall be recorded and related to PGMs or approved Ordnance Survey Bench Marks (OSBM). The full descriptions and locations of PGMs and OSBMs known to the Employer will be supplied to the Archaeological Contractor by the Project Archaeologist. Levelling accuracy between OSBMs/PGMs and site TBMs shall be within $10 \text{ mm} \sqrt{k}$: where 'k' is the total distance levelled in kilometres. Each TBM shall be levelled as part of a closed loop starting and finishing on approved OSBMs or Crossrail PGMs. Where more than one TBM is required per site the Archaeological Contractor shall establish the TBMs as part of the same closed loop.
- 8.6.4 The Archaeological Contractor shall include details of their surveying methodology within their Method Statement (see Section 8), including the setting out of the grid and how they intend to provide the project grid co-ordinates to the Project Archaeologist with the Survey Report.
- 8.6.5 The Archaeological Contractor shall ensure that all trench or excavation limits, and significant archaeology detail are surveyed 'as dug' in relation to the project grid before leaving the site. Ground level height data shall be recorded for each intervention. Survey methodology and a detailed survey record shall be provided to the Project Archaeologist within the Survey Report.

8.7 Specification for photographic survey

- 8.7.1 The photographic survey should record all buildings, structures and surfaces that will be altered or demolished during the proposed construction works. The survey will be undertaken to English Heritage Level 2 standards, and result in a photographic catalogue, a scaled plan indicating the location of photographic subjects, general views of buildings, structures and surfaces, their external appearances and appropriate details and a written record detailing the subjects of the survey, and other relevant details. Photographs should also aim to capture the working life of the yard, recording for example where items required to facilitate the working of the yard are stored, or personal touches that provide a clue to how the yard was used by those working there.

8.8 Trial pit evaluation

- 8.8.1 The evaluation trial trenches are designed to test the geological model shown on Fig. 3 and to assess the level of survival (if any) of the Ilford Silt Member in the areas where construction impact is likely. In addition to these geoaerchaeological

aims, a number of trial trenches specified in Table 2 will evaluate the level of survival of historic assets identified in the gazetteer (Table 1). Although the majority of the proposed trial trenches are located in areas where construction impact is likely two (Trenches 4 and 5) fall outside. It is, however, believed that the excavation of these trenches would be crucial to understanding the underlying geology and testing the proposed deposit survival model. Verification of the location of the historic clay pits and assessment of the extent and depth of historic brickearth extraction and determination of the survival of known historic assets within the site is also required.

- 8.8.2 The proposed location of the trial trenches is shown in Fig. 17. The dimensions of the trenches, exclusive of any trench support systems or stepping employed to remove or shore overlying modern demolition material deposits and thus secure personnel entry to the excavation shall be as indicated in Table 2 below.
- 8.8.1 Trial trenches shall be excavated to the base of faunal-bearing deposits, which on this site are assumed to be at the interface between the Ilford Silt Member and gravels. The geological model constructed to aid preparation of this SSWSI predicts, from estimation of the level of the base of the Ilford Silt Member (*ie* the top of Hackney Gravels) and known ground levels, that trenches will need to be between 2m and 3m in depth.
- 8.8.2 The provision and operation under archaeological supervision of plant equipped with toothless machine buckets, breaking out if required, all temporary works and any hand investigation required to address below ground hazards shall be the responsibility of the Principal Contractor.
- 8.8.3 The machine used to remove modern overburden shall reduce the ground level progressively, in spits of 0.20m to 0.5m depth (dependent on specific site conditions). The Archaeological Contractor's supervising archaeologist and geoarchaeologist shall use their professional judgement to determine the appropriate depth of each spit and will advise the Principal Contractor accordingly. Any variations to the excavation methodology shall be at the discretion of the supervising archaeologist and recorded in writing for inclusion in the final report to the Project Archaeologist. Machine excavation shall cease at the level where archaeological or palaeoenvironmental levels are reached, at which point hand excavation by the Archaeological Contractor will commence.
- 8.8.4 Each spit shall be examined carefully to assist the recovery of any archaeologically significant artefacts and thus to determine when to cease machining. The archaeological level shall be cleaned in plan by the Principal Contractor using a wide blade ditching bucket (*ie* toothless bucket) or similar (if applicable).
- 8.8.5 The Archaeological Contractor shall supervise the excavation of each trial pit in such a manner so as to allow a cumulative or continuous section to be recorded.
- 8.8.6 The trial trench excavations shall be recorded by the Archaeological Contractor to the standards of current best practice. The recording systems adopted during the investigations must be fully compatible with those published by the Museum of London Archaeology Service (MoLAS 1994 3rd ED) and Museum of London (MoL 1998).

Trench No.	Dimensions (in m)	Rationale	Impact type
1	10 x 5	Trench is located at the edge of the projected survival of Ilford Silt and within a cluster of unknown buildings dating from 1919	Proposed new building and hardstanding
2	5 x 5	Trench is intended to test whether the suspected absence of Ilford Silt caused by quarrying/levelling for sidings is correct.	Hardstanding
3	10 x 5	Trench is located at the edge of the projected survival of Ilford Silt	Proposed new building and hardstanding
4	10 x 5	Trench is located within the projected area of surviving Ilford Silt and at the likely edge of 1864 clay pits	
5	10 x 5	Trench is located within the projected area of surviving Ilford Silt, on the edge of 1864 clay pits, and is also intended to assess the survival of historic assets S19, S20 and S30	
6	10 x 5	Trench is located within the projected area of surviving Ilford Silt, and is also intended to assess the survival of historic assets S32 and S39	Proposed new building
7	10 x 5	Trench is located within the 'Brick Field' shown on the 1897 OS map and is intended to assess the survival of an unknown structure shown on the 1919 OS map	Track and siding footway work
8	10 x 5	Trench is located within the projected area of surviving Ilford Silt and within the 'Brick Field' shown on the 1897 OS map	Track and siding footway work
9	10 x 5	Trench is located within the projected area of surviving Ilford Silt, within the 'Brick Field' shown on the 1897 OS map and is intended to assess the survival of historic asset S41	Track and siding footway work

Table 2: Trial trenches

- 8.8.7 The Archaeological Contractor's excavation, sampling and recording policy shall be included in the Archaeological Contractor's Method Statement. This is to include, as a minimum:
- The recording of individual contexts on appropriate *pro formas*;
 - Planning and section drawing of appropriate structures, single contexts and features (usually at 1:20 scale for plans and 1:10 scale);
 - Photographs; and other appropriate drawn and written records;
 - Permanent Ground Markers (PGMs), any temporary benchmarks and approved OS benchmarks shall be indicated on the relevant plans.
 - At least one representative section at (1:10 or 1:20 scale) from ground level to the base of the excavation;
 - The written record of individual context descriptions on appropriate *pro forma*; and
 - Single context planning if appropriate.
- 8.8.8 Site plans shall identify both London Grid and OS co-ordinates. A 'site location plan', indicating site north shall be prepared at 1:1,250 scale. Individual 'trench plans' or 'excavation area plans' at 1:200 (or 1:100) scale shall be prepared which show the location of archaeology investigated in relation to the investigation area.
- 8.8.9 Section drawings shall be located on the relevant plan and both London Grid and OS co-ordinates recorded. The locations of the OSBM or PGM bench markers used and any site TBM shall also be indicated.
- 8.8.10 A record of the full extent in plan of all archaeological deposits as revealed in the investigation shall be made; these plans shall be on polyester based drawing film, and be at a scale of 1:10 or 1:20 unless otherwise agreed with the Project Archaeologist. 'Single context planning' shall be used on deeply stratified sites. Drawing information shall be digitised for eventual CAD applications. The GLHER will accept Autocad DXF or DWG format of extent of site and location of major features with the completed Sites and Monuments Report Form.
- 8.8.11 A 'Harris matrix' stratification diagram shall be employed to record stratigraphic relationships (Harris 1993). This record shall be compiled and fully checked by the *Archaeological Contractor* during the course of the excavations. Spot dating shall be incorporated onto this diagram during the course of excavations.

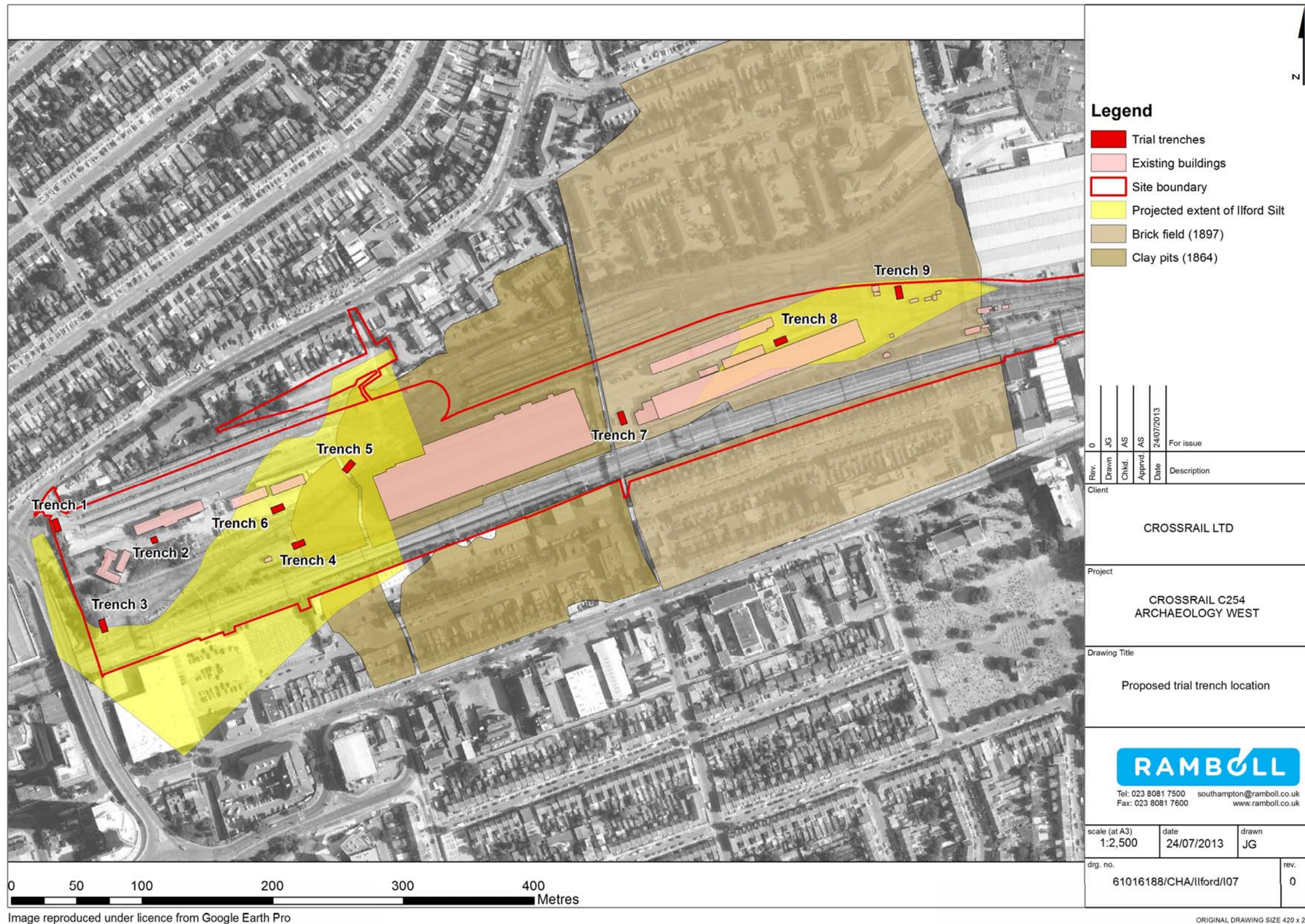


Figure 17: Proposed trial trench location

- 8.8.12 The photographic record shall consist of monochrome prints/negatives and colour transparencies. A 35mm format SLR camera (film or digital) is acceptable for all site photography. The Archaeological Contractor shall maintain a minimum of two 35mm SLR cameras on site at all times during working hours. The photographic record shall include photographs and transparencies of archaeological features and structures. Each photograph and transparency shall clearly show details of the above, and may require the use of artificial lighting to achieve suitable definition. Each photograph and transparency shall include an appropriate graduated scale, a north arrow, and a header board detailing (as a minimum) the project event code and context/feature number. In addition, the Archaeological Contractor shall take appropriate record photographs to illustrate work in progress.
- 8.8.13 The transparencies shall be mounted in suitable frames for long-term curation in preparation for deposition with the archive. Digital photography and video recording may be appropriate in some circumstances and the Archaeological Contractor shall set out proposals for such recording in the Archaeological Contractor's Method Statement for approval by the Project Archaeologist.
- 8.8.14 The Archaeological Contractor's survey and recording policy shall meet the following requirements:
- All levels shall be recorded to London Grid standards and reduced to OS datum;
 - The trench location shall be electronically surveyed with reference to the London Grid and Crossrail PGMs upon the completion of fieldwork by the Archaeological Contractor;
 - The locations of the trench shall be plotted on appropriate scale plans related to the London Grid and labelled with six figure eastings and northings; and
 - The electronic survey record shall be retained with the project archive.
- 8.8.15 The Archaeological Contractor shall identify any temporary works and dewatering requirements associated with the archaeological investigation in the Archaeological Contractor's Method Statement and shall agree the detailed arrangements for such with the Principal Contractor. The Archaeological Contractor will be required to undertake works in accordance with the Principal Contractor's arrangements for matters such as off site-spoil disposal or storage, on-site facilities and services. Relevant requirements shall be incorporated in the Archaeological Contractor's Method Statement.
- 8.8.16 The Principal Contractor shall ensure that water is discharged and arisings from trench excavations are stored in accordance with the Principal Contractor's environmental protection requirements (as set out in the package Works Information and their Environmental Management Plan) and any relevant consents for the worksite.
- 8.8.17 Should any material be excavated that is deemed to be contaminated or potentially contaminated it shall be investigated, controlled (e.g. placed separately from clean material) and removed from the site by the Principal

Contractor in accordance with the Principal Contractor's environmental protection requirements (as set out in their Environmental Management Plan).

- 8.8.18 The Archaeological Contractor shall ensure, in liaison with the Project Archaeologist, that adequate protection is provided for any archaeological remains. Any specific archaeological requirements relating to backfilling shall be included by the Archaeological Contractor in their Method Statement.
- 8.8.19 The trenches, should it be necessary, shall be pumped dry by the Principal Contractor and any necessary protection measures for archaeological remains (in addition to those for below ground infrastructure, services or utilities) shall be completed prior to backfilling. Backfilling and reinstatement shall be undertaken by the Principal Contractor as specified in the package works information and in accordance with the approved Archaeological Contractors Method Statement or other instruction from the Project Archaeologist and/or Project Manager. Generally, all backfill material shall consist of non-toxic, uncontaminated, non-putrescible, natural and inert material which shall be compacted and (if necessary) tested (dynamic compaction test or other) in accordance with a specification provided by the Project Manager. Surface conditions shall be reinstated to the required standard.

8.9 Specification for purposive borehole drilling

- 8.9.1 Should trench excavations not be possible, for whatever reason, the collection of soil samples to allow geoarchaeological and paleoenvironmental science to be undertaken shall be achieved by the recovery of core samples. One or more boreholes will be sunk by contractors provided by the Principal Contractor, with site operations supervised by the Archaeological Contractor's geoarchaeologist. Cores will be recovered by the geoarchaeologist and transported to the laboratory for analysis.

8.10 Specification for the general and targeted watching brief

- 8.10.1 A watching brief, as defined in the Generic SSWSI, is a programme of archaeological monitoring (*i.e.* observation, investigation and recording) which is carried out by a suitably qualified archaeologist during site investigations (*e.g.* geotechnical test pits, boreholes and utilities trial trenches) and construction works. The purpose of a watching brief is to identify the potential of any archaeological remains that are uncovered in the course of the works and record them appropriately (as far as is reasonably practicable). The watching brief shall result in the preparation of an ordered archive which will be incorporated into the post-excavation works and into publication of the project results.
- 8.10.2 Two classes of watching brief are set out in the Generic SSWSI:
- A general watching brief shall comprise observation and recording of the Principal Contractor's works without constraint on their working methods.
 - A targeted watching brief shall comprise observation and recording of the Principal Contractor's works with specific operations carried out under the supervision of the Archaeological Contractor. Under targeted watching brief, the Archaeological Contractor may impose constraints on, or require changes to, the

Principal Contractors' or his sub-contractor's method of working to enable the archaeological investigation to take place alongside construction works.

- 8.10.3 A general watching brief shall be undertaken in areas specified in Section 6.5 of this SSWSI. A targeted watching brief shall be undertaken in areas specified in Section 6.6 of this SSWSI.
- 8.10.4 The Archaeological Contractor's core team shall consist of the Archaeological Contractor's key person (the field director) and other appropriately experienced archaeologists commensurate with the scale and nature of the Principal Contractor's works.
- 8.10.5 The core team shall undertake the observation and any required investigation such as they may reasonably be able to undertake.
- 8.10.6 The Archaeological Contractor's support team shall consist of additional experienced archaeologists. The size of the support team shall be commensurate with the scale and programme of the Principal Contractor's works.
- 8.10.7 The Archaeological Contractor's core and support teams shall be advised where necessary by specialists, as appropriate and as agreed with the Project Archaeologist.
- 8.10.8 The Archaeological Contractor shall record the following observations on a daily basis. The record shall consist of, as a minimum:
- The Event Code and chainage/location of the area observed;
 - The date(s) of the observation;
 - Personnel employed on site;
 - A description of the construction works observed;
 - The works (sub) contractor and personnel undertaking and supervising the construction activity;
 - Depths and extents of excavation works observed;
 - Measure of confidence that any archaeological remains would have been observed and reasons;
 - The areas and horizons (both those containing archaeological remains and those which do not) unaffected by construction activity (with special reference to archaeological sites identified for preservation in situ);
 - The reasons why any particular area of the works was not observed, and noting those areas not subject to disturbance from construction;
 - Location and description of any archaeological remains; and
 - Location and description of any modern remains.
- 8.10.9 A representative sample of archaeological remains shall be recorded, subject to the constraints imposed by a general watching brief. The level of finds recovery shall be determined by the Archaeological Contractor in liaison with the Project Archaeologist (and as discussed with the relevant local authority and English

Heritage if relevant). Any specific variations from this specification shall be indicated in the Archaeological Contractor's Method Statement.

- 8.10.10 The Principal Contractor shall make allowance in their activity programme for the completion of any targeted or general watching briefs as set out in the SSWSIs.
- 8.10.11 In areas where the need for a targeted watching brief has been identified in Section 6.6, the Principal Contractor will remove soils and structures under the supervision of the Archaeological Contractor. The Principal Contractor will limit tracking of vehicles and plant within these areas whilst archaeological recording takes place and/or as instructed by the Project Archaeologist. The Principal Contractor will facilitate recording by the Archaeological Contractor through use of agreed plant, a site share agreement and careful liaison between the Archaeological Contractor's supervising archaeologist and the Principal Contractor's site supervisor.
- 8.10.12 Archaeological remains shall be recorded to best practice standards, recognising the special circumstances of a watching brief which demand flexibility in order to achieve archaeological objectives and requirements within the construction environment.
- 8.10.13 The recording is to include as a minimum:
- The written record of individual context descriptions on appropriate pro-forma.
 - The drawn record shall normally include, plans and section drawings of appropriate features, structures and individual contexts (1:50 1:20 or 1:10). Isolated archaeological remains (artefacts) may be spot located in plan and a height provided where possible. Deposits which are regular in plan (pits and ditches) may be located though co-ordinates, annotated with dimensions, and may be recorded digitally.
 - Other appropriate drawn and written records shall also be produced (for environmental sampling etc).
- 8.10.14 The photographic record shall consist of monochrome prints/negatives and colour transparencies. A 35mm format (film or digital) SLR camera is acceptable for all site photography. The Archaeological Contractor shall maintain a minimum of two 35mm SLR cameras on site at all times during working hours. The photographic record shall include photographs and transparencies of archaeological features, appropriate groups of features, structures, and quaternary deposits. Each photograph and transparency shall clearly show details of the above. Each photograph and transparency shall include an appropriate graduated scale, a north arrow, and a header board detailing (as a minimum) the event code and context/feature number. In addition, the Archaeological Contractor shall take appropriate record photographs to illustrate work in progress.

8.11 Archaeological Science and Finds

- 8.11.1 The strategy for sampling archaeological, geoarchaeological and palaeoenvironmental deposits and structures (which can include soils, timbers, pollen, diatoms, animal bone, human bone etc.) will be developed by the Project Archaeologist in consultation with the English Heritage Regional Science Advisor and the Archaeology Contractor. On-site work and off-site analysis of the processed samples and remains will be undertaken by the Archaeological Contractor's environmental archaeologists or sub-contractors as specified in the Archaeological Contractor's Method Statement.
- 8.11.2 The finds retrieval policies of the appropriate recipient museum will be adopted. In accordance with the collection and retention strategy set out in SSWSI, all finds (artefacts and ecofacts) visible during excavation shall be collected and processed by the *Archaeological Contractor*. In some cases, sampling may be the most appropriate strategy. Finds shall be appropriately packaged and stored under optimum conditions, as detailed in the RESCUE/UKIC publication First Aid for Finds (Watkinson and Neal 1998).
- 8.11.3 Where there is evidence for industrial activity, macroscopic technological residues (or a sample of them) shall be collected by hand. Separate samples (c. 10ml) shall be collected for micro-slugs (hammer-scale and spherical droplets). Reference should be made to the Centre for Archaeology Guideline on Archaeometallurgy (English Heritage 2001). Assessment of any technological residues shall be undertaken.
- 8.11.4 Samples shall be taken for scientific dating (for example radiocarbon dating, OSL, thermoluminescence etc). Procedures and specifications shall follow English Heritage guidance (English Heritage 2008b).
- 8.11.5 Buried soils and sediment sequences shall be inspected and recorded on site (or off-site if core samples have been taken) by the Archaeology Contractor's geoarchaeologist and other scientific specialists. Procedures and techniques presented in the English Heritage documents Environmental Archaeology (English Heritage 2002) and Geoarchaeology (English Heritage 2007) shall be followed. Samples for laboratory assessment shall be collected.
- 8.11.6 Deposits shall be sampled for retrieval and assessment of the preservation conditions and potential for analysis of biological remains following English Heritage guidance (English Heritage 2002). The sampling strategy shall include a reasoned justification for selection of deposits for sampling, and shall be developed by the Archaeology Contractor's environmental archaeologist or recognised bioarchaeologist in liaison with the Project Archaeologist. Flotation samples and samples taken for coarse-mesh sieving from dry deposits shall be processed at the time of the fieldwork wherever possible, to permit variation of sampling strategies if necessary. Sampling strategies for wooden structures shall follow the methodologies presented in Brunning (1996).
- 8.11.7 Artefacts, biological samples and soils shall be assessed for evidence of site and deposit formation processes and taphonomy and especially for evidence of recent changes that may have been caused by alterations in the site environment.
- 8.11.8 Samples for absolute dating and other analyses shall be submitted promptly to the supply laboratory proposed by the Archaeology Contractor or other supplier as instructed by the Project Archaeologist. Delivery times shall be agreed to

ensure that the results are available to aid any development of specifications for subsequent mitigation strategies in the SSWSI.

- 8.11.9 Processing of all soil samples collected for biological assessment, or sub-samples of them, shall be completed as soon as reasonably practicable. The preservation state, density and significance of material retrieved shall be assessed by the Archaeology Contractor's recognised specialist. Special consideration shall be given to any evidence for recent changes in preservation conditions that may have been caused by alterations in the site environment. Unprocessed sub-samples shall be stored in appropriate conditions in accordance with the Archaeology Contractor's Method Statement.
- 8.11.1 Geoarchaeological and palaeoenvironmental samples shall be processed promptly by the Archaeology Contractor's specialist, particularly where storage of unprocessed samples is thought likely to result in deterioration. Appropriate assessment shall be undertaken as agreed with the Project Archaeologist. Where preservation in situ is a viable option, consideration shall be given to minimising the possible effects of compression and loading on the physical integrity of the site and any hydrological or chemical impacts of the proposed construction works (English Heritage 2002).
- 8.11.2 Animal bone assemblages shall be assessed promptly by the Archaeological Contractor's specialist, with reference to English Heritage guidance (English Heritage 2002). Active stabilisation/consolidation shall be carried out to ensure the long-term survival of such assemblages and, once assessed, all material shall be packed and stored in optimum conditions, as described in *First Aid for Finds* (Watkinson and Neal 1998).

8.12 Environmental sampling

- 8.12.1 All appropriate features and deposits shall be sampled to retrieve palaeoenvironmental and economic indicators. The Archaeology Contractor shall make provision for the sampling of a wide range of contexts for assessment and analysis for plant and animal micro/macro fossils and soils/sediments, in order to fulfil the aims set out in the SS-WSI.
- 8.12.2 The Archaeology Contractor shall use ten litre plastic buckets (with lids and handles), or strong polythene bags (double bagged) secured at the neck, for the recovery of bulk 'disturbed' environmental samples. An adhesive label recording the project event code, context number and sample information shall be securely fixed to a vertical face of the bucket only or attached to the neck of the bag. Labels shall be completed with an indelible ink pen. A duplicate non-adhesive label shall be inserted within the bucket or between the polythene bags.
- 8.12.3 The selection, preparation for and methods of taking samples together with their size, presentation and processing shall be in accordance with current best practice (e.g. IFA Standard and Guidance for Artefact and Environmental Study, Collection, Research and Conservation 2008d; English Heritage – Geoarchaeology, 2007; English Heritage - Archaeological Science at PPG16 interventions: Best Practice Guidance for Curators and Commissioning Archaeologists, 2003) and advice received from the English Heritage Regional Science Advisor and other relevant bodies.
- 8.12.4 The Archaeology Contractor shall be responsible for the protection of all samples and finds and for their transport (including loading and unloading) to the

Archaeology Contractor's facilities or other location as agreed with the Project Archaeologist. Samples shall be protected at all times from temperatures below 5 and above 25 degrees Celsius and from wetting and drying out due to weather exposure.

- 8.12.5 Bulk samples shall normally be in the range of 10-60 litres. The size selected will depend on the likely density of macrofossils in the soil. The lower end of the range (10-20 litres) will be suitable for the recovery of macrofossils from waterlogged deposits. For non-waterlogged deposits the sample volume is likely to be in the middle to higher range (20-40 or 40-60 litres) dependant upon site activity, conditions and preservation.
- 8.12.6 The Archaeology Contractor shall use appropriately sized monolith or Kubiena boxes for the recovery of 'undisturbed' monolith samples for geo-archaeological study (pollen, other microfossil and micromorphological studies etc). Care shall be taken to ensure that wherever possible only newly exposed sections are sampled to avoid contamination, desiccation and decalcification. This sampling shall be undertaken under supervision of the Archaeology Contractor's environmental specialist. Boxes shall be wrapped neatly and tightly in bin-liners or plastic sacks and secured with rubber bands. A label shall be attached to the outside (in duplicate) with site name and code, feature/context number and depths of sample.
- 8.12.7 The Archaeology Contractor shall record the depth of the 'undisturbed' monolith at the top and the bottom of the sample. There shall be a 50mm overlap between each monolith. This information shall be plotted onto a section drawing at an appropriate scale, with all levels reduced to heights relative to Ordnance Datum. Where the sample crosses archaeological context boundaries these shall be noted on the sample recording pro-forma.
- 8.12.8 Where it is not possible to insert monolith boxes, the Archaeology Contractor shall take a vertical series of small 'spot' samples. Samples shall be at 20mm vertical intervals with no more than 10mm depth being sampled. In the case of deposits with a low organic content it may be necessary to take as much as 5g or even 20g per sample. If so, sampling shall be extended laterally at a given depth in 10mm deep spits.
- 8.12.9 Where appropriate, the Archaeology Contractor shall take contiguous column samples for the retrieval of macrofossils. The individual sub-samples will be of 1-10kg, depending on the nature of the deposit and the category of material to be retrieved. Where several specialists are involved it may be necessary to take separate subsamples for a range of palaeo-environmental evidence, for example, insects, molluscs and seeds, to ensure that adequate sub-samples are available for specialist assessment.

9 Archaeological Contractor Deliverables

9.1 Archaeological Contractor's Method Statement

- 9.1.1 The Archaeological Contractor shall provide a detailed Archaeological Method Statement (AMS) for the works, for the Project Archaeologist's approval. The AMS shall be prepared in association with the Principal Contractor, taking

account of their Environmental Management Plan and other relevant site information provided by them and requirements for the works set out in the Works Information (e.g. relating to health and safety, security, engineering design requirements and attendances). The AMS shall include, as appropriate:

- A resource plan and programme and CVs;
- The Archaeological Contractor's IT capability and proposed IT plan (including specific survey methods for on-site recording of stratigraphic profiles and sub-surface topographic modelling;
- The Archaeological Contractor's approach to Archaeological Science;
- The methods for survey and setting out works;
- The methods to address the specific event types required;
- The safe method of working whilst excavating trenches or pits including any temporary works required;
- The method for disposing of water from trenches and test pits in waterlogged ground;
- Site management plan to include requirements/responsibilities of the Principal Contractor and any other requirements;
- The retention and disposal policies for samples and artefacts recovered during the work;
- The method for excavating and recording inhumations and cremations in compliance with the generic Crossrail standards for Human Remains (see Section 7.1);
- The method for preparation of the required reports, archive and all associated deliverables;
- The procedures for assessment of potential for analysis (post excavation assessment), analysis and publication proposals;
- The method for preparation of the digital dataset, digital drawings, and digital report deliverables;
- The Archaeological Contractor's methods and approach for undertaking the site based works and off site processes to completion.
- The Health and Safety Plan and Site-Specific Risk Assessment (including unexploded ordnance);
- Details of the Archaeological Contractor's Quality Assurance Plan;
- The procedures for on- and off-site security and emergency response plan (including environmental incidents);

- The method for complying with project generic and site specific environmental and consent requirements; and
- The Archaeological Contractor's requirements and specification for services and facilities and attendances required to be supplied by the Principal Contractor or the Employer.

9.2 Site Archives

- 9.2.1 The site archive shall be organised to be compatible with other archaeological archives in London any specific requirements of the receiving museum. This requirement for archival compatibility includes computerised databases.
- 9.2.2 For London archives, individual descriptions of all archaeological strata and features excavated or exposed shall be entered onto prepared pro-forma recording sheets which include the same fields of entry on the recording sheets of Museum of London Archaeology. Sample recording sheets, sample registers, finds recording sheets, registered finds catalogues and photographic record cards shall also follow the Museum of London Archaeology equivalents.
- 9.2.3 Archives shall be prepared to conform with current best practise (e.g. Brown and Duncan 2007; Institute of Field Archaeologists 2008f) The archive shall cover all finds, samples and records (drawn, written, photographic and electronic) collected and produced during the works. The archive shall be indexed and internally consistent. The Archaeological Contractor shall complete the site archive and submit to the Project Archaeologist within eight weeks of completion of a fieldwork event.
- 9.2.4 The site archive shall be deposited with a museum to be confirmed by the Project Archaeologist.

9.3 Digital Data

- 9.3.1 The Archaeological Contractor shall produce a digital data archive of all primary field data produced during the works in accordance with ADS guidelines (Richards and Robinson 2001).
- 9.3.2 The Archaeological Contractor shall prepare and provide field and laboratory data, evaluation or excavation trench and phasing plans showing archaeological features recorded, and report text in digital form, as well as in paper form. Consideration should be given to recording electronic plans during fieldwork.
- 9.3.3 The digital archive for each fieldwork event shall be copied to CD-R or DVD (recordable laser disc) and submitted to the Project Archaeologist for archiving in the Employer's document management system.
- 9.3.4 Final reports, site plans and other illustrations shall be prepared in accordance with the Employer's Information Management standards and procedures.
- 9.3.5 All data files submitted shall be scanned by a virus detection programme updated to the most current version. The disk label shall clearly indicate:

- Confirmation that this check has been carried out (including details of the virus checking programme name and version used) and that the submission is virus free.
 - Fieldwork event name and code.
 - Supplier company name, date and QA details (as a minimum, the name, position and signature of the approver).
- 9.3.6 Prior to commencing the works, the Archaeological Contractor shall submit an example hard copy and data output of each of the data formats required (*i.e.* data, graphic, CAD and text) produced by their current software, for approval by the Project Archaeologist. The Archaeological Contractor shall inform the Project Archaeologist of any changes or upgrades made to approved software prior to processing any works data. The sample disk shall include data from a previous real job or jobs.
- 9.3.7 A sequential numbering of data issues shall be rigorously adhered to so that no data versions are submitted out of sequence. The organisation of the data prior to submission shall be the responsibility of the Archaeological Contractor. The Archaeological Contractor shall ensure that data originating from different sources within the Archaeological Contractor's organisation is compatible with the project requirements. The Archaeological Contractor shall nominate one person to the Project Archaeologist who is the main point of contact for matters relating to the digital data submissions.
- 9.3.8 Where errors or inconsistencies are noted in the data, by either the Project Archaeologist or Archaeological Contractor they shall be corrected by the Archaeological Contractor and a corrected data file issued to the Project Archaeologist. When a change or addition is made to the data within an issue, a complete data group shall be re-issued, not just the changed fields. This may not require complete replacement of the whole data set which includes other previous issues.
- 9.3.9 Where any changes are made to a data record between digital data submissions, the Archaeological Contractor shall record the date of the change and the name of the person carrying out the change. The Archaeological Contractor shall ensure that each data amendment is carried out correctly.
- 9.3.10 The Archaeological Contractor shall make two identical copies of the digital archive. The first copy shall be retained by the Archaeological Contractor until the expiry of the Contract maintenance period. The second copy shall be issued to the Project Archaeologist.
- 9.3.11 A digital archive for each Crossrail site (incorporating individual event archives) shall be submitted to a regional or national data archive as agreed with the service provider by the Employer.

9.4 Interim Statement

- 9.4.1 Within seven days of completion of a fieldwork event the Archaeological Contractor shall submit an Interim Statement to the Project Archaeologist.
- 9.4.2 The Interim Statement shall be brief, and the information contained commensurate with the timescale for production. The report shall not duplicate

effort to be utilised at a later date and shall draw on the data gathered during the initial assessment undertaken during fieldwork.

- 9.4.3 A site plan indicating all as-dug investigations shall be provided. Key stratigraphic profiles and topographic templates of the major stratigraphic units shall be provided.
- 9.4.4 The Interim Statement including illustrations shall be submitted as a single PDF file to the Project Archaeologist. CAD drawing files shall also be submitted.
- 9.4.5 The Interim Statement text shall be submitted in hard copy and as an MS Word document in accordance with the Employer's information management standards and procedures.
- 9.4.6 The Interim Statement shall include an approved report title sheet and QA page (to be supplied by the Employer).
- 9.4.7 The following shall appear in the footer or header of each Interim Statement: © CRL Ltd, 2013
- 9.4.8 Copies of the Interim Statement shall be provided by the Project Archaeologist to Adam Single (English Heritage GLAAS) and the London Borough of Redbridge for comment.

9.5 Survey Report

- 9.5.1 The Archaeological Contractor shall provide a written and graphic survey report for the works upon completion of fieldwork. Evidence shall be provided for check measurements and results of levelling for establishment of TBMs. The survey report shall be submitted by the Archaeological Contractor to the Project Archaeologist within two weeks of the completion of fieldwork.
- 9.5.2 The Archaeological Contractor shall prepare and submit 'as excavated' site area outlines and levels in accordance with Crossrail standard CRS-SDT-05. Each drawing shall identify the relevant event code and sub-site division, if applicable.

9.6 Fieldwork Report

- 9.6.1 The photographic survey, geoarchaeological test pitting and trench excavation/borehole drilling report shall be prepared by the Archaeological Contractor within six weeks of the completion of the fieldwork (unless this is varied by the Project Archaeologist). A separate watching brief report should also be prepared within six weeks of the completion of the watching brief fieldwork. The reports shall follow the standard structure set out in GLAAS standards and guidance for archaeological fieldwork, City of London Planning Advice Note 3 and IFA standards, as appropriate, *i.e.*

Contents list

Non-technical summary

1. Introduction
2. Planning background
3. Previous work(s) relevant to archaeology of site (DBA, DDBA, surveys etc)
4. Geology and topography of site

Page 58 of 58

Document uncontrolled once printed. All controlled documents are saved on the CRL Document System

5. Research objectives and aims
6. Methodology of site-based and off-site work
7. Results and observations including quantitative report, stratigraphic report (including any constraints on site).
8. Assessment of results against original expectations (using criteria for assessing national importance i.e. period, relative completeness, condition, rarity, and group value) and review of evaluation strategy
9. Statement of potential of archaeology
10. Conclusions and recommendations for appropriate mitigation strategy
11. Publication and dissemination proposals (in addition to fieldwork report)
12. Archive deposition
13. Bibliography
14. Acknowledgements

Appendices

1. Index of archaeological archive
 2. Summary of SSWSI
 3. Greater London Historic Environment Record form
 4. OASIS record form
 5. Registers
 6. Site matrices
 7. A3 plans and other drawings for illustration
- 9.6.2 The reports shall provide an illustrated factual statement and statement of importance with associated assessment of potential for further fieldwork and/or analysis of the archive. The reports shall utilise information collected during archaeological fieldwork and from any other appropriate sources agreed with the Project Archaeologist.
- 9.6.3 The reports shall include sections detailing the background to the project, any previous relevant research and investigation, location and topography/geology, a description of the methodology employed and the techniques adopted. Where relevant, these sections shall include location plans with scale and grid co-ordinates.
- 9.6.4 Each component of the works (e.g. stratigraphic/structural, artefactual and environmental/economic) shall be supported by a statement setting out:
- A quantification of the resource (tabulated and cross referenced as appropriate);
 - Provisional dating and evidence for residuality and intrusiveness;
 - The range of material, including sampling and/or taphonomic biases; and
 - The condition of the material, including preservation bias.

- 9.6.5 The stratigraphic statement shall include a description of the geomorphology and sedimentation record of the survey area, a description of the fieldwork results (brief context descriptions supported by plans and sections as necessary, with levels related to Ordnance Datum), and a trench summary table indicating depths of all major stratigraphic units, and their boundaries. Photographs shall be included where appropriate.
- 9.6.6 The assessment of results and statement of potential shall include the Archaeological Contractor's conclusions based on the recorded data, e.g. the monument/site class represented, site/feature function and relevant parallels. The statement shall also comment on the potential of the data to address the projects' research themes. As appropriate, comment shall be made on the site as a whole and the individual components (e.g. artefactual, palaeo-environmental, economic). The statement shall utilise the criteria laid down by the Secretary of State for Culture, Media and Sport Criteria for Scheduling in order to establish importance.
- 9.6.7 In reporting the results of the works, the accuracy of the original expectations and the appropriateness of the methods adopted shall be assessed by the Archaeological Contractor in order to illustrate what level of confidence can be placed on the information. The Project Archaeologist will use that information as the basis for developing any further mitigation strategy and/or further analysis and publication.
- 9.6.8 The report shall be illustrated with a site location plan, survey location plans as appropriate (to include archaeological interpretation of results), and individual trench and area plans identifying archaeological features exposed and investigated.
- 9.6.9 Copies of the reports shall be provided by the Project Archaeologist to Adam Single (English Heritage) and the London Borough of Redbridge for comment.
- 9.6.10 The following shall appear in the footer or header of each Fieldwork Report:
© CRL Ltd, 2013

9.7 GLHER Summary Sheet

- 9.7.1 The Archaeological Contractor shall complete a GLHER Summary Sheet for the works (*i.e.* one per fieldwork event). The Summary Sheet shall be included in the reports as outlined above..

9.8 Summary Report

- 9.8.1 A short annual summary of the works shall be prepared by the Archaeological Contractor for submission to the Project Archaeologist for subsequent publication within *London Archaeologist* Round-Up or other publication outlet specified by the Project Archaeologist.

9.9 Post Excavation Assessment

- 9.9.1 If instructed by the Project Archaeologist, the Archaeological Contractor shall undertake a post-excavation assessment of the site archive and submit a report of their findings to the Project Archaeologist for approval. Assessment of

potential for analysis shall be undertaken in accordance with English Heritage guidelines.

- 9.9.2 The Archaeological Contractor shall provide details with their Method Statement of its current post-excavation assessment procedures.

10 Site Monitoring and Progress Reports

- 10.1.1 The GLAAS officer shall be informed in writing at least one week in advance of commencement of fieldwork.
- 10.1.2 The Project Archaeologist shall arrange and convene monitoring site visits by the external consultees, as appropriate. There shall be no unauthorised access to the works in any other circumstances. Any visits to the works shall be in accordance with the Principal Contractor's health and safety, site access and security requirements. Arrangements for GLAAS monitoring of the archaeological works will be made during and following the above consultation.
- 10.1.3 Periodic updates on the progress of the Crossrail archaeology programme shall be submitted to the external consultees by the Project Archaeologist. The Archaeology Contractor shall provide information to the Project Archaeologist as requested to inform this reporting.
- 10.1.4 Prior to commencing the works the Archaeological Contractor shall agree a programme of weekly written progress reports and periodic progress meetings with the Project Archaeologist and/or Project Manager and shall be represented at such meetings to the satisfaction of the Project Archaeologist. The Archaeological Contractor shall provide information describing progress on-site to date, the processing of samples and artefacts and feedback from any initial assessment.

11 Personnel Requirements

- 11.1.1 The Archaeological Contractor shall provide experienced project personnel as described below. The personnel shall be approved by the Project Archaeologist. Approval may be withdrawn by the Employer at their discretion and in accordance with the contract conditions.
- 11.1.2 The Archaeological Contractor shall submit CVs of all proposed personnel including any specialists, but excluding site technician grades, to the Project Archaeologist for approval if this has not already been done as part of the pre-qualification or post-contract appointment process.
- 11.1.3 The works shall be managed, directed and staffed by appropriately qualified and experienced personnel. The Archaeological Contractor's Key Person shall possess at least ten years relevant experience.
- 11.1.4 The excavation, sampling and recording of the works shall be directed in the field by a Fieldwork Director who is a Member of the Institute of Field Archaeologists (MIFA). The Fieldwork Director shall be on site throughout the fieldwork stages.
- 11.1.5 The Archaeological Contractor's project team shall include an environmental archaeologist suitably qualified in archaeological science and geoarchaeological sediment description methods, and on-site sample processing and assessment techniques.

- 11.1.6 The Archaeological Contractor's project team shall be staffed by technician grades with minimum six months experience in appropriate aspects of excavation and recording.
- 11.1.7 Specialist historic building recording staff employed on any aspect of the works, including post-excavation assessment or analysis of any kind including the writing of reports, shall be suitably qualified and shall be supervised by personnel with a minimum of ten years of relevant experience in their field (this may be inclusive of post-graduate studies).
- 11.1.8 Specialist staff shall be available, normally at 24 hours notice, for the duration of the works to provide advice on any specialist tasks to be undertaken.

12 References

Gibbard, P.L., 1994. *The Pleistocene History of the Lower Thames Valley*. Cambridge: Cambridge University Press.

Bridgland, D.R., 1994. *Quaternary of the Thames*. London : Chapman and Hall.

Brunning, R. 1996, Waterlogged wood. Guidelines on the recording, sampling, conservation and curation of waterlogged wood. English Heritage, London

English Heritage 2001. Archaeometallurgy. Centre for Archaeology Guidelines 2001/01, English Heritage, London

English Heritage 2002, Environmental Archaeology. A guide to the theory and practice of methods, from sampling and recovery to post-excavation, Centre for Archaeology Guidelines 2002/01, English Heritage, London

English Heritage, 2007, *Geoarchaeology*, English Heritage, London

English Heritage 2008, Luminescence dating. Guidelines, English Heritage, London

Juby, C., 2011, *London before London: Reconstructing a Palaeolithic Landscape*, unpublished thesis, University of London

Museum of London, 1994. Archaeology Site Manual.

Museum of London, 1998, General Standards for the Preparation of Archaeological Archives deposited with the Museum of London

Nixon, T, McAdam, E, Tomber, R, and Swain, H, 2003, A Research Framework for London Archaeology 2002, Museum of London Archaeology Service

Richards JD and Robinson D (eds) 2001, Digital archives from excavation and fieldwork: guide to good practice. 2nd Ed. Archaeology Data Service

Watkinson, D. and Neal, V. 1998, First Aid for Finds (3rd edition), RESCUE and the Archaeology Section of the United Kingdom Institute for Conservation

West, R.G., 1969. Pollen analyses from interglacial deposits at Aveley and Grays, Essex. *Proceedings of the Geologists' Association*, 80, 271-282.

13 Definitions/Abbreviations/Acronyms

The following is a list of the most commonly used definitions, abbreviations and acronyms within CRL SSWSIs:

ATD	Above Tunnel Datum Tunnel Datum = Ordnance Datum plus 100m
BP	Before Present
c.	Circa
CDI	Common Design Item
CDM	Construction (Design and Management) Regulations
CICP	Crossrail Integrated Construction Programme
CLRL	Cross London Rail Links Ltd
CPFR	Crossrail Project Functional Requirements
dB	Decibel
dB(A)	Decibel (ambient)
DDA	Disability Discrimination Act
DfT	Department for Transport
DLR	Docklands Light Railway
Dom Doc	Lotus Domino Document Manager (software programme)
EMP	Environmental Management Plan
EMR	Environmental Minimum Requirements
ES	Environmental Statement
EWMA	Enabling Works Managing Agent
GLHER	Greater London Historic Environment Record
HF	Human Factors
HMRI	Her Majesty's Railway Inspectorate
IDC	Inter-Discipline Design Check
IDR	Inter-Discipline Design Review
IRD	Initial Reference Design

km	kilometre
km/h	kilometres per hour
LB	London Borough
LFEPA	London Fire and Emergency Planning Authority
LLAU	Limit of Land to be Acquired or Used
LMP	Lorry Management Plans
LoD	Limit of Deviation
LU	London Underground Ltd
m	metre
M&E	Mechanical and Electrical
MDC	Multi-Disciplinary Consultant
MDC4	Multi-Disciplinary Consultant 4, Halcrow
NLL	North London Line
NR	Network Rail
O&M	Operations and Maintenance
OHLE	Overhead Line Equipment
OSD	Over Site Development
RM	Requirements Management
RMP	Requirements Management Plan
RSPG	Railway Safety Principles and Guidance
SI	Systems Integration/Site Investigation
SRA	Strategic Rail Authority
SRC	Systems and Rolling Stock Consultants
SRS	Systems Requirements Specification
TBM	Tunnel Boring Machine
TfL	Transport for London
TOC	Train Operating Company
VE	Value Engineering
VM	Value Management

Annex 1 Site Information

13.1.1 For Services and Utilities, Extinguishments of Rights of Way, Surface Water Control, Protective Fencing, Credit Boards, Care in Executing the Site Operations and Parking of Vehicles please refer to C254 Works Information Volumes 1 and 2 or the Principal Contractor's Method Statements or Construction Phase Plans.

Annex 2 Health and Safety Requirements

13.1.2 For CDM requirements, Archaeological Contractor's Risk Assessments and Health and Safety Plans, Archaeological Contractor's Safety Audits, Safety Inspections, Reporting of Accidents, please refer to Package Work Order C254 Works Information Volumes 1 and 2.

13.1.3 The Designer's Risk Assessment to accompany this SSWSI is presented below:



Designer's Risk Assessment

Project Summary

Job Name:

Job Number:

Project Director: Project Manager:

Status:

Entries

Design Element: Ilford Depot Task/Project: Date Created: 25/04/2013 Created By: Andy Shelley

Hazard	Initial Assessment			Mitigation	Revised Assessment		
	At Risk	Probability	Severity		Probability	Severity	Residual Risk
Lack of understanding of the site and its hazards, and the purpose and design of the archaeological works, causes injury.	✓ Construction Operatives ✓ Users	Likely	High	Attend all inductions. No lone working. Use PPE. Operatives to familiarise themselves with all WSIs and Risk Assessments generated by this work.	Unlikely	High	✓ H & S Plan Low
Striking live services during the course of archaeological mitigation works causes injury.	✓ Construction Operatives ✓ Users	Likely	High	All archaeological work will be undertaken under the supervision of the Principal Contractor and will require a Permit to Dig to be issued. The archaeological contractor should confirm with the Principal Contractor in advance of works that there are no live services in areas they are to investigate. The Principal Contractor should ensure that there are no live services in areas requiring archaeological investigation.	Unlikely	High	✓ H & S Plan Low
Trial trench excavations destabilise nearby structures, causing collapse and injury.	✓ Construction Operatives ✓ Users	Likely	High	All trenching to be undertaken only after nearby buildings have been demolished to ground level.	Unlikely	High	✓ H & S Plan Low
Adjacent plant causing injury during trial trench excavations, mitigation excavations, strip, map and sample excavations and general watching briefs	✓ Construction Operatives ✓ Users	Likely	High	Use of PPE. Use designated routes only. Attend site inductions. Be aware at all times. All plant to be operated by certified PC operatives.	Unlikely	High	✓ H & S Plan Low
Vehicle movements causes injury whilst undertaking archaeological works.	✓ Construction Operatives ✓ Users	Likely	High	Use designated routes. Attend inductions. Be accompanied. Use of PPE.	Unlikely	High	✓ H & S Plan Low
Encountering contaminated land causes injury.	✓ Construction Operatives ✓ Users	Likely	High	Principal Contractor to supply all relevant information in advance of works. Use PPE at all times. Attend site inductions. Familiarise oneself with the mitigation measures in place to deal with known contaminated land. No lone working.	Unlikely	High	✓ H & S Plan Low
Trial Trench excavations collapse causing injury	✓ Construction Operatives ✓ Users	Likely	High	All trenches to be dug only to safe working depth. Greater depths to be achieved using trench shoring systems installed, maintained and certified by trained and certified operatives, or by shoring or battering arrangements, all to be approved for use and installed by Principal Contractor. GI works indicate London Clay and therefore a low probability of collapse within shallow trenches. Archaeological contractor to familiarise themselves with the results of GI logs, available from the Principal Contractor.	Unlikely	High	✓ H & S Plan No residual risk.
Slips, trips and falls during archaeological attendance causing injury	✓ Construction Operatives ✓ Users	Likely	High	Use PPE at all times as specified by PC. Use designated routes only. Attend site inductions. Be aware at all times. Use ladders installed by Principal Contractor to gain access/egress to trenches. Familiarise oneself with Site First Aiders and First Aid Stations. No lone working.	Unlikely	High	✓ H & S Plan Low

Annex 3 Personal Protective Equipment (PPE)

13.1.4 PPE must conform to Network Rail worksite specifications and consist of:

- Orange rail-compliant high visibility vest and trousers;
- Hard hat;
- Gloves;
- Safety glasses;
- Laced boots with ankle support, steel insoles and toe caps (rigger boots are not permitted on Crossrail sites);
- Protective disposable contamination suits for work on rail sites or other identified contaminated areas

Annex 4 Labelling of Hazardous Substances, Contaminated Land

13.1.5 Please refer to Package Work Order C254 Works Information Volumes 1 and 2.

Annex 5 CRL Health and Safety Management System, CRL Drugs and Alcohol Policy

13.1.6 Please refer to Package Work Order C254 Works Information Volumes 1 and 2.

Annex 6 CRL and work on Network Rail Land

13.1.7 Please refer to Package Work Order C254 Works Information Volumes 1 and 2.

Annex 7 Environmental Protection Requirements

13.1.8 Please refer to Package Work Order C254 Works Information Volumes 1 and 2 and Principal Contractor's Method Statements and Environmental Plan.

Annex 8 Programme and Order of Work for Implementation of Works and Integration with Other Activities

13.1.9 The programming of the archaeological works set out within this SSWSI is currently being determined in consultation with the Project Archaeologist and Crossrail's C336 Project Planner, and will be notified to the Archaeological Contractor in one or more supplementary bulletins to this SSWSI.

Annex 9 Enabling and Temporary Works Design Requirements, Attendances and Implementation

13.1.10 The Archaeological Contractor is likely to require (this will be confirmed in the Archaeological Contractor's AMS) the Principal Contractor to provide the following services/enabement during the excavation of the trial trench excavations and/or targeted watching briefs:

- Any temporary power, task and safety lighting facilities required;
- All below-ground and surface services to be disconnected prior to works commencing;
- All information on known contaminated ground risks, and measures to mitigate the risks stemming from encountering contaminated ground;
- Office, light tool storage and welfare facilities for up to four staff;
- Excavation of trial trenches to dimensions provided in Section 8, using plant fitted with both toothed and flat-bladed buckets (up to 1.8m in width). Excavations to proceed in 0.25m spits under direction of supervising archaeologist;
- Any concrete breaking required to enable excavations to proceed;
- All spoil management, leaving clear working areas around each trench;
- Provision, installation and maintenance of temporary earthwork support for excavations requiring shoring, or provision of plant and operatives to step or batter trenches if required;
- Dewatering of excavations (if required);
- Provision of Confined Space Working emergency escape equipment (if required);
- Backfilling of any excavations (if required);
- Provision, installation and maintenance of edge protection and trench access and egress equipment.
- A safe site with safe access routes from compound to the working areas. Delineated working areas for different site activities and contractors.
- Explosive Ordnance Engineer in attendance (where required).
- Attendance;
- Other temporary works as may be required to safely undertake the works specified.

Annex 10 Security Requirements

13.1.11 Please refer to Package Work Order C254 Works Information Vols 1 and 2.

Annex 11 Need for screening or other protective works

13.1.12 Please refer to Package Work Order C254 Works Information Vols 1 and 2.

Annex 12 Procedure for Notification of the Discovery of Human Remains

13.1.13 Certain aspects of the normal legal procedure for the removal of human remains (and associated monuments) from burial grounds has been modified by Schedule 15 to the Crossrail Act 2008. However for other aspects, normal legislation applies.

13.1.14 Whilst it is not expected that human remains will be present at PNY, should they be discovered all subsequent works must be undertaken in accordance with relevant legislative and environmental health requirements as set out in the Environmental Requirements (archaeology) section of the relevant package Works Information and best practice guidance e.g. Council for the Care of Churches (1999) and English Heritage (2002 and 2002a).

13.1.15 Should human remains be discovered, the Archaeological Contractor shall notify the Project Archaeologist immediately so that these procedures can be implemented. This notification may be initially made personally or by telephone but shall be confirmed in writing within 24 hours of discovery.

13.1.16 On discovery of human remains the Principal Contractor will be required to cease all works at that location until further instruction is provided by the Project Archaeologist. The Archaeological Contractor shall undertake an initial in situ observation and assessment of the remains and shall advise the Project Archaeologist of the course of action required.

13.1.17 Lifting of human skeletal remains shall be kept to the minimum compatible with an adequate evaluation or excavation. Notwithstanding this, the Archaeological Contractor shall ensure that all burials are planned/photographed in situ and that appropriate samples have been recovered prior to any lifting.

13.1.18 Visible grave goods and other obvious artefacts, shall be recorded and lifted before the end of the working day to avoid the risk of vandalism and theft. Where this is not feasible or appropriate, the Archaeological Contractor shall ensure, on liaison with the Project Archaeologist that adequate site security is provided by the Principal Contractor. As a minimum, this will require a 24-hour comprehensive security regime until sensitive remains have been recorded and lifted.

Annex 13 Procedure for notification of the material falling under the Treasure Act 1996

13.1.19 The Treasure Act 1996 defines 'Treasure' as:

- Any object at least 300 years old when found which is: not a coin, but has metallic content of which at least 10% is precious metal; or
- One of at least two coins with at least 10% precious metal content;
- One of at least 10 coins;
- Any object at least 200 years old designated as treasure by the Secretary of State;

- Any object which would have been 'Treasure Trove';
- Any object found with any of the above.

The Treasure (Designation) Order 2002 extends the definition of treasure to include:

- Finds of at least two base metal objects (other than coins) of prehistoric date; and
- Any object (other than a coin) of prehistoric date with any precious metal content.

13.1.20 All finds falling within the definitions of treasure shall be reported immediately to the Project Archaeologist and all subsequent works must be undertaken in accordance with the relevant legislative requirements as set out in the Environmental Requirements (archaeology) section of the relevant package Works Information and Annex 11.

13.1.21 To protect the finds from theft, the Archaeological Contractor shall record the finds and remove them to a safe place. Where recording and removal is not feasible or appropriate on the day of discovery, the Archaeological Contractor shall ensure, on liaison with the Project Archaeologist that adequate site security is provided by the Principal Contractor.

13.1.22 Subject to the Provisions of the Treasure Act 1996, all material that is defined as Treasure is vested in the franchisee or, if none, the Crown.

13.1.23 With respect to Treasure finds, a reward may be payable to the finder, the landowner and/or the occupier. The Crown usually offers finds to a museum.

Annex 14 Procedure for notification of major unexpected discoveries

13.1.24 Where unexpected, potentially nationally-important archaeological remains (as defined in the Crossrail Environmental Minimum Requirements and Generic SSWSI) are identified during the works, the Archaeological Contractor shall immediately notify the Project Archaeologist and thereafter, once given approval by the Project Archaeologist to proceed, undertake works in accordance with the Environmental Requirements (Archaeology) section of the C254 Works Information. They shall adhere to the procedures set out in the Generic SSWSI.

13.1.25 The Archaeological Contractor shall submit details of their procedure for excavating and recording such remains in their Archaeology Method Statement.

13.1.26 In the event of the discovery of unexpected, potentially nationally important archaeological remains, this SSWSI will be updated to incorporate any additional specific primary fieldwork event aims.